geoh5py Documentation

Release 0.6.1

MiraGeoscience

Feb 09, 2023

CONTENTS

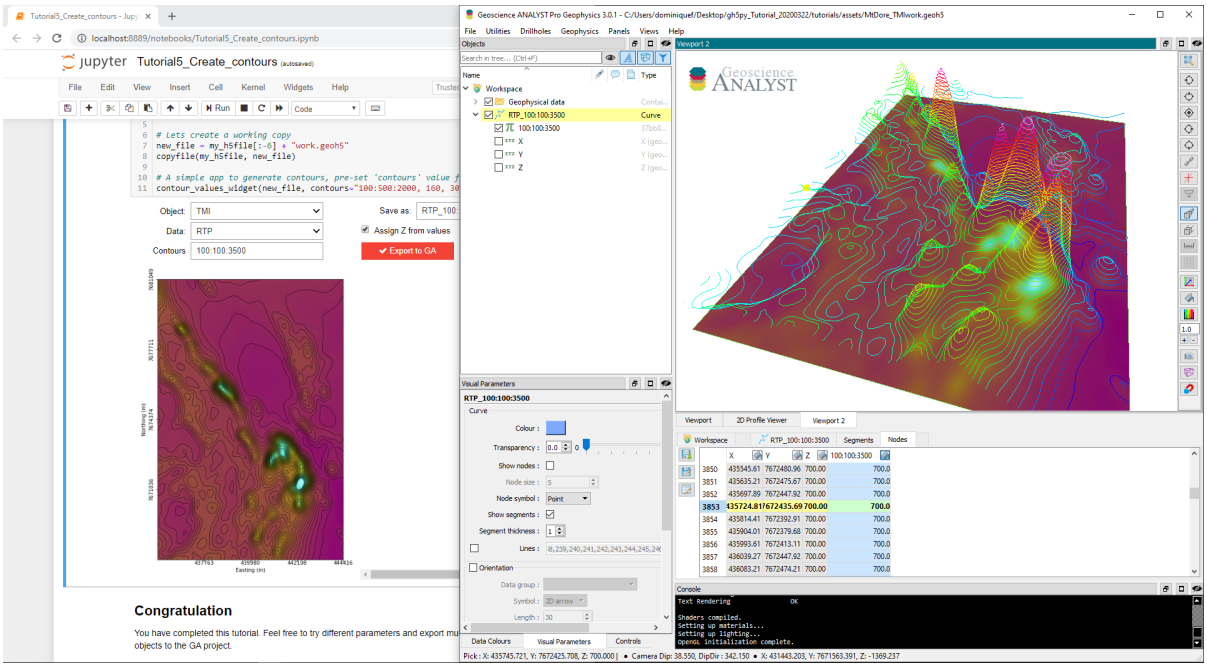
Welcome to the documentation page for **geoh5py**!

CHAPTER

ONE

IN SHORT

The **geoh5py** library has been created for the manipulation and storage of a wide range of geoscientific data (points, curve, surface, 2D and 3D grids) in geoh5 file format. Users will be able to directly leverage the powerful visualization capabilities of Geoscience ANALYST along with open-source code from the Python ecosystem.



CHAPTER

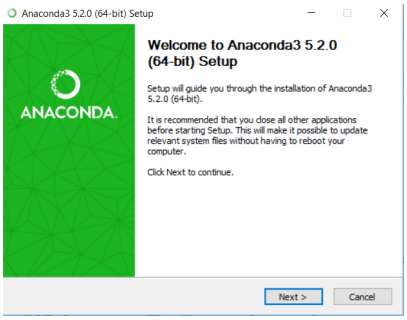
TWO

CONTENTS:

2.1 Installation

geoh5py is currently written for Python 3.7 or higher, and depends on NumPy and h5py.

Note: Users will likely want to take advantage of other packages available in the Python ecosystem. We therefore recommend using Anaconda to manage the installation.



Install **geoh5py** from PyPI:

```
$ pip install geoh5py
```

To install the latest development version of **geoh5py**, you can use `pip` with the latest GitHub `development` branch:

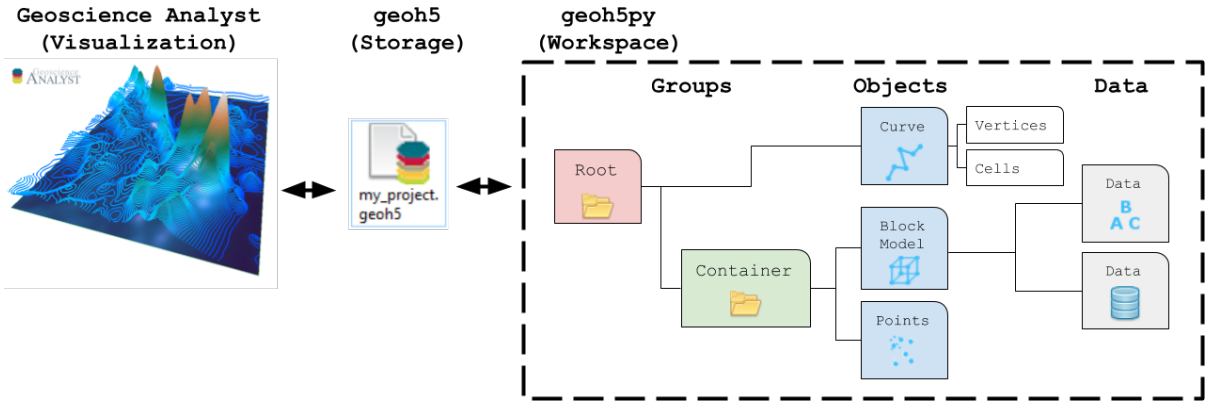
```
$ pip install git+https://github.com/MiraGeoscience/geoh5py.git
```

To work with **geoh5py** source code in development, install from GitHub:

```
$ git clone --recursive https://github.com/MiraGeoscience/geoh5py.git
$ cd geoh5py
$ python setup.py install
```

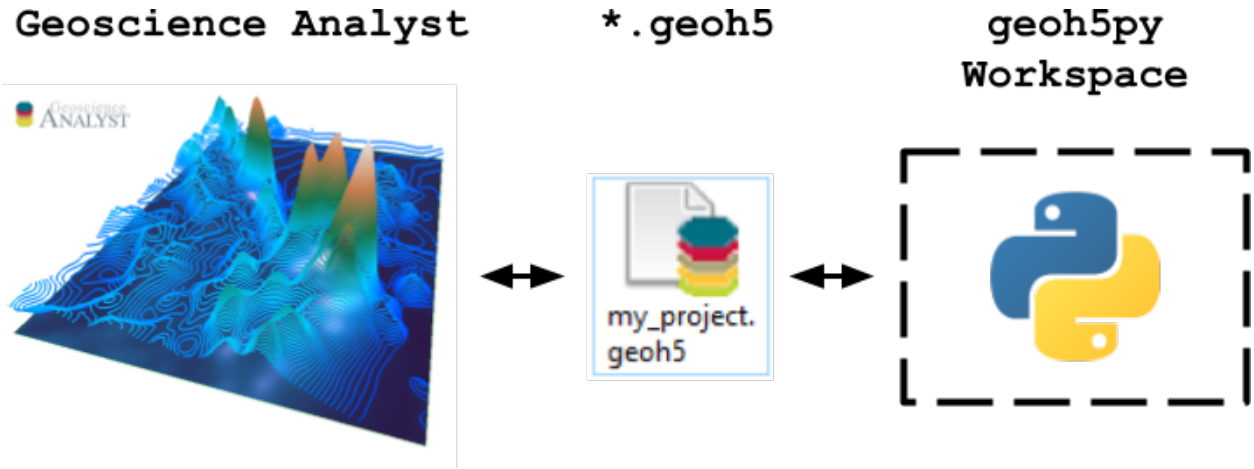
2.2 Tutorials

This section provides information on how to use the **geoh5py** package, from the creation of a *Workspace* to the creation and manipulation of Entities



2.2.1 Workspace

The core element of a project is the `Workspace`. A project Workspace holds core information about the author, version and all entities stored in the `geoh5` file. It also knows how to create the core structure needed by Geoscience ANALYST for visualization.



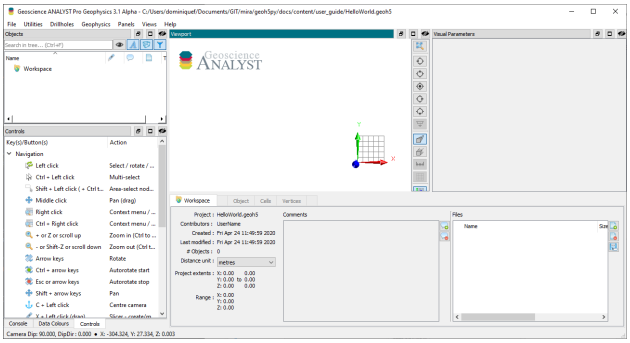
Open and close

You can either open an existing project or create a new project by simply entering the desired file name.

```
[1]: from geoh5py.workspace import Workspace

     # Create a new project
     workspace = Workspace("my_project.geoh5")
```

Et voila!



By default, the `*.geoh5` file is accessed in "read-write" mode. In the eventuality that the file is already used by Geoscience ANALYST, the mode gets changed to "read-only". This prevents users from modifying the file while used in an active session, but still allows them to extract data from the workspace. The same restriction does not apply to multiple python processes, as permitted by the `Single Writer Multiple Reader (SWMR)` feature of HDF5.

[2]:
```
print(workspace.geoh5)
```

```
<HDF5 file "my_project.geoh5" (mode r+)>
```

After completing the read/write process, the workspace must be closed in order to release the file. Geoscience ANALYST does not allow reading on an opened file.

[3]:
```
workspace.close()

print(workspace._geoh5)
```

```
None
```

Context manager

Likewise, a workspace can be accessed via a context manager which will handle closing the file at the of a process.

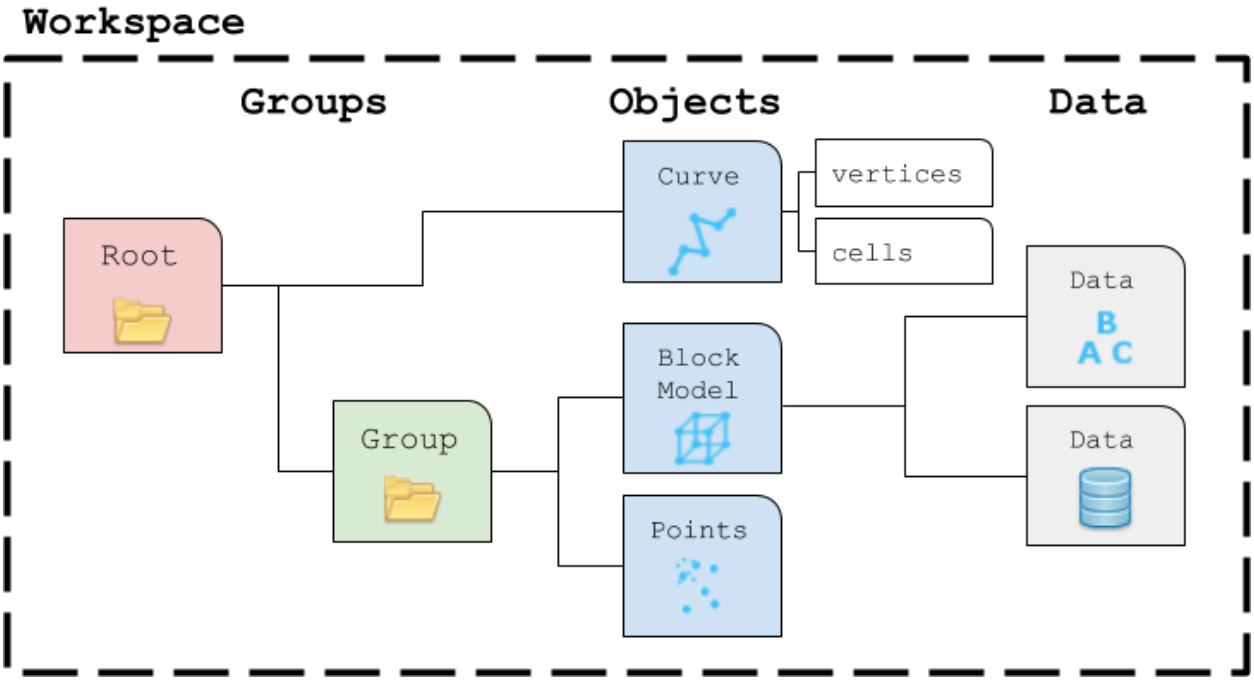
[4]:
```
with Workspace("my_project.geoh5") as workspace:
    print(workspace.geoh5)

print(workspace._geoh5)
```

```
<HDF5 file "my_project.geoh5" (mode r+)>
None
```

2.2.2 Entities

This section introduces the different entities that can be created and stored in the `geoh5` file format.

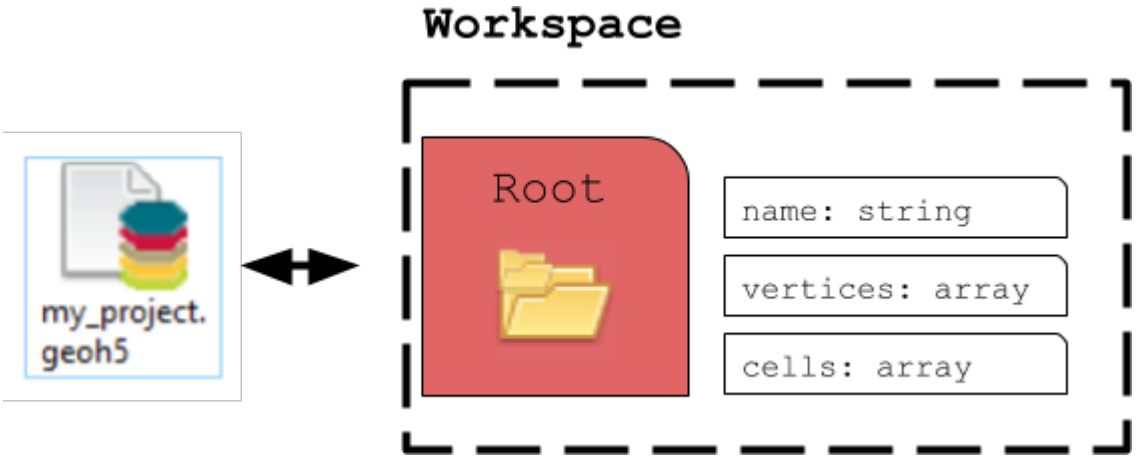


Groups

`Groups` are effectively containers for other entities, such as `Objects` (Points, Curve, Surface, etc.) and other `Groups`. Groups are used to establish `parent-child` relationships and to store information about a collection of entities.

RootGroup

By default, the parent of any new `Entity` is the workspace `RootGroup`. It is the only entity in the `Workspace` without a parent. Users rarely have to interect with the `Root` group as it is mainly used to maintain the overall project hierarchy.



ContainerGroup

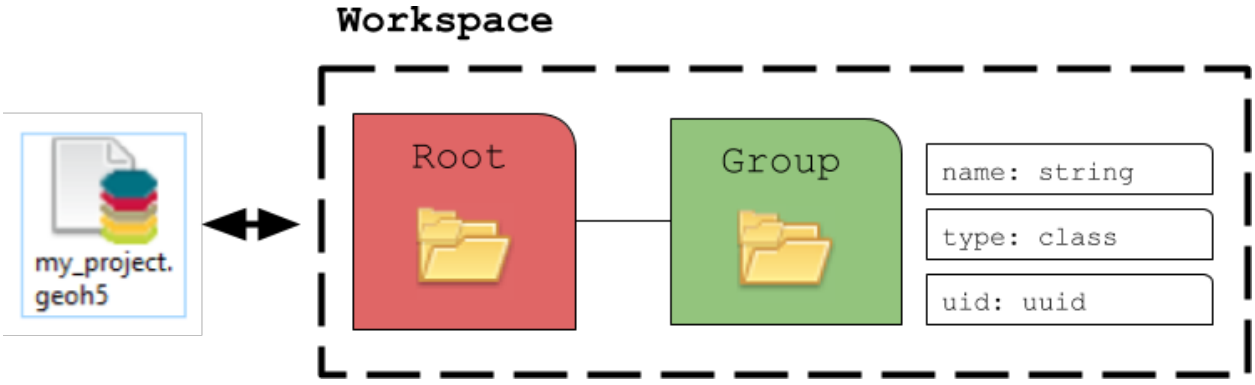
A `ContainerGroup` can easily be added to the workspace and can be assigned a `name` and `description`.

[1]:
```
from geoh5py.groups import ContainerGroup
from geoh5py.workspace import Workspace
import numpy as np

# Create a blank project
workspace = Workspace("my_project.geoh5")

# Add a group
group = ContainerGroup.create(workspace, name='myGroup')
```

At creation, "myGroup" is written to the project `geoh5` file and visible in the Analyst project tree.



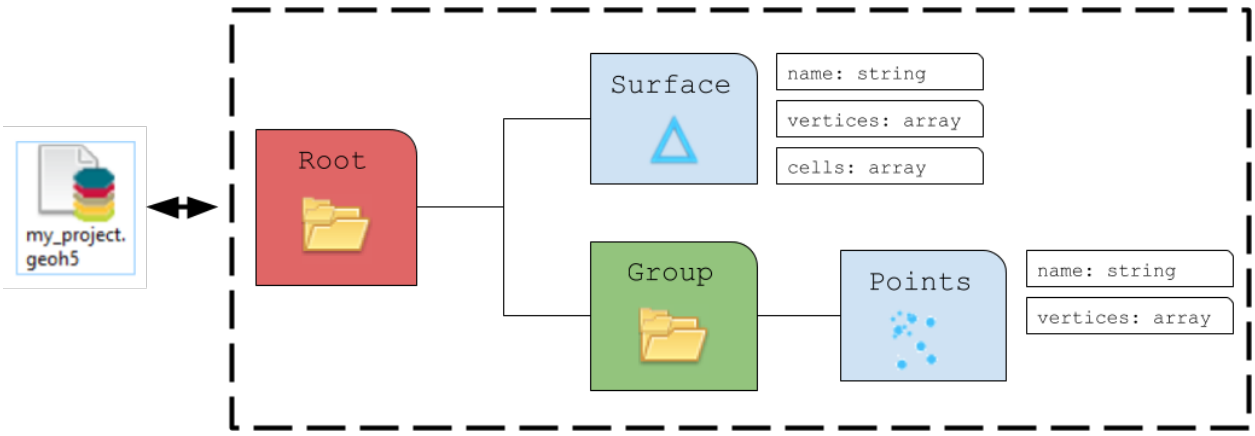
Any entity can be accessed by its `name` or `uid` (unique identifier):

[2]:
```
print(group.uid)
print(workspace.get_entity("myGroup")[0] == workspace.get_entity(group.uid)[0])
```

```
c44087e9-91c5-4854-8393-efdb7821fad2
True
```

Objects

The `geoh5` format enables storing a wide variety of `Object` entities that can be displayed in 3D. This section describes the collection of `Objects` entities currently supported by `geoh5py`.



Points

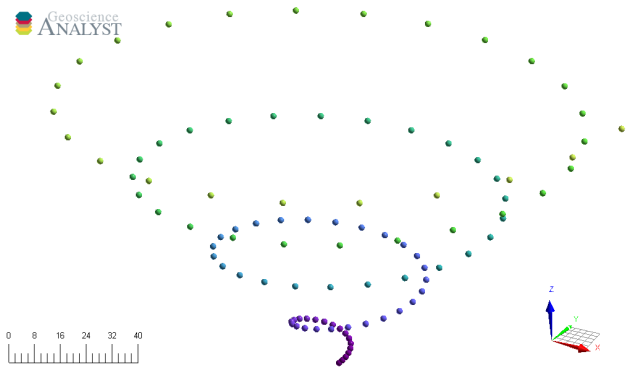
The `Points` object consists of a list of `vertices` that define the location of actual data in 3D space. As for all other `Objects`, it can be created from an array of 3D coordinates and added to any group as follow:

[3]:
```
from geoh5py.objects import Points

# Generate a numpy array of xyz locations
n = 100
radius, theta = np.arange(n), np.linspace(0, np.pi*8, n)

x, y = radius * np.cos(theta), radius * np.sin(theta)
z = (x**2. + y**2.)**0.5
xyz = np.c_[x.ravel(), y.ravel(), z.ravel()] # Form a 2D array

# Create the Point object
points = Points.create(
    workspace,       # The target Workspace
    vertices=xyz     # Set vertices
)
```



Curve

The `Curve` object, also known as a polyline, is often used to define contours, survey lines or geological contacts. It is a sub-class of the `Points` object with the added `cells` property, that defines the line segments connecting its `vertices`. By default, all vertices are connected sequentially following the order of the input `vertices`.

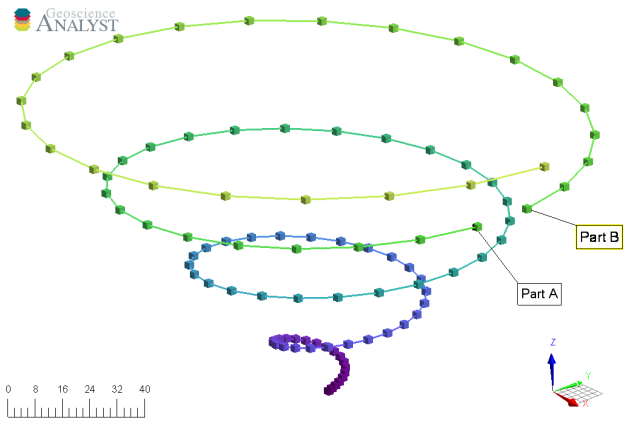
[4]:
```
from geoh5py.objects import Curve

# Create the Curve object
curve = Curve.create(
    workspace,       # The target Workspace
    vertices=xyz
)
```

Alternatively, the `cells` property can be modified, either directly or by assigning `parts` identification to each `vertices`:

[5]:
```
# Split the curve into two parts
part_id = np.ones(n, dtype="int32")
part_id[:75] = 2

# Assign the part
curve.parts = part_id
```



Drillhole

`Drillhole` objects are different from other objects as their 3D geometry is defined by the `collar` and `surveys` attributes. As for version `geoh5 v2.0`, the drillholes require a `DrillholeGroup` entity to store the geometry and data.

[6]:
```
from geoh5py.groups import DrillholeGroup
from geoh5py.objects import Drillhole

dh_group = DrillholeGroup.create(workspace)

# Create a simple well
total_depth = 100
dist = np.linspace(0, total_depth, 10)
```

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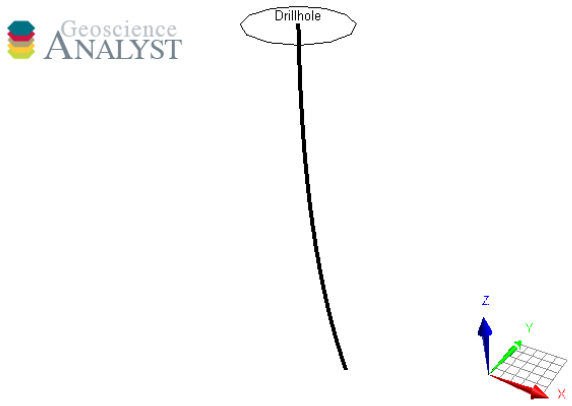
```
azm = np.ones_like(dist) * 45.
dip = np.linspace(-89, -75, dist.shape[0])
collar = np.r_[0., 10., 10]

well = Drillhole.create(
    workspace, collar=collar, surveys=np.c_[dist, azm, dip], name="Drillhole", parent=dh_
↪group
)

print(well.name)
```

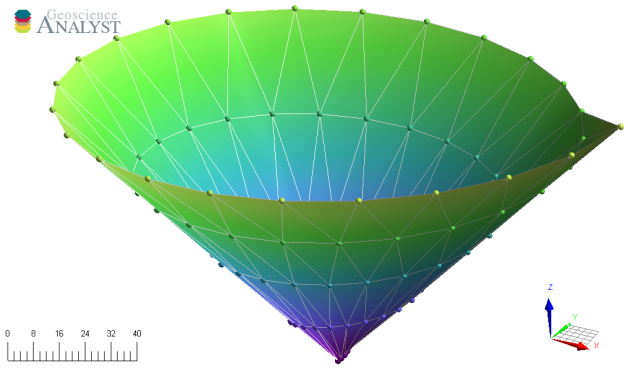
```
Drillhole
```



Surface

The `Surface` object is also described by `vertices` and `cells` that form a net of triangles. If omitted on creation, the `cells` property is calculated using a 2D `scipy.spatial.Delaunay` triangulation.

[7]:
```
from geoh5py.objects import Surface
from scipy.spatial import Delaunay

# Create a triangulated surface from points
surf_2D = Delaunay(xyz[:, :2])

# Create the Surface object
surface = Surface.create(
    workspace,
    vertices=points.vertices, # Add vertices
    cells=surf_2D.simplices
)
```



GeoImage

The `GeoImage` object handles raster data, either single or 3-band images.

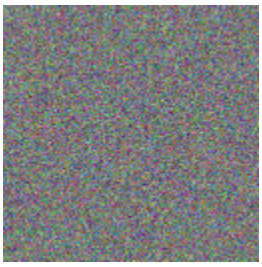
[8]:
```
from geoh5py.objects import GeoImage

geoimage = GeoImage.create(workspace)
```

Image values can be assigned to the object from either a 2D `numpy.ndarray` for single band (gray):

[9]:
```
geoimage.image = np.random.randn(128, 128)
display(geoimage.image)
```

or as 3D `numpy.ndarray` for 3-band RGB image:

[10]:
```
geoimage.image = np.random.randn(128, 128, 3)
display(geoimage.image)
```



or directly from file (png, jpeg, tiff).

[11]:
```
geoimage.image = "./images/flin_flin_geology.jpg"
```

A `PIL.Image` object gets exposed to the user, which can be used for common raster manipulation (rotation, filtering, etc). The modified raster is stored back on file as a blob (`bytes`).

[12]:
```
display(geoimage.image)
```

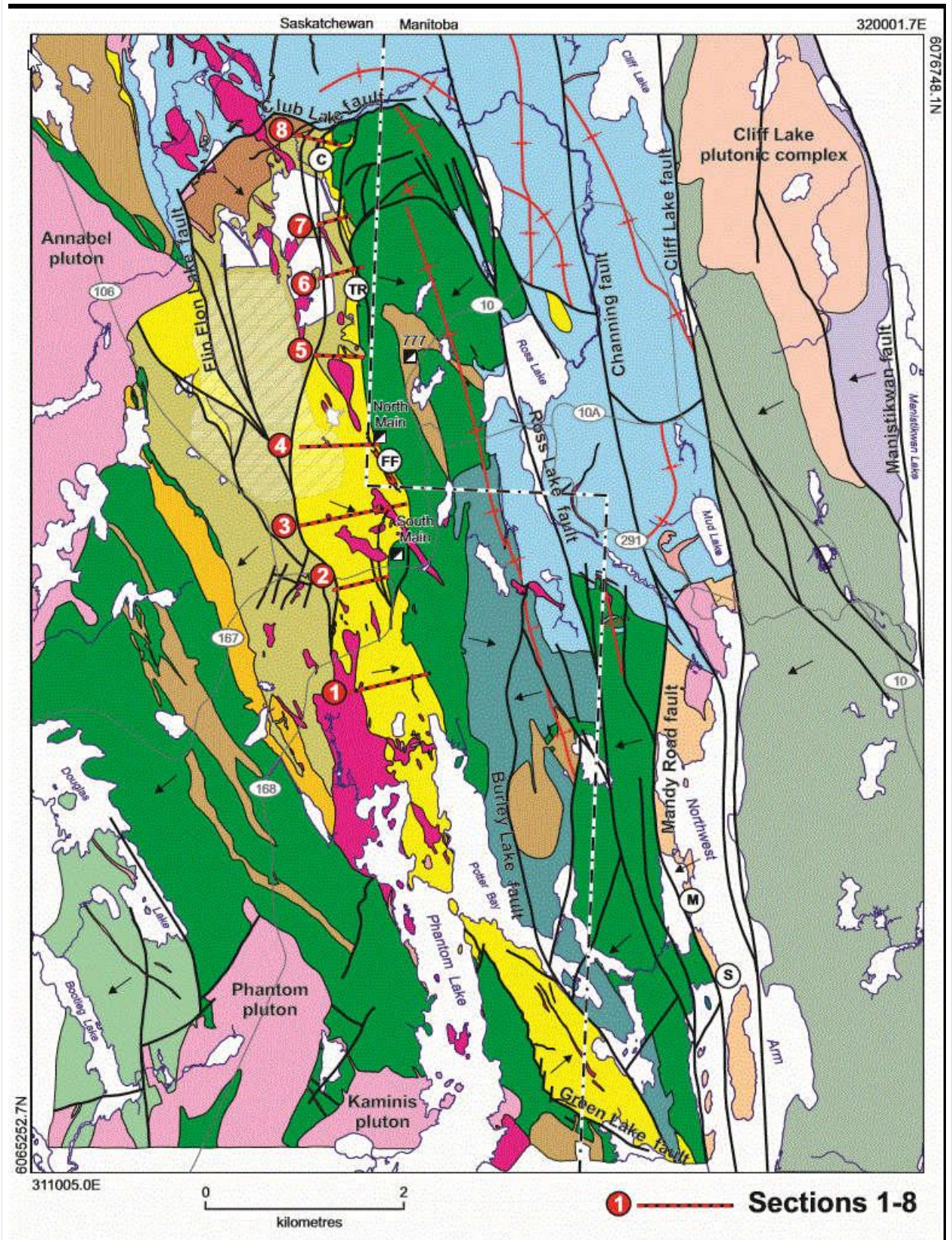


Figure 4. Geology and structure of the Flin Flon District showing the location of stops and transects (modified after Simard et al., 2010).

Geo-referencing

By default, the `GeoImage` object will be displayed at the origin (xy-plane) with dimensions equal to the pixel count. The utility function *GeoImage.georeference* lets users geo-reference the image in 3D space based on at least three (3) input reference points (pixels) with associated world coordinates.

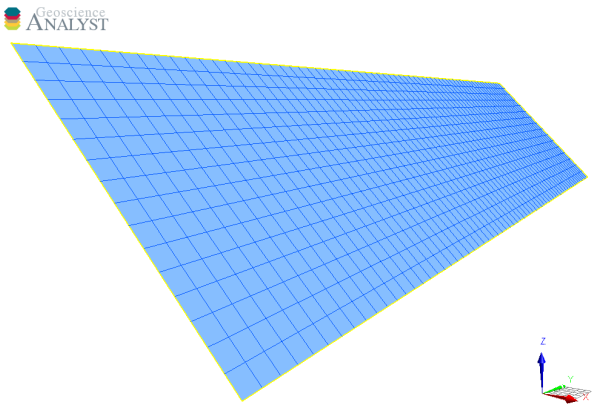
[13]:
```
pixels = [
    [18, 73],
    [757, 1014],
    [18, 1014],

]
coords = [
    [311005, 6065252, 0],
    [320001, 6076748, 0],
    [311005, 6076748, 0]
]

geoimage.georeference(pixels, coords)
print(geoimage.vertices)
```

```
[[ 310785.88227334 6077065.63655685       0.        ]
 [ 320232.29093369 6077065.63655686       0.        ]
 [ 320232.29093369 6064360.17428268       0.        ]
 [ 310785.88227334 6064360.17428268       0.        ]]
```

Grid2D

The `Grid2D` object defines a regular grid of `cells` often used to display model sections or to compute data derivatives. A `Grid2D` can be oriented in 3D space using the `origin`, `rotation` and `dip` parameters.

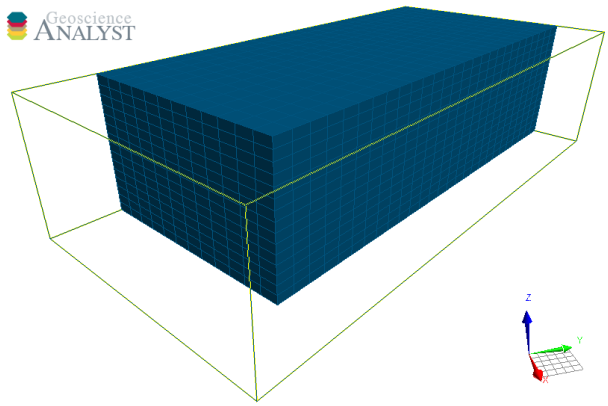
[14]:
```
from geoh5py.objects import Grid2D

# Create the Surface object
grid = Grid2D.create(
    workspace,
    origin = [25, -75, 50],
    u_cell_size = 2.5,
    v_cell_size = 2.5,
    u_count = 64,
    v_count = 16,
    rotation = 90.0,
    dip = 45.0,
)
```



BlockModel

The `BlockModel` object defines a rectilinear grid of cells, also known as a tensor mesh. The `cells` center position is determined by `cell_delimiters` (offsets) along perpendicular axes (`u`, `v`, `z`) and relative to the `origin`. `BlockModel` can be oriented horizontally by controlling the `rotation` parameter.

[15]:
```
from geoh5py.objects import BlockModel

# Create the Surface object
blockmodel = BlockModel.create(
    workspace,
    origin = [25, -100, 50],
    u_cell_delimiters=np.cumsum(np.ones(16) * 5), # Offsets along u
    v_cell_delimiters=np.cumsum(np.ones(32) * 5), # Offsets along v
    z_cell_delimiters=np.cumsum(np.ones(16) * -2.5),  # Offsets along z (down)
    rotation = 30.0
)
```

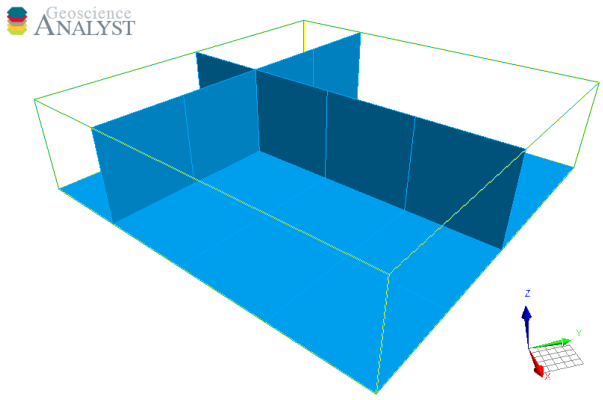


Octree

The `Octree` object is type of 3D grid that uses a tree structure to define `cells`. Each cell can be subdivided it into eight octants allowing for a more efficient local refinement of the mesh. The `Octree` object can also be oriented horizontally by controlling the `rotation` parameter.

[16]:
```
from geoh5py.objects import Octree

octree = Octree.create(
        workspace,
        origin=[25, -100, 50],
        u_count=16,       # Number of cells in power 2
        v_count=32,
        w_count=16,
        u_cell_size=5.0, # Base cell size (highest octree level)
        v_cell_size=5.0,
        w_cell_size=2.5, # Offsets along z (down)
        rotation=30,
)
```

By default, the octree mesh will be refined at the lowest level possible along each axes.

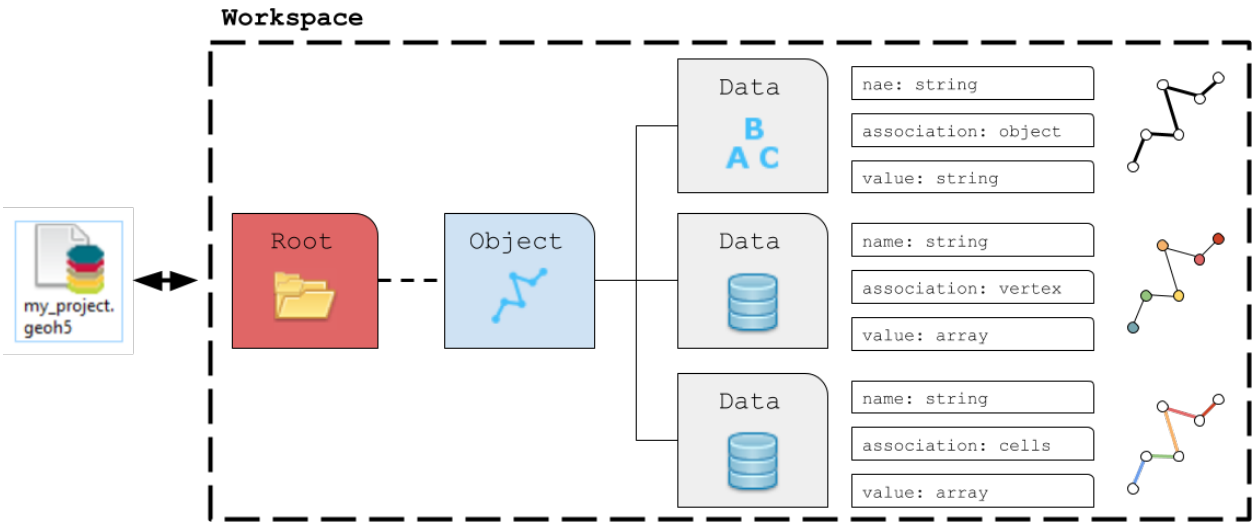


[17]:
```
workspace.close()
```

2.2.3 Data

The `geoh5` format allows storing data (values) on different parts of an `Object`. The data types currently supported by `geoh5py` are

- Float
- Integer
- Text
- Colormap
- Well log



[1]:
```
from geoh5py.workspace import Workspace
import numpy as np

# Re-use the previous workspace
workspace = Workspace("my_project.geoh5")

# Get the curve from previous section
curve = workspace.get_entity("Curve")[0]
```

Float

Numerical `float` data can be attached to the various elements making up object. Data can be added to an `Object` entity using the `add_data` method.

[2]:
```
curve.add_data({
    "my_cell_values": {
        "association":"CELL",
        "values": np.random.randn(curve.n_cells)
    }
})
```

[2]:
```
<geoh5py.data.float_data.FloatData at 0x7fdca41eea10>
```

The `association` can be one of:

- OBJECT: Single element characterizing the parent object
- VERTEX: Array of values associated with the parent object vertices
- CELL: Array of values associated with the parent object cells

The length and order of the array of values must be consistent with the corresponding element of `association`. If the `association` argument is omited, `geoh5py` will attempt to assign the data to the correct part based on the shape of the data values, either `object.n_values` or `object.n_cells`

[3]:
```
# Add multiple data vectors on a single call
data = {}
for ii in range(8):
```

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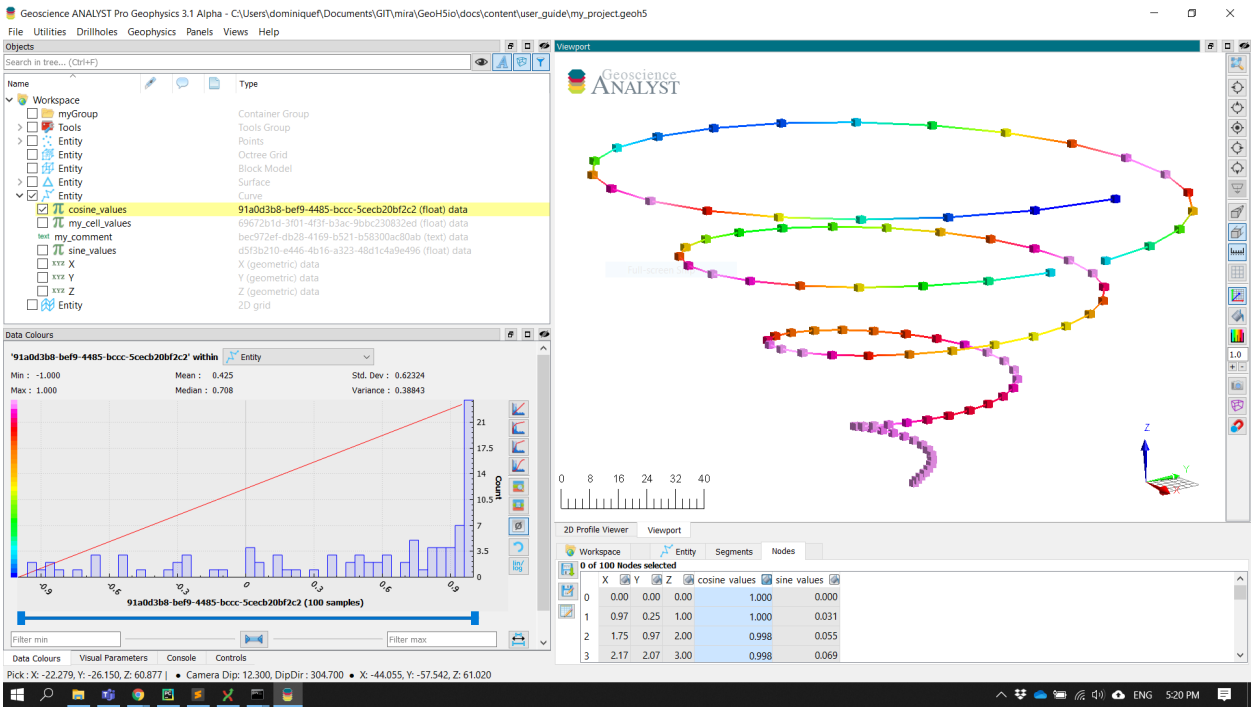
```
    data[f"Period:{ii}"] = {
        "association":"VERTEX",
        "values": (ii+1) * np.cos(ii*curve.vertices[:, 0]*np.pi/curve.vertices[:, 0].
↪max()/4.)
    }

data_list = curve.add_data(data)
print([obj.name for obj in data_list])
```

```
['Period:0', 'Period:1', 'Period:2', 'Period:3', 'Period:4', 'Period:5', 'Period:6',
↪'Period:7']
```

The newly created data is directly added to the project's `geoh5` file and available for visualization:



Integer

Same implementation as for *Float* data type but with values provided as integer (`int32`).

Text

Text (string) data can only be associated to the object itself.

[4]:
```
curve.add_data({
    "my_comment": {
        "association":"OBJECT",
        "values": "hello_world"
    }
})
```

[4]:
```
<geoh5py.data.text_data.TextData at 0x7fdca41bdb90>
```

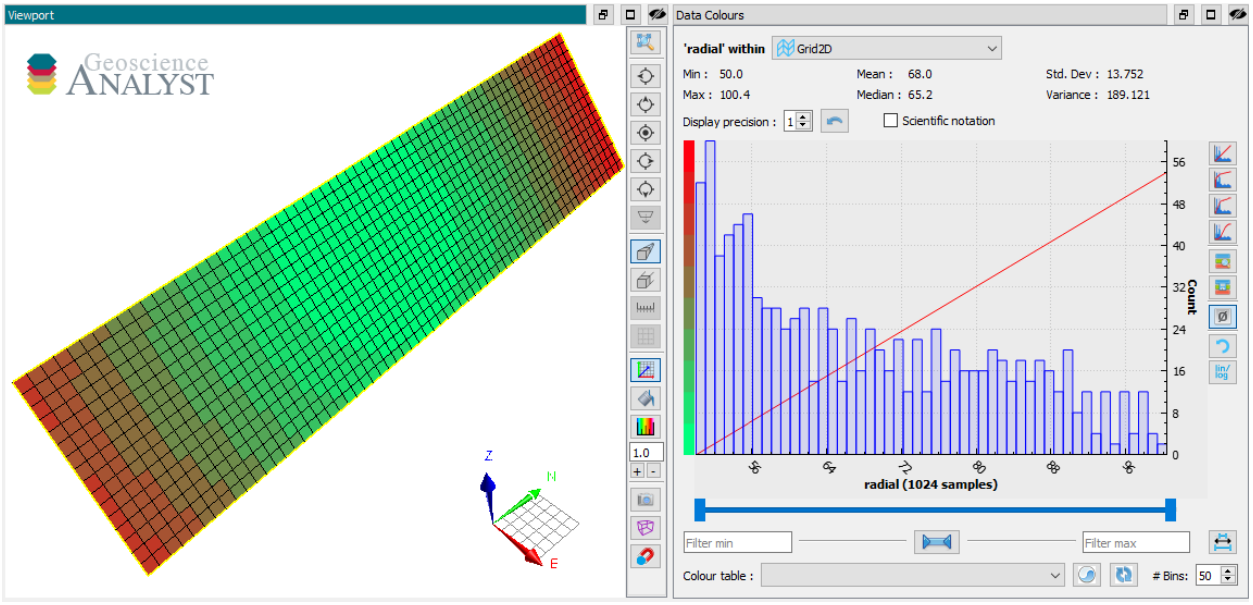
Colormap

The colormap data type can be used to store or customize the color palette used by Geoscience ANALYST.

[5]:
```
from geoh5py.data.color_map import ColorMap

# Create some data on a grid2D entity.
grid = workspace.get_entity("Grid2D")[0]

# Add data
radius = grid.add_data({
    "radial": {"values": np.linalg.norm(grid.centroids, axis=1)}
})
```



[6]:
```
# Create a simple colormap that spans the data range
nc = 10
rgba = np.vstack([
    np.linspace(radius.values.min(), radius.values.max(), nc), # Values
    np.linspace(0, 255, nc), # Red
    np.linspace(255, 0, nc), # Green
    np.linspace(125, 15, nc), # Blue,
    np.ones(nc) * 255, # Alpha,
]).T
```

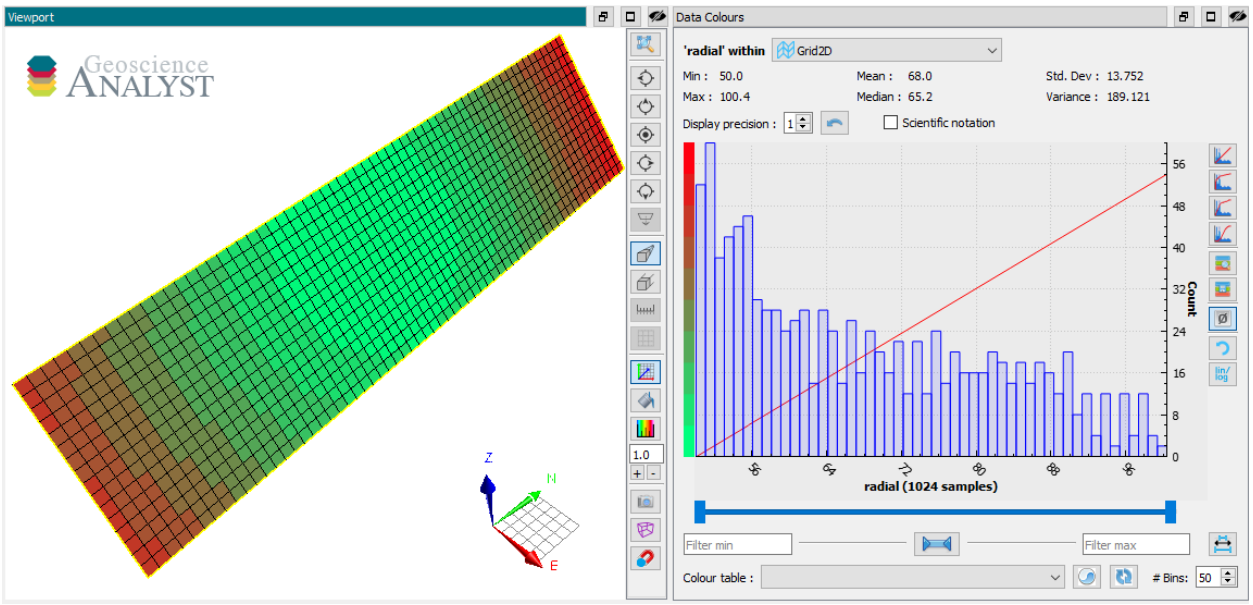
We now have an array that contains a range of integer values for red, green, blue and alpha (RGBA) over the span of the data values. This array can be used to implicitly create a *ColorMap* from the `EntityType`.

[7]:
```
# Assign the colormap to the data type
radius.entity_type.color_map = rgba
```

The resulting `ColorMap` stores the values to `geoh5` as a `numpy.recarray` with fields for `Value`, `Red`, `Green`, `Blue` and `Alpha`.

[8]:
```
radius.entity_type.color_map._values
```

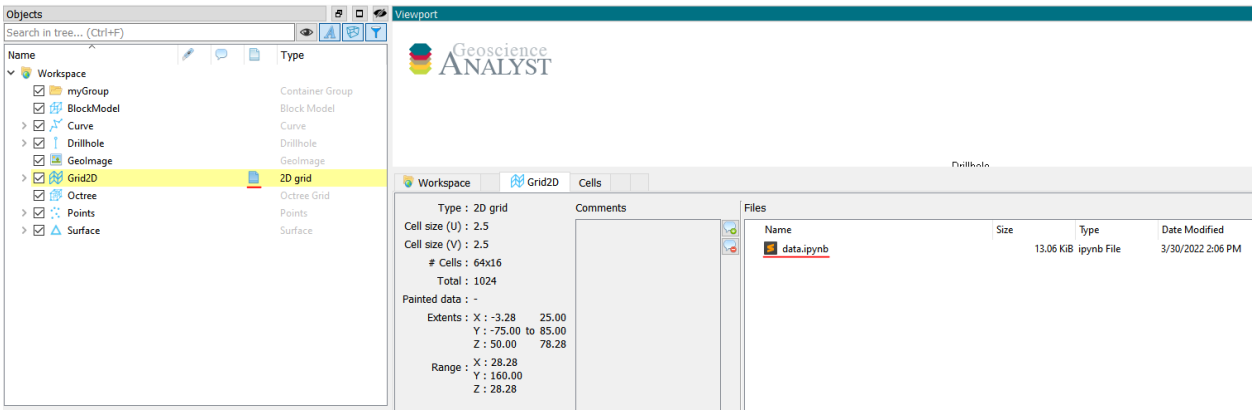
[8]:
```
rec.array([( 50.03124024,   0, 255, 125, 255),
           ( 55.62664299,  28, 226, 112, 255),
           ( 61.22204575,  56, 198, 100, 255),
           ( 66.8174485 ,  85, 170,  88, 255),
           ( 72.41285126, 113, 141,  76, 255),
           ( 78.00825401, 141, 113,  63, 255),
           ( 83.60365676, 170,  85,  51, 255),
           ( 89.19905952, 198,  56,  39, 255),
           ( 94.79446227, 226,  28,  27, 255),
           (100.38986503, 255,   0,  15, 255)],
          dtype=[('Value', '<f8'), ('Red', 'u1'), ('Green', 'u1'), ('Blue', 'u1'), (
↪'Alpha', 'u1')])
```



Files

Raw files can be added to groups and objects and stored as blob (bytes) data in `geoh5`.

[9]:
```
file_data = grid.add_file("./data.ipynb")
```



The information can easily be re-exported out to disk with the `save` method.

[10]:
```
file_data.save_file(path="./temp", name="new_name.ipynb")
```

Well Data

In the case of *Drillhole* objects, data are always stored as `from-to` interval values.

Depth Data

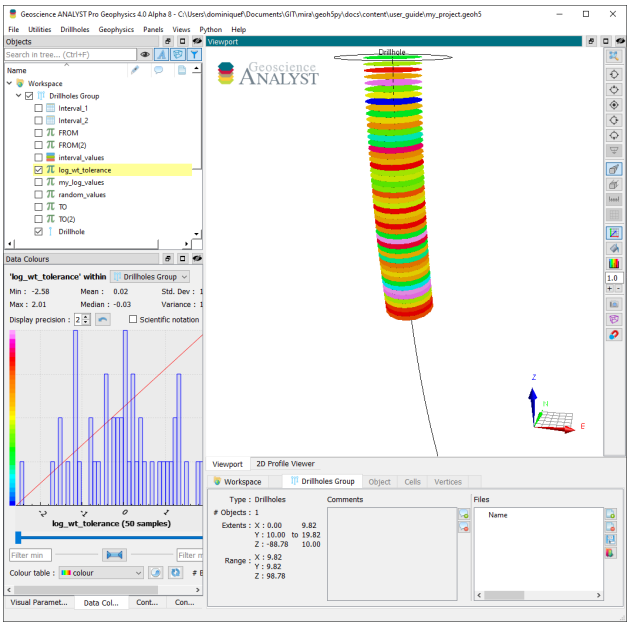
Depth data are used to represent measurements recorded at discrete depths along the well path. A `depth` attribute is required on creation. Depth markers are converted internally to `from-to` intervals by adding a small depth values defined by the `collocation_distance`. If the `Drillhole` object already holds depth data at the same location, `geoh5py` will group the datasets under the same `PropertyGroup`.

[12]:
```
well = workspace.get_entity("Drillhole")[0]
depths_A = np.arange(0, 50.) # First list of depth

# Second list slightly offsetted on the first few depths
depths_B = np.arange(0.01, 50.01)

# Add both set of log data with 0.5 m tolerance
well.add_data({
    "my_log_values": {
            "depth": depths_A,
            "values": np.random.randn(depths_A.shape[0]),
    },
    "log_wt_tolerance": {
            "depth": depths_B,
            "values": np.random.randn(depths_B.shape[0]),
    }
})
```

[12]:
```
[<abc.FloatDataConcatenated at 0x7fdc79a2f3d0>,
 <abc.FloatDataConcatenated at 0x7fdc79ac2850>]
```



Interval (From-To) Data

Interval data are defined by constant values bounded by a start (FROM) and an end (TO) depth. A `from-to` attribute defined as a `numpy.ndarray (nD, 2)` is expected on creation. Subsequent data are appended to the same interval `PropertyGroup` if the `from-to` values match within the collocation distance parameter. Users can control the tolerance for matching intervals by supplying a `collocation_distance` argument in meters, or by setting the default on the drillhole entity (`default_collocation_distance = 1e-2` meters).

[13]:
```
# Define a from-to array
from_to = np.vstack([
    [0.25, 25.5],
    [30.1, 55.5],
    [56.5, 80.2]
])

# Add some reference data
well.add_data({
    "interval_values": {
        "values": np.asarray([1, 2, 3]),
        "from-to": from_to,
        "value_map": {
            1: "Unit_A",
            2: "Unit_B",
            3: "Unit_C"
        },
        "type": "referenced",
    }
})

# Add float data on the same intervals
well.add_data({
    "random_values": {
```

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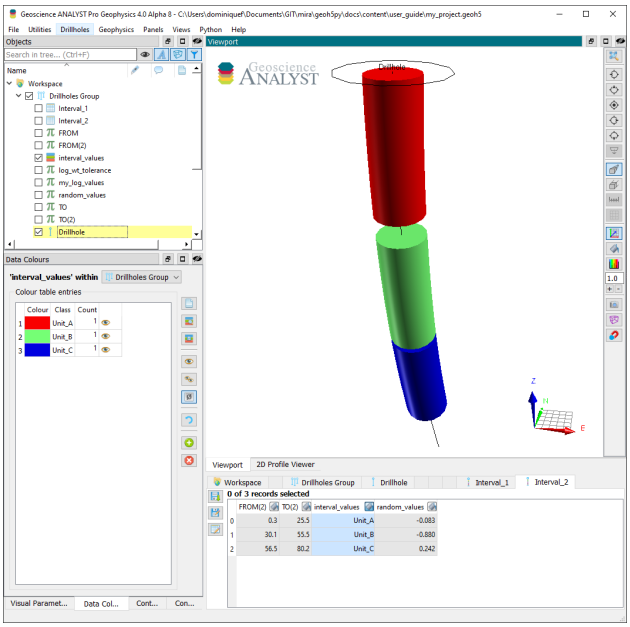
```
        "values": np.random.randn(from_to.shape[0]),
        "from-to": from_to,
    }
})
```

```
/home/docs/checkouts/readthedocs.org/user_builds/geoh5py/conda/v0.6.1/lib/python3.7/site-
↪packages/geoh5py/data/integer_data.py:66: UserWarning: Values provided in int64 are␣
↪converted to int32 for PrimitiveTypeEnum.REFERENCED data 'interval_values.'
  f"Values provided in {values.dtype} are converted to int32 for "
```

[13]:
```
<abc.FloatDataConcatenated at 0x7fdc77a058d0>
```



Get data

Just like any `Entity`, data can be retrieved from the `Workspace` using the `get_entity` method. For convenience, `Objects` also have a `get_data_list` and `get_data` method that focusses only on their respective children `Data`.

[14]:
```
my_list = curve.get_data_list()
print(my_list, curve.get_data(my_list[0]))
```

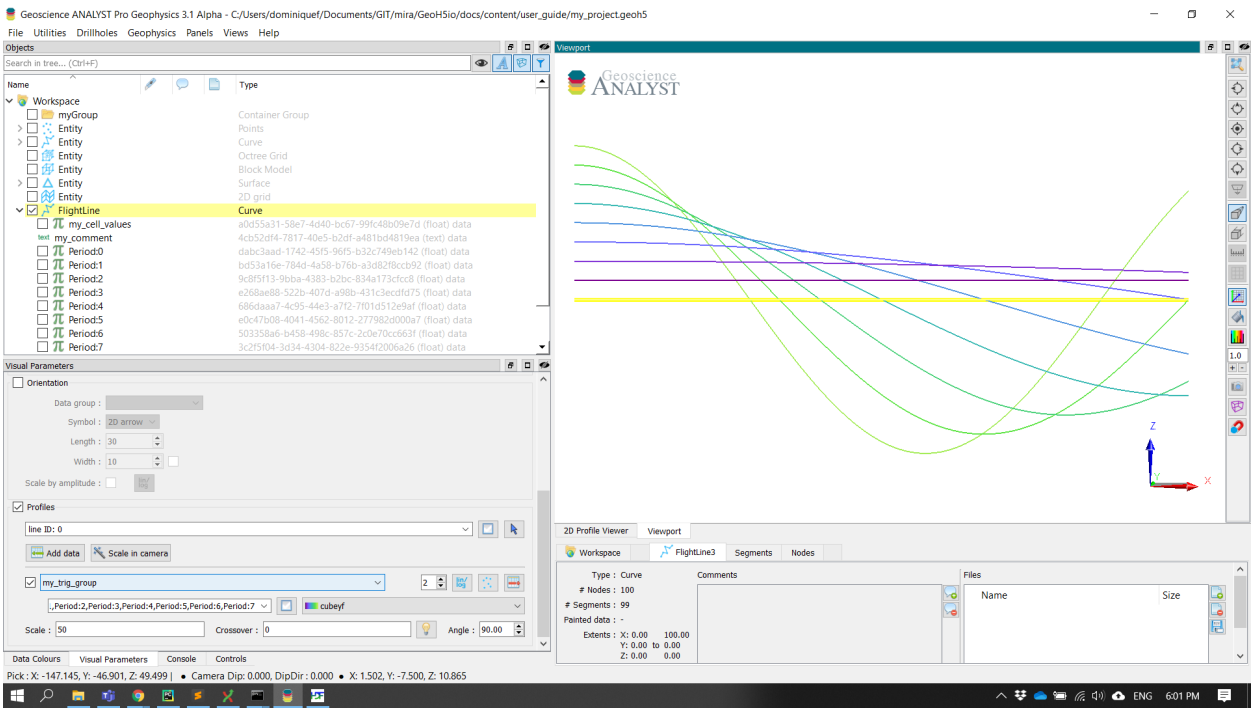
```
['Period:0', 'Period:1', 'Period:2', 'Period:3', 'Period:4', 'Period:5', 'Period:6',
↪'Period:7', 'my_cell_values', 'my_comment'] [<geoh5py.data.float_data.FloatData object␣
↪at 0x7fdc79a4c490>]
```

2.2.4 Property Groups

`Data` entities sharing the same parent `Object` and `association` can be linked within a `property_groups` and made available through profiling. This can be used to group data that would normally be stored as 2D array.

[15]:
```
# Add another VERTEX data and create a group with previous
curve.add_data_to_group([obj.name for obj in data_list], "my_trig_group")
```

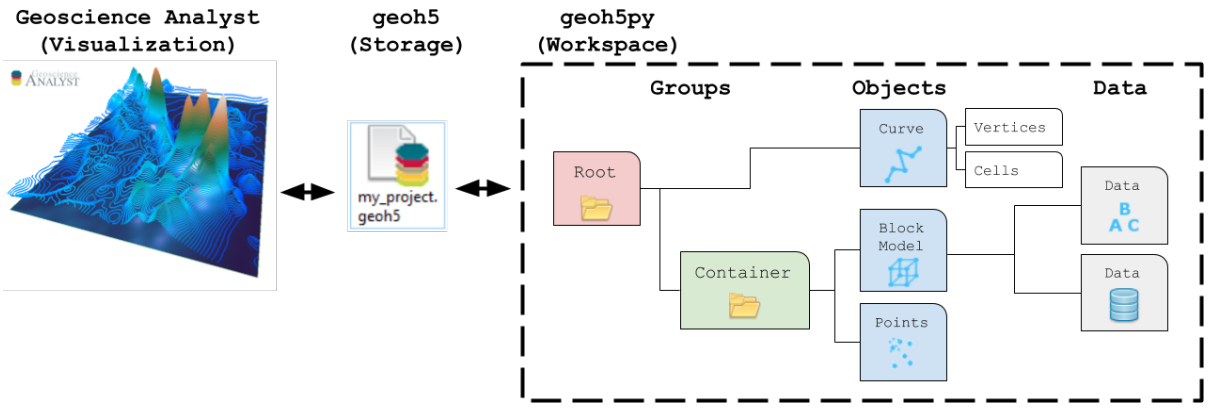
[15]:
```
<geoh5py.groups.property_group.PropertyGroup at 0x7fdc77a05190>
```



[16]:
```
workspace.close()
```

2.2.5 Surveys

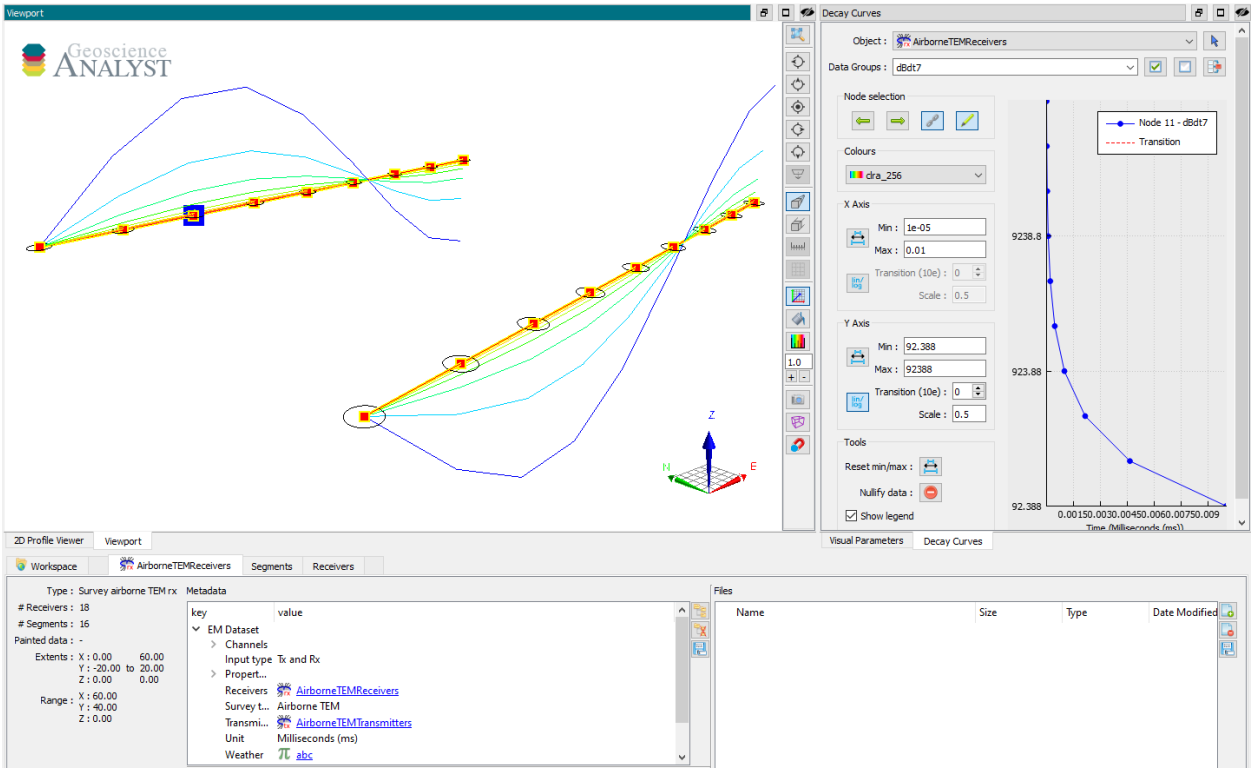
This section provides information on how to create geophysical surveys programmatically.



Airborne Time-Domain

This type of survey can be used to store airborne time-domain electromagnetic (ATEM) data defined by a fixed transmitter-receiver loop configuration. The survey is made up of two entities (*AirborneTEMTransmitters* and *AirborneTEMReceivers*) linked by their metadata.

The following example shows how to generate an airborne TEM survey with associated data stored in `geoh5` format and accessible from Geoscience ANALYST.




```
[1]: import numpy as np
     from geoh5py.workspace import Workspace
     from geoh5py.objects import AirborneTEMReceivers, AirborneTEMTransmitters

     # Create a new project
     workspace = Workspace("my_project.geoh5")

     # Define the pole locations
     n_stations = 9
     n_lines = 2
     x_loc, y_loc = np.meshgrid(np.linspace(0, 60, n_stations), np.linspace(-20, 20., n_
     ↪lines))
     vertices = np.c_[x_loc.ravel(), y_loc.ravel(), np.zeros_like(x_loc).ravel()]

     # Assign a line ID to the poles (vertices)
     parts = np.kron(np.arange(n_lines), np.ones(n_stations)).astype('int')

     # Create the survey as a coincident loop system
     aem_receivers = AirborneTEMReceivers.create(workspace, vertices=vertices, parts=parts)
     aem_transmitters = AirborneTEMTransmitters.create(workspace, vertices=vertices,␣
```

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```
↪parts=parts)
```

We have so far created two seperate entities, one for transmitter locations and another for the receivers. In order to finalize the survey, the association must be made between the two entities:

[2]:
```
aem_receivers.transmitters = aem_transmitters
```

or equivalently

[3]:
```
aem_transmitters.receivers = aem_receivers
```

Only one of the two options above is needed.

Once linked, the two entities will share changes applied to the metadata. For example, changing the `input_type` property on the transmitters yield:

[4]:
```
aem_transmitters.input_type = "Tx and Rx"
print(aem_receivers.input_type)
```

```
Tx and Rx
```

Metadata

Along with the survey object itself, the metadata contains all the necessary information to define the geophysical experiment.

[5]:
```
aem_receivers.metadata
```

[5]:
```
{'EM Dataset': {'Channels': [],
  'Input type': 'Tx and Rx',
  'Property groups': [],
  'Receivers': UUID('23c9f5a4-76e8-4df3-97e4-e4b4d3ac66f1'),
  'Survey type': 'Airborne TEM',
  'Transmitters': UUID('2123066a-3fb4-428b-9612-185b1be419ad'),
  'Unit': 'Milliseconds (ms)',
  'Waveform': {'Timing mark': 0.0}}}
```

Channels

List of time channels at which the data are provided.

[6]:
```
aem_receivers.channels = np.logspace(-5, -2, 10) # Simple sweep from 1 to 10 ms
```

Input type

Label defining how the survey was created.

- `Rx`: Survey defined from the `AirborneTEMReceivers` positions, with the`AirborneTEMTransmitters` added from offsets.
- `Tx`: Survey defined from the `AirborneTEMTransmitters` position, with the`AirborneTEMReceivers` added from offsets.
- `Tx and Rx`: Survey defined by both the `AirborneTEMTransmitters` and the`AirborneTEMReceivers` positions.

Property groups

List of *PropertyGroup*s defining the various data components (e.g. `dBzdt`, `Bz`, ...). It is expected that each component contains data channels at all times and in the same order as defined in `Channels`.

The class method *add_component_data* can help users add data from nested dictionaries. Below is an example using four components:

[7]:
```
# Create some simple data
data_fun = lambda t: 1./ t * np.sin(np.pi * (x_loc * y_loc).ravel() / 800.)

# Create a nested dictionary of time data.
data = {
    "dBdt" : {
        f"time[{tt}]": {"values": data_fun(time)} for tt, time in enumerate(aem_
↪receivers.channels)
    }
}

aem_receivers.add_components_data(data)
```

[7]:
```
[<geoh5py.groups.property_group.PropertyGroup at 0x7f9fcc795a10>]
```

Metadata are also updated to reflect the addition of component data.

[8]:
```
aem_receivers.metadata
```

[8]:
```
{'EM Dataset': {'Channels': [1e-05,
   2.1544346900318823e-05,
   4.641588833612782e-05,
   0.0001,
   0.00021544346900318823,
   0.00046415888336127773,
   0.001,
   0.002154434690031882,
   0.004641588833612777,
   0.01],
  'Input type': 'Tx and Rx',
  'Property groups': ['dBdt'],
  'Receivers': UUID('23c9f5a4-76e8-4df3-97e4-e4b4d3ac66f1'),
  'Survey type': 'Airborne TEM',
  'Transmitters': UUID('2123066a-3fb4-428b-9612-185b1be419ad'),
```

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```
 'Unit': 'Milliseconds (ms)',
 'Waveform': {'Timing mark': 0.0}}}
```

Data channels associated with each component can be quickly accessed through the *BaseEMSurvey.components* property:

[9]:
```
aem_receivers.components['dBdt']
```

[9]:
```
[<geoh5py.data.float_data.FloatData at 0x7f9fa0048e50>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa0036a90>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa0036790>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa0036150>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa0036310>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa0036d50>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa0036a50>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa00367d0>,
 <geoh5py.data.float_data.FloatData at 0x7f9fa0036a10>,
 <geoh5py.data.float_data.FloatData at 0x7f9fcc795910>]
```

Receivers

Generic label used for surveys to identify the receiver entity. References to itself in the case of `AirborneTEMReceivers`.

Survey type

Static label identifier for `Airborne TEM` survey type.

Transmitters

Generic label used for surveys to identify the transmitter entity. References to itself in the case of `AirborneTEMTransmitters`.

Unit

Units for time sampling of the data - must be one of `Seconds (s)`, `Milliseconds (ms)`, `Microseconds (us)` or `Nanoseconds (ns)`.

Loop radius

Specifies the transmitter loop radius.

Custom fields

`Metadata` are stored in `geoh5` as a `json` structure allowing for custom data fields to be added to the survey. Information such as flight data, date/time, offsets, etc. can be added as `string`, `float` and `int`.

[10]:
```
aem_receivers.edit_metadata({"Weather": "sunny"})
```

|atem_custom|

Aternatively, a `uuid.UUID` value can be used if the information is to be provided at every survey position.

[11]:
```
# Add a new data entry
abc = aem_receivers.add_data({
    "abc": {"values": np.random.randn(aem_receivers.n_vertices)}
})

# Assign the data as 'Weather' metadata
aem_receivers.edit_metadata({"Weather": abc.uid})
```

`Geoscience ANALYST` will automatically create a link referencing the data field to the entity in the project tree.

|atem_uid|

Reserved keywords

For known metadata, such as flight dynamics (`yaw`, `pitch`, `roll`) and offsets (`inline`, `crossline`, `vertical`) the suffix `property` and `value` will get replaced based on the input value:

[12]:
```
aem_receivers.yaw = 15.
```

|atem_yaw_value|

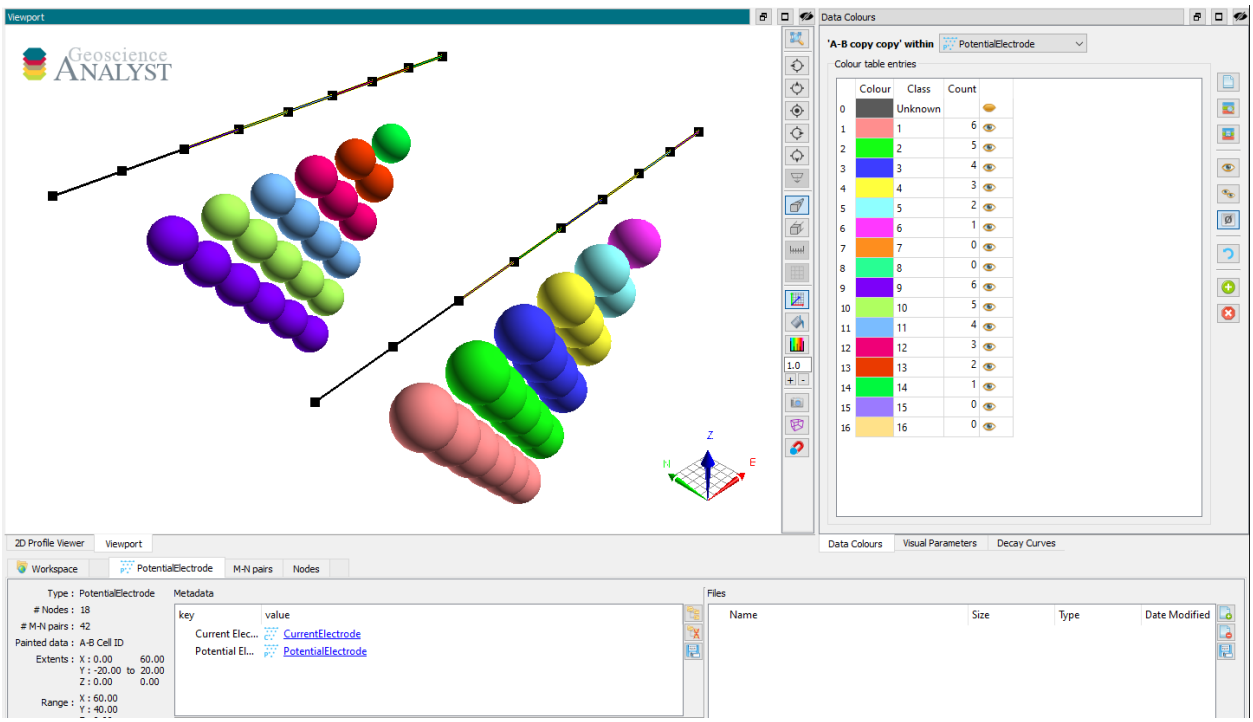
[13]:
```
aem_receivers.yaw = abc.uid  # Assign to the yaw property
```

|atem_yaw_property|

Direct Current and Induced Polarization (DC-IP)

This survey type is meant to handle direct-current resistivity data. The survey object is made up of two curve entities defining the transmitter (current) and receiver (potential) electrodes.

The following example shows how to generate a DC-IP survey with associated data stored in `geoh5` format and accessible from Geoscience ANALYST.



Current Electrode (transmitters)

The *CurrentElectrode* entity defines the A-B dipole pairs used to inject current into the ground. It is a sub-class of the *PotentialElectrode* object defined by vertices (poles) and cells (dipoles). Here we generate four (4) parallel EW lines with eight dipoles per line.

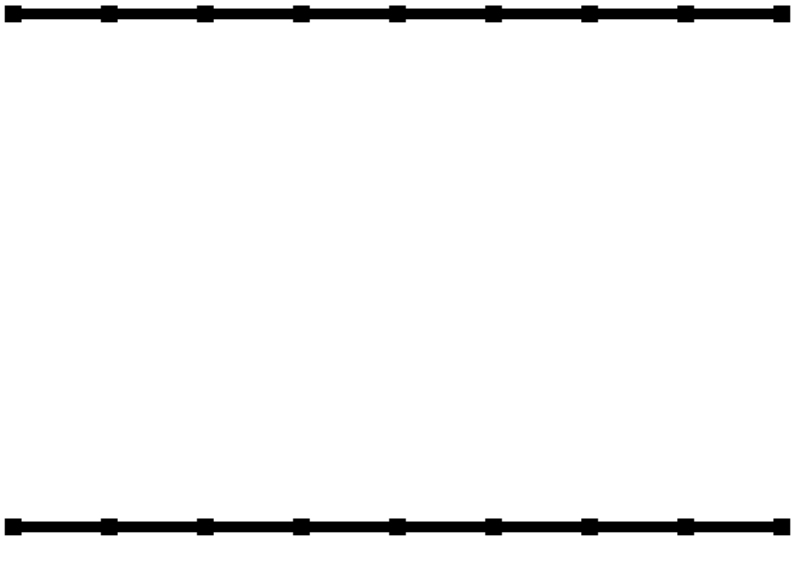
[1]:
```
import numpy as np
import uuid
from geoh5py.workspace import Workspace
from geoh5py.objects import CurrentElectrode, PotentialElectrode

# Create a new project
workspace = Workspace("my_project.geoh5")

# Define the pole locations
n_poles = 9
n_lines = 2
x_loc, y_loc = np.meshgrid(np.linspace(0, 60, n_poles), np.linspace(-20, 20., n_lines))
vertices = np.c_[x_loc.ravel(), y_loc.ravel(), np.zeros_like(x_loc).ravel()]

# Assign a line ID to the poles (vertices)
parts = np.kron(np.arange(n_lines), np.ones(n_poles)).astype('int')

# Create the CurrentElectrode object
currents = CurrentElectrode.create(workspace, vertices=vertices, parts=parts)
```



At this stage the `CurrentElectrode` object has segments (`cells`) connecting all poles in series along line.

AB Cell ID

A key element of the DCIP survey objects is the `ab_cell_id` property. This `ReferenceData` contains the map referencing each cell of the `CurrentElectrode` object to a unique A-B source identifier with name.

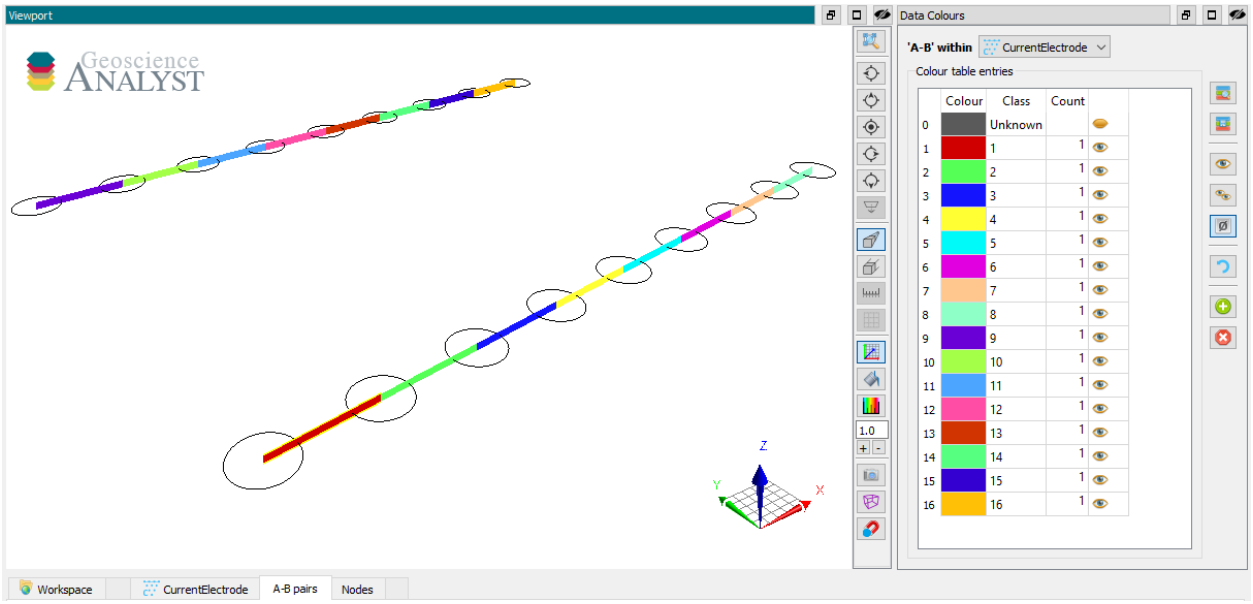
The utility function *add_default_ab_cell_id* can help generate this map with a simple name string incrementor.

[2]:
```
currents.add_default_ab_cell_id()
print(currents.ab_cell_id.value_map.map)
```

```
{0: 'Unknown', 1: '1', 2: '2', 3: '3', 4: '4', 5: '5', 6: '6', 7: '7', 8: '8', 9: '9',␣
↪10: '10', 11: '11', 12: '12', 13: '13', 14: '14', 15: '15', 16: '16'}
```

```
/home/docs/checkouts/readthedocs.org/user_builds/geoh5py/conda/v0.6.1/lib/python3.7/site-
↪packages/geoh5py/data/integer_data.py:66: UserWarning: Values provided in int64 are␣
↪converted to int32 for PrimitiveTypeEnum.REFERENCED data 'A-B Cell ID.'
  f"Values provided in {values.dtype} are converted to int32 for "
```

In this specific case, every `cell` on the curve corresponds to a unique dipole source current. For more complex survey configurations, users can edit the `cell` property in order to define different combinations of connections between poles.



Note: The first entry `{0:Unknown}` is a reserved field used by Geoscience ANALYST to flag unknown data entries.

Potential Electrode (receivers)

The *PotentialElectrode* object defines the M-N dipole pairs used to measure the electric potential (receivers). It is a sub-class of the *Curve* object defined by `vertices` (poles) and `cells` (dipoles).

Although poles could be set independently on the `CurrentElectrode` and `PotentialElectrode` objects, here we re-uses the same locations for simplicity:

[3]:
```
potentials = PotentialElectrode.create(workspace, vertices=vertices)
```

Next, we must define the receiver dipoles. The following routine generates a maximum of six (6) receivers dipoles per injection currents along line.

[4]:
```
N = 6
dipoles = []
current_id = []

for val in currents.ab_cell_id.values: # For each source dipole
    if val == 0:  # Skip the unknown
        continue

    cell_id = val - 1 # Python 0 indexing
    line = currents.parts[currents.cells[cell_id, 0]]
    for m_n in range(N):
        dipole_ids = (currents.cells[cell_id, :] + 2 + m_n).astype("uint32") # Skip two␣
↪poles

        # Shorten the array as we get to the end of the line
        if (
            any(dipole_ids > (potentials.n_vertices - 1))
            or any(currents.parts[dipole_ids] != line)
        ):
```

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```
            continue

        dipoles += [dipole_ids] # Save the receiver id
        current_id += [val] # Save the source id

potentials.cells = np.vstack(dipoles)
```

Finally, users need to create an association between each receiver dipole (M-N) to a dipole current (A-B). The mapping is done through the `ab_cell_id` property of the `PotentialElectrode`. An integer (ID) value must be assigned to each cell, corresponding to the *AB Cell ID* pairs stored on the associated `CurrentElectrode` object.

[5]:
```
potentials.ab_cell_id = np.asarray(current_id, dtype="int32")
```

Metadata

The link between the sources *CurrentElectrode* and the receivers *PotentialElectrode* is established by the `metadata`, shared by both entities. The connection can be made by assigning `current_electrodes` to the receivers:

[6]:
```
potentials.current_electrodes = currents
```

or equivalently by setting `potential_electrodes` to the currents

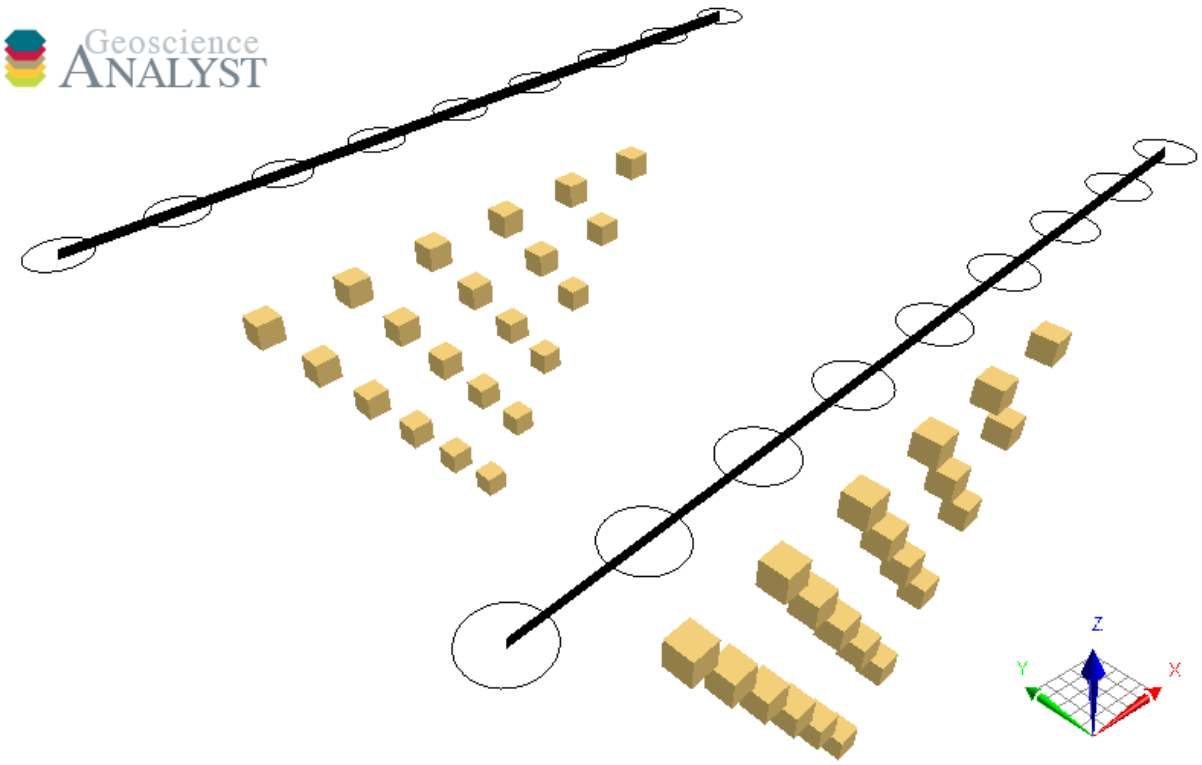
[7]:
```
currents.potential_electrodes = potentials
```

In both cases, the link between the two objects gets encoded automatically to their respective `metadata`.

[8]:
```
print(potentials.metadata == currents.metadata)
currents.metadata
```

```
True
```

[8]:
```
{'Current Electrodes': UUID('4cdaadb4-00ba-4326-bf2e-ccedda9b5862'),
 'Potential Electrodes': UUID('409642a5-c75d-4a99-8609-e5596c3fa33a')}
```



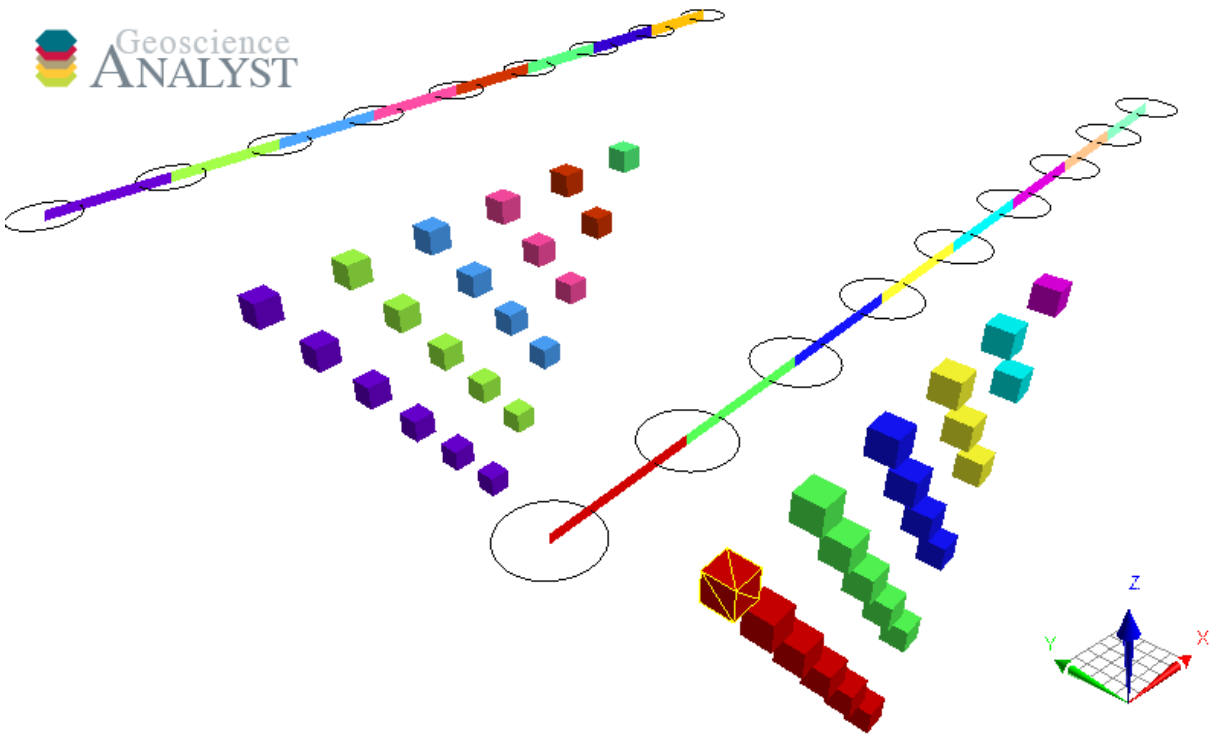
Note: The `ab_cell_id` property of the `CurrentElectrode` and `PotentialElectrode` are two different `ReferenceData` entities:

[9]:
```
print(potentials.ab_cell_id == currents.ab_cell_id)
```
```
False
```

but share the same `DataType` that holds the map of unique source dipoles.

[10]:
```
print(potentials.ab_cell_id.entity_type == currents.ab_cell_id.entity_type)
```
```
True
```

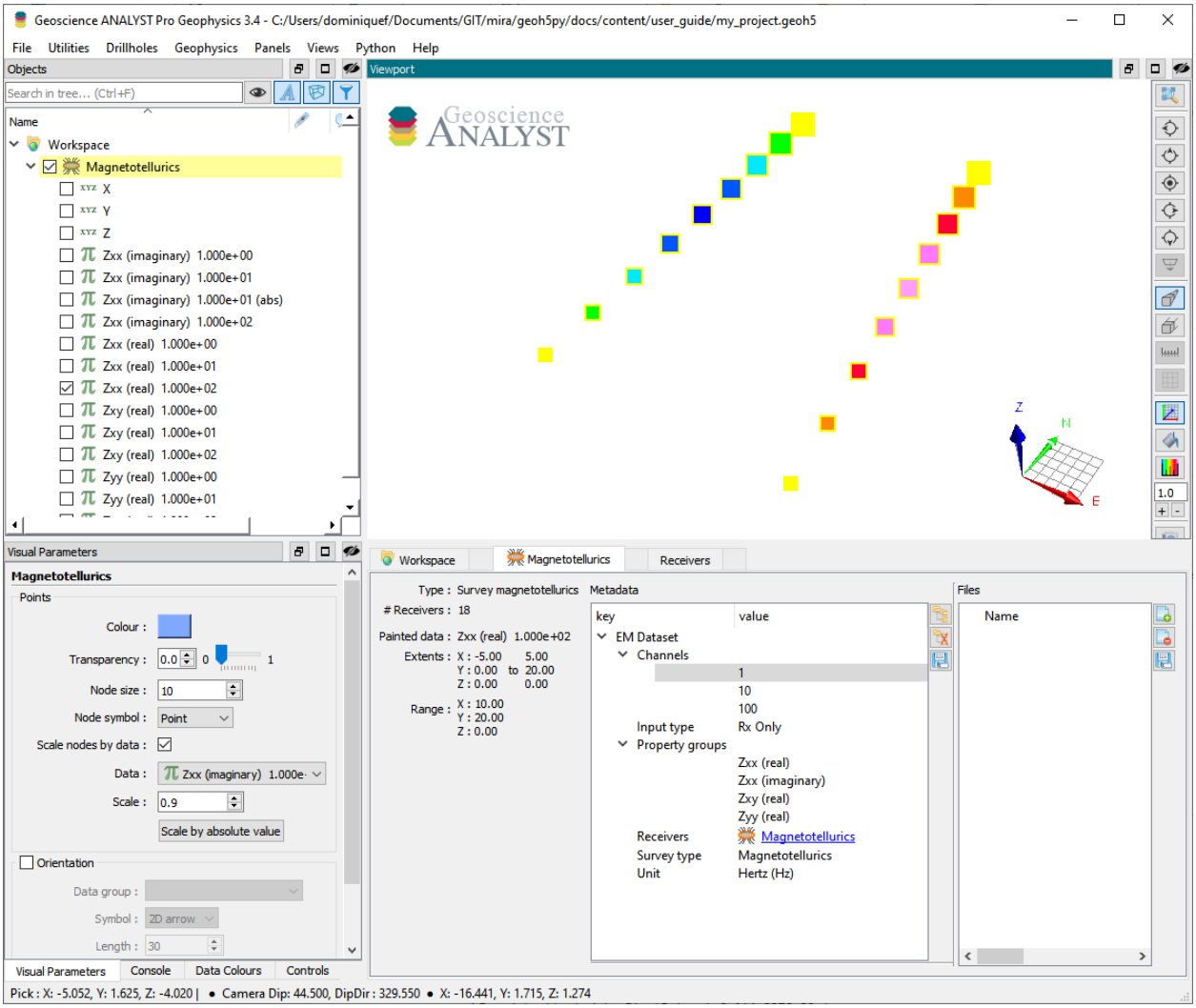
This link between `DataType` allows users to query the data by dipole sources and display the values as pseudo-section in Geoscience ANALYST



Magnetotellurics

This object can be used to store magnetotelluric (MT) surveys - a natural-source geophysical method. Data are provided in the frequency-domain as point source measurements of either impedances or apparent resistity/phase.

The following example shows how to generate an MT survey with associated data stored in `geoh5` format and accessible from Geoscience ANALYST.



[1]:
```
import numpy as np
from geoh5py.workspace import Workspace
from geoh5py.objects import MTReceivers

# Create a new project
workspace = Workspace("my_project.geoh5")

# Define a synthetic survey with receivers on 2 lines, 60 m apart
x_loc, y_loc = np.meshgrid(np.linspace(-5, 5, 2), np.linspace(0., 20., 9))
vertices = np.c_[x_loc.ravel(), y_loc.ravel(), np.zeros_like(x_loc).ravel()]

# Create the survey from vertices
mt_survey = MTReceivers.create(workspace, vertices=vertices)
```

Only receivers are needed to define the survey as MT uses the ambient electromagntic field of the Earth - no transmitters (source) required.

Metadata

Along with the *MTReceivers*, the metadata contains all the necessary information to define the geophysical experiment.

[2]:
```
mt_survey.metadata
```

[2]:
```
{'EM Dataset': {'Channels': [],
  'Input type': 'Rx only',
  'Property groups': [],
  'Receivers': UUID('f18b816d-3695-4500-a451-abe19c5f1fd1'),
  'Survey type': 'Magnetotellurics',
  'Unit': 'Hertz (Hz)'}}
```

Channels

List of frequencies at which the data are provided.

[3]:
```
mt_survey.channels = [1., 10., 100.]
```

Input type

Generic label used in the `geoh5` standard for all EM survey entities. Restricted to `Rx only` in the case of natural sources methods.

Property groups

List of *PropertyGroup*s defining the various data components (e.g. `Zxx (real)`, `Zxy (imag)`, ...). It is not required to supply all components of the impedence tensor, but it is expected that each component contains a list of data channels of length and in the same order as the `Channels` (one `Data` per frequency).

The class method *add_components_data* can help users add data from nested dictionaries. Below is an example using four components:

[4]:
```
# Arbitrary data generator using sine functions
data_fun = lambda c, f: (c+1.) * np.sin(f * np.pi * (x_loc * y_loc).ravel() / 200.)

# Create a nested dictionary of component and frequency data.
data = {
    component : {
        f"{component}_{freq}": {"values": (ff+1)*1000. + (cc+1) * 100. + np.
↪arange(vertices.shape[0])} for ff, freq in enumerate(mt_survey.channels)
    } for cc, component in enumerate([
        "Zxx (real)", "Zxx (imaginary)",
        "Zxy (real)", "Zxy (imaginary)",
        "Zyx (real)", "Zyx (imaginary)",
        "Zyy (real)", "Zyy (imaginary)",
    ])
}

mt_survey.add_components_data(data)
```

[4]:
```
[<geoh5py.groups.property_group.PropertyGroup at 0x7faa78f3a650>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7faa78f3a950>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7faa78f40290>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7faa78f40e90>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7faa78f44a10>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7faa78f47650>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7faa78f47dd0>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7faa78f49a90>]
```

Metadata are updated immediately to reflect the addition of components:

[5]:
```
mt_survey.metadata
```

[5]:
```
{'EM Dataset': {'Channels': [1.0, 10.0, 100.0],
  'Input type': 'Rx only',
  'Property groups': ['Zxx (real)',
   'Zxx (imaginary)',
   'Zxy (real)',
   'Zxy (imaginary)',
   'Zyx (real)',
   'Zyx (imaginary)',
   'Zyy (real)',
   'Zyy (imaginary)'],
  'Receivers': UUID('f18b816d-3695-4500-a451-abe19c5f1fd1'),
  'Survey type': 'Magnetotellurics',
  'Unit': 'Hertz (Hz)'}}
```

Data channels associated with each component can be quickly accessed through the *BaseEMSurvey.components* property:

[6]:
```
mt_survey.components
```

[6]:
```
{'Zxx (real)': [<geoh5py.data.float_data.FloatData at 0x7faaa47072d0>,
  <geoh5py.data.float_data.FloatData at 0x7faaa4707750>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f3a250>],
 'Zxx (imaginary)': [<geoh5py.data.float_data.FloatData at 0x7faa78f3a0d0>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f3af50>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f3a690>],
 'Zxy (real)': [<geoh5py.data.float_data.FloatData at 0x7faa78f3a990>,
  <geoh5py.data.float_data.FloatData at 0x7faaa4707f10>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f40390>],
 'Zxy (imaginary)': [<geoh5py.data.float_data.FloatData at 0x7faa78f402d0>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f40b50>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f40c90>],
 'Zyx (real)': [<geoh5py.data.float_data.FloatData at 0x7faa78f40f10>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f44950>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f44810>],
 'Zyx (imaginary)': [<geoh5py.data.float_data.FloatData at 0x7faa78f448d0>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f47590>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f47450>],
 'Zyy (real)': [<geoh5py.data.float_data.FloatData at 0x7faa78f47610>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f47e90>,
  <geoh5py.data.float_data.FloatData at 0x7faa78f47f50>],
 'Zyy (imaginary)': [<geoh5py.data.float_data.FloatData at 0x7faa78f49350>,
```

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```
 <geoh5py.data.float_data.FloatData at 0x7faa78f49b90>,
 <geoh5py.data.float_data.FloatData at 0x7faa78f49b10>]}
```

Receivers

Generic label used in the `geoh5` standard for EM survey to identify the receiver entity. Restricted to itself in the case of `MTReceivers`.

Survey type

Label identifier for `Magnetotellurics` survey type.

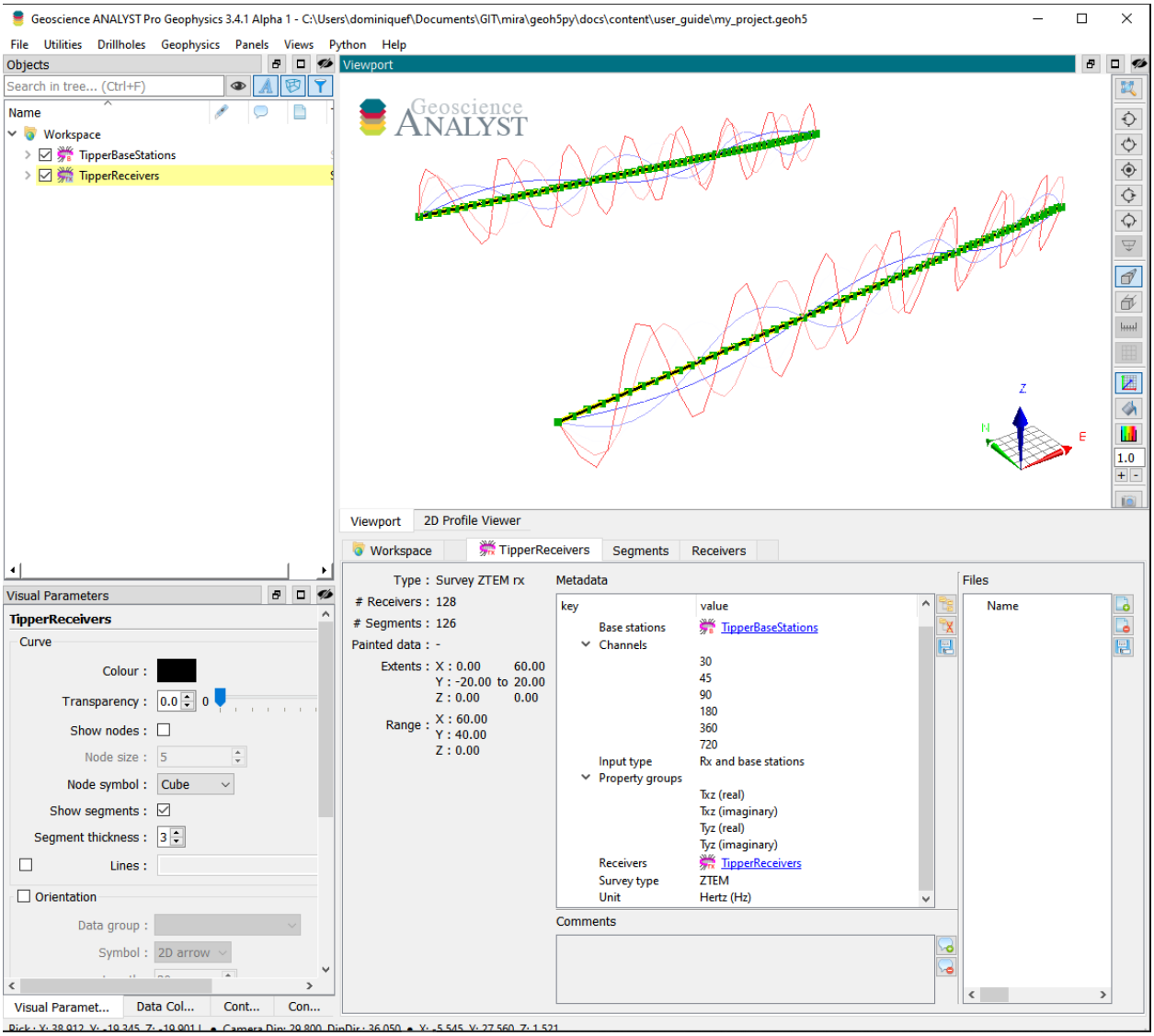
Unit

Units for frequency sampling of the data: `Hertz (Hz)`, `KiloHertz (kHz)`, `MegaHertz (MHz)` or `Gigahertz (GHz)`.

Tipper

This object can be used to store tipper (ZTEM) surveys - a natural-source geophysical method. Data are provided in the frequency-domain as point source measurements of tipper data.

The following example shows how to generate a tipper survey with associated data stored in `geoh5` format and accessible from Geoscience ANALYST.




```
[1]: import numpy as np
     from geoh5py.workspace import Workspace
     from geoh5py.objects import TipperReceivers, TipperBaseStations

     # Create a new project
     workspace = Workspace("my_project.geoh5")

     # Define the pole locations
     n_stations = 64
     n_lines = 2
     x_loc, y_loc = np.meshgrid(np.linspace(0, 60, n_stations), np.linspace(-20, 20., n_
     ↪lines))
     vertices = np.c_[x_loc.ravel(), y_loc.ravel(), np.zeros_like(x_loc).ravel()]

     # Assign a line ID to the poles (vertices)
     parts = np.kron(np.arange(n_lines), np.ones(n_stations)).astype('int')
```

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```
# Create the survey from vertices
receivers = TipperReceivers.create(workspace, vertices=vertices, parts=parts)
base = TipperBaseStations.create(workspace, vertices=vertices)
```

We have so far created two seperate entities, one for the receiver locations and another for the base station(s). In order to finalize the survey, the association must be made between the two entities:

[2]:
```
receivers.base_station = base
```

or equivalently

[3]:
```
base.receivers = receivers
```

Only one of the two options above is needed.

Metadata

Along with the *TipperReceivers*, the metadata contains all the necessary information to define the geophysical experiment.

[4]:
```
receivers.metadata
```

[4]:
```
{'EM Dataset': {'Base stations': UUID('4edf0384-08b5-4839-8c65-16efaa2642bb'),
  'Channels': [],
  'Input type': 'Rx and base stations',
  'Property groups': [],
  'Receivers': UUID('1aebc83b-784a-4ddf-abe0-96c0cdab9e3c'),
  'Survey type': 'ZTEM',
  'Unit': 'Hertz (Hz)'}}
```

Channels

List of frequencies at which the data are provided.

[5]:
```
receivers.channels = [30., 45., 90., 180., 360., 720.]
```

Input type

Generic label used in the `geoh5` standard for all EM survey entities. Restricted to `Rx and base station` in the case of a tipper survey.

Property groups

List of *PropertyGroup*s defining the various data components (e.g. `Txz (real)`, `Tyz (imag)`, ...). It is not required to supply all components of the impedence tensor, but it is expected that each component contains a list of data channels of length and in the same order as the `Channels` (one `Data` per frequency).

The class method *add_components_data* can help users add data from nested dictionaries. Below is an example using four components:

[6]:
```
# Arbitrary data generator using sine functions
data_fun = lambda c, f: (c+1.) * (f+1.) * np.sin(f * np.pi * (x_loc * y_loc).ravel() /␣
↪400.)

# Create a nested dictionary of component and frequency data.
data = {
    component : {
        f"{component}_{freq}": {"values": data_fun(cc, ff)} for ff, freq in␣
↪enumerate(receivers.channels)
    } for cc, component in enumerate([
        "Txz (real)", "Txz (imaginary)",
        "Tyz (real)", "Tyz (imaginary)",
    ])
}

receivers.add_components_data(data)
```

[6]:
```
[<geoh5py.groups.property_group.PropertyGroup at 0x7f2fc0236990>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7f2f97211b10>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7f2f9721af50>,
 <geoh5py.groups.property_group.PropertyGroup at 0x7f2f9721f390>]
```

Metadata are updated immediately to reflect the addition of components:

[7]:
```
receivers.metadata
```

[7]:
```
{'EM Dataset': {'Base stations': UUID('4edf0384-08b5-4839-8c65-16efaa2642bb'),
  'Channels': [30.0, 45.0, 90.0, 180.0, 360.0, 720.0],
  'Input type': 'Rx and base stations',
  'Property groups': ['Txz (real)',
   'Txz (imaginary)',
   'Tyz (real)',
   'Tyz (imaginary)'],
  'Receivers': UUID('1aebc83b-784a-4ddf-abe0-96c0cdab9e3c'),
  'Survey type': 'ZTEM',
  'Unit': 'Hertz (Hz)'}}
```

Data channels associated with each component can be quickly accessed through the *BaseEMSurvey.components* property:

[8]:
```
receivers.components
```

[8]:
```
{'Txz (real)': [<geoh5py.data.float_data.FloatData at 0x7f2f972112d0>,
  <geoh5py.data.float_data.FloatData at 0x7f2fc0203050>,
  <geoh5py.data.float_data.FloatData at 0x7f2fc0203710>,
  <geoh5py.data.float_data.FloatData at 0x7f2f9731fa90>,
```

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```
 <geoh5py.data.float_data.FloatData at 0x7f2f9731f950>,
 <geoh5py.data.float_data.FloatData at 0x7f2fc0236a90>],
'Txz (imaginary)': [<geoh5py.data.float_data.FloatData at 0x7f2fc0217210>,
 <geoh5py.data.float_data.FloatData at 0x7f2fc02362d0>,
 <geoh5py.data.float_data.FloatData at 0x7f2f97211610>,
 <geoh5py.data.float_data.FloatData at 0x7f2f97211910>,
 <geoh5py.data.float_data.FloatData at 0x7f2f97211590>,
 <geoh5py.data.float_data.FloatData at 0x7f2f97211990>],
'Tyz (real)': [<geoh5py.data.float_data.FloatData at 0x7f2f97211bd0>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721ac50>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721aa10>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721ac10>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721a950>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721add0>],
'Tyz (imaginary)': [<geoh5py.data.float_data.FloatData at 0x7f2f9721ae90>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721fb90>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721fd10>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721fdd0>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721ff50>,
 <geoh5py.data.float_data.FloatData at 0x7f2f9721f9d0>]}
```

Receivers

Generic label used in the `geoh5` standard for EM survey to identify the *TipperReceivers* entity.

Base stations

Generic label used in the `geoh5` standard for EM survey to identify the *TipperBaseStations* entity.

Survey type

Label identifier for `ZTEM` survey type.

Unit

Units for frequency sampling of the data: `Hertz (Hz)`, `KiloHertz (kHz)`, `MegaHertz (MHz)` or `Gigahertz (GHz)`.

[9]:
```
workspace.finalize()
```

```
/home/docs/checkouts/readthedocs.org/user_builds/geoh5py/conda/v0.6.1/lib/python3.7/site-
↪packages/geoh5py/workspace/workspace.py:854: UserWarning: The 'finalize' method will␣
↪be deprecated in future versions of geoh5py in favor of `workspace.close()`. Please␣
↪update your code to suppress this warning.
  "The 'finalize' method will be deprecated in future versions of geoh5py in"
```

2.3 geoh5py

2.3.1 geoh5py.data

geoh5py.data.blob_data

class geoh5py.data.blob_data.**BlobData**(*data_type:* DataType, ***kwargs*)

Bases: *Data*

classmethod primitive_type() → *PrimitiveTypeEnum*

geoh5py.data.color_map

class geoh5py.data.color_map.**ColorMap**(***kwargs*)

Bases: object

Records colors assigned to value ranges (where Value is the start of the range).

property name: str

str: Name of the colormap

property parent

Parent data type

property values: np.ndarray | None

numpy.array: Colormap defined by values and corresponding RGBA:

```
values = [
    [V_1, R_1, G_1, B_1, A_1],
    ..., [V_i, R_i, G_i, B_i, A_i]
]
```

where V (Values) are sorted floats defining the position of each RGBA. R (Red), G (Green), B (Blue) and A (Alpha) are integer values between [0, 255].

geoh5py.data.data

class geoh5py.data.data.**Data**(*data_type:* DataType, ***kwargs*)

Bases: *Entity*

Base class for Data entities.

add_file(*file: str*)

Alias not implemented from base Entity class.

property association: *DataAssociationEnum* | None

DataAssociationEnum: Relationship made between the *values()* and elements of the *parent* object. Association can be set from a str chosen from the list of available *DataAssociationEnum* options.

property entity_type: *DataType*

DataType

property modifiable: bool

bool Entity can be modified.

property n_values: int | None

int: Number of expected data values based on *association*

abstract classmethod primitive_type() → *PrimitiveTypeEnum*

remove_data_from_group(*data: list | Entity | uuid.UUID | str*, *name: str | None = None*)

Remove self from a property group.

property values

Data values

geoh5py.data.data_association_enum

class geoh5py.data.data_association_enum.**DataAssociationEnum**(*value*)

Bases: Enum

Known data association between *values* and the *parent* object. Available options:

CELL = 2

DEPTH = 6

FACE = 4

GROUP = 5

OBJECT = 1

UNKNOWN = 0

VERTEX = 3

geoh5py.data.data_type

class geoh5py.data.data_type.**DataType**(*workspace: workspace.Workspace*, ***kwargs*)

Bases: *EntityType*

DataType class

property color_map: *ColorMap* | None

ColorMap: Colormap used for plotting

The colormap can be set from a dict of sorted values with corresponding RGBA color.

```
color_map = {
    val_1: [r_1, g_1, b_1, a_1],
    ...,
    val_i: [r_i, g_i, b_i, a_i]
}
```

classmethod create(*workspace: workspace.Workspace*, *data_class: type[data.Data]*) → *DataType*

Creates a new instance of *DataType* with corresponding *PrimitiveTypeEnum*.

Parameters

data_class – A *Data* implementation class.

Returns
A new instance of *DataType*.

classmethod find_or_create(*workspace:* workspace.Workspace, ***kwargs*) → *DataType*

Find or creates an EntityType with given UUID that matches the given Group implementation class.

Parameters
workspace – An active Workspace class

Returns
A new instance of DataType.

classmethod for_x_data(*workspace:* workspace.Workspace) → *DataType*

classmethod for_y_data(*workspace:* workspace.Workspace) → *DataType*

classmethod for_z_data(*workspace:* workspace.Workspace) → *DataType*

property hidden: bool

`bool`: Hidden data [False]

property mapping: str

`str`: Color stretching type chosen from: 'linear', ['equal_area'], 'logarithmic', 'cdf', 'missing'

property number_of_bins: int | None

`int`: Number of bins used by the histogram [50]

property primitive_type: *PrimitiveTypeEnum* | None

PrimitiveTypeEnum

property transparent_no_data: bool

`bool`: Use transparent for no-data-value [True]

property units: str | None

`str`: Data units

property value_map: *ReferenceValueMap* | None

ReferenceValueMap: Reference value map for `ReferenceData`

The value_map can be set from a `dict` of sorted values with corresponding `str` description.

```
value_map = {
    val_1: str_1,
    ...,
    val_i: str_i
}
```

geoh5py.data.data_unit

class geoh5py.data.data_unit.**DataUnit**(*unit_name: str | None = None*)

Bases: `object`

Data unit

property name: str | None

geoh5py.data.datetime_data

class geoh5py.data.datetime_data.**DatetimeData**(*data_type:* DataType, ***kwargs*)

Bases: *TextData*

classmethod primitive_type() → *PrimitiveTypeEnum*

geoh5py.data.filename_data

class geoh5py.data.filename_data.**FilenameData**(*data_type:* DataType, *file_name=None*, ***kwargs*)

Bases: *Data*

property file_name: str | None

str Text value.

classmethod primitive_type() → *PrimitiveTypeEnum*

save_file(*path: str = './'*, *name=None*)

Save the file to disk.

Parameters

- **path** – Directory to save the file to.
- **name** – Name given to the file.

property values: bytes | None

Binary str value representation of a file.

geoh5py.data.float_data

class geoh5py.data.float_data.**FloatData**(*data_type:* DataType, ***kwargs*)

Bases: *NumericData*

Data container for floats values

property ndv: float

No-Data-Value

classmethod primitive_type() → *PrimitiveTypeEnum*

geoh5py.data.geometric_data_constants

class geoh5py.data.geometric_data_constants.**GeometricDataConstants**

Bases: object

classmethod primitive_type() → *PrimitiveTypeEnum*

classmethod x_datatype_uid() → UUID

classmethod y_datatype_uid() → UUID

classmethod z_datatype_uid() → UUID

geoh5py.data.integer_data

class geoh5py.data.integer_data.**IntegerData**(*data_type:* DataType, ***kwargs*)

Bases: *NumericData*

property ndv: int

No-Data-Value

classmethod primitive_type() → *PrimitiveTypeEnum*

property values: np.ndarray | None

Returns

values: An array of integer values

geoh5py.data.numeric_data

class geoh5py.data.numeric_data.**NumericData**(*data_type:* DataType, ***kwargs*)

Bases: *Data*, ABC

Data container for floats values

check_vector_length(*values*) → ndarray

Check for possible mismatch between the length of values stored and the expected number of cells or vertices.

abstract property ndv

No-data-value

classmethod primitive_type() → *PrimitiveTypeEnum*

property values: np.ndarray | None

Returns

values: An array of float values

geoh5py.data.primitive_type_enum

class geoh5py.data.primitive_type_enum.**PrimitiveTypeEnum**(*value*)

Bases: Enum

Known data type.

Available options:

BLOB = 6

DATETIME = 8

FILENAME = 5

FLOAT = 2

GEOMETRIC = 9

INTEGER = 1

INVALID = 0

MULTI_TEXT = 10

REFERENCED = 4

TEXT = 3

VECTOR = 7

geoh5py.data.reference_value_map

class geoh5py.data.reference_value_map.**ReferenceValueMap**(*color_map: dict[int, str] | None = None*)

Bases: ABC

Maps from reference index to reference value of ReferencedData.

property map

dict: A reference dictionary mapping values to strings

geoh5py.data.referenced_data

class geoh5py.data.referenced_data.**ReferencedData**(*data_type:* DataType, ***kwargs*)

Bases: *IntegerData*

Reference data described by indices and associated strings.

classmethod primitive_type() → *PrimitiveTypeEnum*

property value_map

Pointer to the data.data_type.DataType.value_map

geoh5py.data.text_data

class geoh5py.data.text_data.**CommentsData**(*data_type:* DataType, ***kwargs*)

Bases: *Data*

Comments added to an Object or Group. Stored as a list of dictionaries with the following keys:

```
comments = [
    {
        "Author": "username",
        "Date": "2020-05-21T10:12:15",
        "Text": "A text comment."
    },
]
```

classmethod primitive_type() → *PrimitiveTypeEnum*

property values: list[dict] | None

list List of comments

class geoh5py.data.text_data.**MultiTextData**(*data_type:* DataType, ***kwargs*)

Bases: *Data*

classmethod primitive_type() → *PrimitiveTypeEnum*

property values: np.ndarray | str | None

str Text value.

class geoh5py.data.text_data.**TextData**(*data_type:* DataType, ***kwargs*)

Bases: *Data*

classmethod primitive_type() → *PrimitiveTypeEnum*

property values: np.ndarray | str | None

str Text value.

geoh5py.data.unknown_data

class geoh5py.data.unknown_data.**UnknownData**(*data_type:* DataType, *association:* DataAssociationEnum, *name: str*, *uid: uuid.UUID | None = None*)

Bases: *Data*

classmethod primitive_type() → *PrimitiveTypeEnum*

2.3.2 geoh5py.groups

geoh5py.groups.container_group

class geoh5py.groups.container_group.**ContainerGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for the basic Container group.

classmethod default_type_uid() → UUID

geoh5py.groups.custom_group

class geoh5py.groups.custom_group.**CustomGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

A custom group, for an unlisted Group type.

classmethod default_type_uid() → uuid.UUID | None

geoh5py.groups.drillhole_group

class geoh5py.groups.drillhole_group.**DrillholeGroup**(*group_type:* GroupType, *name='Drillholes Group'*, ***kwargs*)

Bases: *Group*

The type for the group containing drillholes.

classmethod default_type_uid() → UUID

class geoh5py.groups.drillhole_group.**IntegratorDrillholeGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *DrillholeGroup*

The type for the group containing drillholes.

classmethod default_type_uid() → UUID

geoh5py.groups.giftools_group

class geoh5py.groups.giftools_group.**GiftoolsGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a GIFtools group.

classmethod default_type_uid() → UUID

geoh5py.groups.group

class geoh5py.groups.group.**Group**(*group_type:* GroupType, ***kwargs*)

Bases: *Entity*

Base Group class

add_comment(*comment: str*, *author: str | None = None*)

Add text comment to an object.

Parameters

- **comment** – Text to be added as comment.
- **author** – Author's name or `contributors`.

property comments

Fetch a *CommentsData* entity from children.

copy_from_extent(*bounds: np.ndarray*, *parent=None*, *copy_children: bool = True*) → *Group* | None

Find indices of vertices within a rectangular bounds.

Parameters

- **bounds** – shape(2, 2) Bounding box defined by the South-West and North-East coordinates. Extents can also be provided as 3D coordinates with shape(2, 3) defining the top and bottom limits.
- **attributes** – Dictionary of attributes to clip by extent.

abstract classmethod default_type_uid() → uuid.UUID | None

property entity_type: *GroupType*

property extent

Bounding box 3D coordinates defining the limits of the entity.

classmethod find_or_create_type(*workspace:* workspace.Workspace, ***kwargs*) → *GroupType*

geoh5py.groups.group_type

class geoh5py.groups.group_type.**GroupType**(*workspace:* workspace.Workspace, ***kwargs*)

Bases: *EntityType*

property allow_delete_content: bool

bool: [True] Allow to delete the group *children*.

property allow_move_content: bool

bool: [True] Allow to move the group *children*.

static create_custom(*workspace:* workspace.Workspace, ***kwargs*) → *GroupType*

Creates a new instance of GroupType for an unlisted custom Group type with a new auto-generated UUID.

classmethod find_or_create(*workspace:* workspace.Workspace, *entity_class*, ***kwargs*) → *GroupType*

Find or creates an EntityType with given UUID that matches the given Group implementation class.

Parameters

- **workspace** – An active Workspace class
- **entity_class** – An Group implementation class.

Returns

A new instance of GroupType.

geoh5py.groups.integrator_group

class geoh5py.groups.integrator_group.**AirborneTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Airborne Theme.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**EarthModelsTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Earth Models Theme.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**GeochemistryMineralogyDataSet**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Geochemistry & Mineralogy DataSet.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**GeochemistryMineralogyTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Geochemistry & Mineralogy Theme.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**GeophysicsTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Geophysics Theme.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**GroundTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Ground Theme.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**IntegratorGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR group.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**IntegratorProject**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR group.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**ObservationPointsTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Observation Points Theme.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**QueryGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Query Group.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**RockPropertiesTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Rock Properties Theme.

classmethod default_type_uid() → UUID

class geoh5py.groups.integrator_group.**SamplesTheme**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for a INTEGRATOR Samples Theme.

classmethod default_type_uid() → UUID

geoh5py.groups.maps_group

class geoh5py.groups.maps_group.**MapsGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for the basic Container group.

classmethod default_type_uid() → UUID

geoh5py.groups.notype_group

class geoh5py.groups.notype_group.**NoTypeGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

A group with no type.

classmethod default_type_uid() → UUID

geoh5py.groups.property_group

class geoh5py.groups.property_group.**PropertyGroup**(*parent:* ObjectBase, ***kwargs*)

Bases: ABC

Property group listing data children of an object. This group is not registered to the workspace and only visible to the parent object.

property association: *DataAssociationEnum*

DataAssociationEnum Data association

property attribute_map: dict

dict Attribute names mapping between geoh5 and geoh5py

property name: str

str Name of the group

property parent: *Entity*

The parent *ObjectBase*

property properties: list[uuid.UUID]

List of unique identifiers for the *Data* contained in the property group.

property property_group_type: str

property uid: UUID

uuid.UUID Unique identifier

geoh5py.groups.root_group

class geoh5py.groups.root_group.**RootGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *NoTypeGroup*

The Root group of a workspace.

property parent

Parental entity of root is always None

geoh5py.groups.simpeg_group

class geoh5py.groups.simpeg_group.**SimPEGGroup**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

Group for SimPEG inversions.

classmethod default_type_uid() → UUID

property options: dict | None

Metadata attached to the entity.

geoh5py.groups.survey_group

class geoh5py.groups.survey_group.**AirborneGeophysics**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

The type for the basic Container group.

classmethod default_type_uid() → UUID

2.3.3 geoh5py.io

geoh5py.io.h5_reader

class geoh5py.io.h5_reader.**H5Reader**

Bases: `object`

Class to read information from a geoh5 file.

classmethod fetch_array_attribute(*file: str | h5py.File*, *uid: uuid.UUID*, *entity_type: str*, *key: str*) → np.ndarray | None

Get an entity attribute stores as array such as *cells*.

Parameters

- **file** – `h5py.File` or name of the target geoh5 file
- **uid** – Unique identifier of the target object.
- **entity_type** – Group type to fetch entity from.
- **key** – Field attribute name.

Return cells

`numpy.ndarray` of `int`.

classmethod fetch_attributes(*file: str | h5py.File*, *uid: uuid.UUID*, *entity_type: str*) → tuple[dict, dict, dict] | None

Get attributes of an *Entity*.

Parameters

- **file** – h5py.File or name of the target geoh5 file
- **uid** – Unique identifier
- **entity_type** – Type of entity from 'group', 'data', 'object', 'group_type', 'data_type', 'object_type'

Returns

attributes: dict of attributes for the *Entity*
type_attributes: dict of attributes for the EntityType
property_groups: dict of data uuid.UUID

classmethod fetch_children(*file: str | h5py.File*, *uid: uuid.UUID*, *entity_type: str*) → dict

Get *children* of an *Entity*.

Parameters

- **file** – h5py.File or name of the target geoh5 file
- **uid** – Unique identifier
- **entity_type** – Type of entity from 'group', 'data', 'object', 'group_type', 'data_type', 'object_type'

Return children
[{uuid: type}, …] List of dictionaries for the children uid and type

classmethod fetch_concatenated_attributes(*file: str | h5py.File*, *uid: uuid.UUID*, *entity_type: str*, *label: str*) → list | dict | None

Get 'Attributes', 'Data' or 'Index' from Concatenator group.

Parameters

- **file** – h5py.File or name of the target geoh5 file
- **uid** – Unique identifier
- **entity_type** – Type of entity from 'group', 'data', 'object', 'group_type', 'data_type', 'object_type'
- **label** – Group identifier for the attribute requested.

Return children
[{uuid: type}, …] List of dictionaries for the children uid and type

classmethod fetch_concatenated_values(*file: str | h5py.File*, *uid: uuid.UUID*, *entity_type: str*, *label: str*) → tuple | None

Get *children* values of concatenated group.

Parameters

- **file** – h5py.File or name of the target geoh5 file
- **uid** – Unique identifier
- **entity_type** – Type of entity from 'group', 'data', 'object', 'group_type', 'data_type', 'object_type'

- **label** – Group identifier for the attribute requested.

Return children
[{uuid: type}, ...] List of dictionaries for the children uid and type

classmethod fetch_file_object(*file: str | h5py.File*, *uid: uuid.UUID*, *file_name: str*) → bytes | None

Load data associated with an image file

Parameters

- **file** – Name of the target geoh5 file
- **uid** – Unique identifier of the target entity
- **file_name** – Name of the file stored as bytes data.

Return values
Data file stored as bytes

classmethod fetch_metadata(*file: str | h5py.File*, *uid: uuid.UUID*, *entity_type: str = 'Objects'*, *argument: str = 'Metadata'*) → str | dict | None

Fetch text of dictionary type attributes of an entity.

Parameters

- **file** – Target h5 file.
- **uid** – Unique identifier of the target Entity.
- **entity_type** – Base type of the target Entity.
- **argument** – Label name of the dictionary.

classmethod fetch_project_attributes(*file: str | h5py.File*) → dict[Any, Any]

Get attributes of an *Entity*.

Parameters
file – `h5py.File` or name of the target geoh5 file

Return attributes
`dict` of attributes.

classmethod fetch_property_groups(*file: str | h5py.File*, *uid: uuid.UUID*) → dict[str, dict[str, str]]

Get the property groups.

Parameters

- **file** – `h5py.File` or name of the target geoh5 file
- **uid** – Unique identifier of the target entity

Return property_group_attributes
`dict` of property groups and respective attributes.

```
property_group = {
    "group_1": {"attribute": value, ...},
    ...,
    "group_N": {"attribute": value, ...},
}
```

classmethod fetch_type(*file: str | h5py.File*, *uid: uuid.UUID*, *entity_type: str*) → dict

Fetch a type from the target geoh5.

Parameters

- **file** – h5py.File or name of the target geoh5 file
- **uid** – Unique identifier of the target entity
- **entity_type** – One of 'Data', 'Object' or 'Group'

Return property_group_attributes
dict of property groups and respective attributes.

classmethod fetch_type_attributes(*type_handle: Group*) → dict

Fetch type attributes from a given h5 handle.

classmethod fetch_uuids(*file: str | h5py.File*, *entity_type: str*) → list

Fetch all uuids of a given type from geoh5

Parameters

- **file** – h5py.File or name of the target geoh5 file
- **entity_type** – Type of entity from 'group', 'data', 'object', 'group_type', 'data_type', 'object_type'

Return uuids
[uuid1, uuid2, . . .] List of uuids

classmethod fetch_value_map(*h5_handle: Group*) → dict

Get data value_map

Parameters
h5_handle – Handle to the target h5 group.

Return value_map
dict of {int: str}

classmethod fetch_values(*file: str | h5py.File*, *uid: uuid.UUID*) → np.ndarray | str | float | None

Get data *values*

Parameters

- **file** – h5py.File or name of the target geoh5 file
- **uid** – Unique identifier of the target entity

Return values
numpy.array of float

static format_type_string(*string: str*) → str

Format names used for types.

geoh5py.io.h5_writer

class geoh5py.io.h5_writer.**H5Writer**

Bases: object

Writing class to a geoh5 file.

classmethod clear_stats_cache(*file: str | h5py.File*, *entity:* Data) → None

Clear the StatsCache dataset.

Parameters

- **file** – Name or handle to a geoh5 file.

- **entity** – Target entity.

classmethod create_dataset(*entity_handle*, *dataset: ndarray*, *label: str*) → None

Create a dataset on geoh5.

Parameters

- **entity_handle** – Pointer to a hdf5 group
- **dataset** – Array of values to be written
- **label** – Name of the dataset on file

classmethod create_geoh5(*file: str | h5py.File*, *workspace:* workspace.Workspace)

Add the geoh5 core structure.

Parameters

- **file** – Name or handle to a geoh5 file.
- **workspace** – *Workspace* object defining the project structure.

Return h5file
Pointer to a geoh5 file.

classmethod fetch_handle(*file: str | h5py.File*, *entity*, *return_parent: bool = False*) → None | h5py.Group

Get a pointer to an *Entity* in geoh5.

Parameters

- **file** – Name or handle to a geoh5 file
- **entity** – Target *Entity*
- **return_parent** – Option to return the handle to the parent entity.

Return entity_handle
HDF5 pointer to an existing entity, parent or None if not found.

static remove_child(*file: str | h5py.File*, *uid: uuid.UUID*, *ref_type: str*, *parent:* Entity) → None

Remove a child from a parent.

Parameters

- **file** – Name or handle to a geoh5 file
- **uid** – uuid of the target *Entity*
- **ref_type** – Input type from: 'Types', 'Groups', 'Objects' or 'Data
- **parent** – Remove entity from parent.

static remove_entity(*file: str | h5py.File*, *uid: uuid.UUID*, *ref_type: str*, *parent:* Entity | *None = None*) → None

Remove an entity and its type from the target geoh5 file.

Parameters

- **file** – Name or handle to a geoh5 file
- **uid** – uuid of the target *Entity*
- **ref_type** – Input type from: 'Types', 'Groups', 'Objects' or 'Data
- **parent** – Remove entity from parent.

classmethod save_entity(*file: str | h5py.File*, *entity*, *add_children: bool = True*) → h5py.Group

Write an *Entity* to geoh5 with its *children*.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target *Entity*.
- **add_children** – Add *children*.

str_type = dtype('O')

classmethod update_concatenated_field(*file: str | h5py.File*, *entity*, *attribute: str*, *channel: str*) → None

Update the attributes of a concatenated *Entity*.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target *Entity*.
- **attribute** – Name of the attribute to get updated.
- **channel** – Name of the data or index to be modified.

classmethod update_field(*file: str | h5py.File*, *entity*, *attribute: str*, ***kwargs*) → None

Update the attributes of an *Entity*.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target *Entity*.
- **attribute** – Name of the attribute to get updated.

classmethod write_array_attribute(*file: str | h5py.File*, *entity*, *attribute*, *values=None*, ***kwargs*) → None

Add `surveys` of an object.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target entity.
- **attribute** – Name of the attribute to be written to geoh5

classmethod write_attributes(*file: str | h5py.File*, *entity*) → None

Write attributes of an *Entity*.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Entity with attributes to be added to the geoh5 file.

classmethod write_color_map(*file: str | h5py.File*, *entity_type: shared.EntityType*) → None

Add *ColorMap* to a *DataType*.

Parameters

- **file** – Name or handle to a geoh5 file
- **entity_type** – Target entity_type with color_map

classmethod write_data_values(*file: str | h5py.File*, *entity*, *attribute*, *values=None*, ***kwargs*) → None

Add data *values*.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target entity.
- **attribute** – Name of the attribute to be written to geoh5

classmethod write_entity(*file: str | h5py.File*, *entity*) → h5py.Group

Add an *Entity* and its attributes to geoh5. The function returns a pointer to the entity if already present on file.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target *Entity*.

Return entity
Pointer to the written entity. Active link if "close_file" is False.

classmethod write_entity_type(*file: str | h5py.File*, *entity_type: shared.EntityType*) → h5py.Group

Add an *EntityType* to geoh5.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity_type** – Entity with type to be added.

Return type
Pointer to *EntityType* in geoh5.

classmethod write_file_name_data(*entity_handle: Group*, *entity:* FilenameData, *values: bytes*) → None

Write a dataset for the file name and file blob.

Parameters

- **entity_handle** – Pointer to the geoh5 Group.
- **entity** – Target *FilenameData* entity.
- **values** – Bytes data

classmethod write_properties(*file: str | h5py.File*, *entity:* Entity) → None

Add properties of an *Entity*.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target *Entity*.

classmethod write_property_groups(*file: str | h5py.File*, *entity*) → None

Write *PropertyGroup* associated with an *Entity*.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Target *Entity*.

classmethod write_to_parent(*file: str | h5py.File*, *entity:* Entity, *recursively=False*) → None

Add/create an *Entity* and add it to its parent.

Parameters

- **file** – Name or handle to a geoh5 file.
- **entity** – Entity to be added or linked to a parent in geoh5.
- **recursively** – Add parents recursively until reaching the *RootGroup*.

classmethod write_value_map(*file: str | h5py.File*, *entity_type: shared.EntityType*) → None

Add *ReferenceValueMap* to a *DataType*.

Parameters

- **file** – Name or handle to a geoh5 file
- **entity_type** – Target entity_type with value_map

classmethod write_visible(*file: str | h5py.File*, *entity*) → None

Needs revision once Visualization is implemented

Parameters

- **file** – Name or handle to a geoh5 file
- **entity** – Target entity

2.3.4 geoh5py.objects

geoh5py.objects.surveys

geoh5py.objects.surveys.electromagnetics

geoh5py.objects.surveys.electromagnetics.airborne_tem

class geoh5py.objects.surveys.electromagnetics.airborne_tem.**AirborneTEMReceivers**(*object_type:* ObjectType, *name='Airborne TEM Rx'*, ***kwargs*)

Bases: *BaseAirborneTEM*

Airborne time-domain electromagnetic receivers class.

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property type

Survey element type

class geoh5py.objects.surveys.electromagnetics.airborne_tem.**AirborneTEMTransmitters**(*object_type: ObjectType, name='Airborne TEM Tx', **kwargs*)

Bases: *BaseAirborneTEM*

Airborne time-domain electromagnetic transmitters class.

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property type
Survey element type

class geoh5py.objects.surveys.electromagnetics.airborne_tem.**BaseAirborneTEM**(*object_type: ObjectType, name='Curve', **kwargs*)

Bases: *BaseTEMSurvey*, *Curve*

property crossline_offset: float | uuid.UUID | None
Numeric value or property UUID for the crossline offset between receiver and transmitter.

property default_input_types: list[str]
Choice of survey creation types.

property default_metadata: dict
Default dictionary of metadata for AirborneTEM entities.

property default_receiver_type

Returns
Transmitter class

property default_transmitter_type

Returns
Transmitter class

fetch_metadata(*key: str*) → float | uuid.UUID | None
Fetch entry from the metadata.

property inline_offset: float | uuid.UUID | None
Numeric value or property UUID for the inline offset between receiver and transmitter.

property loop_radius: float | None
Transmitter loop radius

property pitch: float | uuid.UUID | None
Numeric value or property UUID for the pitch angle of the transmitter loop.

property relative_to_bearing: bool | None
Data relative_to_bearing

property roll: float | uuid.UUID | None

Numeric value or property UUID for the roll angle of the transmitter loop.

set_metadata(*key: str*, *value: float | uuid.UUID | None*)

property vertical_offset: float | uuid.UUID | None

Numeric value or property UUID for the vertical offset between receiver and transmitter.

property yaw: float | uuid.UUID | None

Numeric value or property UUID for the yaw angle of the transmitter loop.

geoh5py.objects.surveys.electromagnetics.base

class geoh5py.objects.surveys.electromagnetics.base.**BaseEMSurvey**(*object_type:* ObjectType, ***kwargs*)

Bases: *ObjectBase*, ABC

A base electromagnetics survey object.

add_components_data(*data: dict*) → list[*PropertyGroup*]

Add lists of data components to an EM survey. The name of each component is appended to the metadata 'Property groups'.

Data channels must be provided for every frequency or time in order specified by `channels`. The data channels can be supplied as either a list of *geoh5py.data.float_data.FloatData* entities or `uuid.UUID`

```
data = {
    "Component A": [
        data_entity_1,
        data_entity_2,
    ],
    "Component B": [...],
},
```

or a nested dictionary of arguments defining new Data entities as defined by the *add_data()* method.

```
data = {
    "Component A": {
        time_1: {
            'values': [v_11, v_12, ...],
            "entity_type": entity_type_A,
            ...,
        },
        time_2: {...},
        ...,
    },
    "Component B": {...},
}
```

Parameters

data – Dictionary of data components to be added to the survey.

Returns

List of property groups for all components added.

add_validate_component_data(*name: str*, *data_block: list | dict*)

Append a property group to the entity and its metadata after validations.

property channels

List of measured channels.

property components: dict | None

Rapid access to the list of data entities for all components.

copy(*parent=None*, *copy_children: bool = True*, ***kwargs*) → *BaseEMSurvey*

Function to copy a AirborneTEMReceivers to a different parent entity.

Parameters

- **parent** – Target parent to copy the entity under. Copied to current *parent* if None.
- **copy_children** – Create copies of AirborneTEMReceivers along with it.

Return entity

Registered AirborneTEMReceivers to the workspace.

abstract property default_input_types: list[str] | None

Input types. Must be one of 'Rx', 'Tx', 'Tx and Rx'.

property default_metadata

Default metadata structure. Implemented on the child class.

abstract property default_receiver_type: type

Returns

Receivers implemented on the child class.

abstract property default_transmitter_type: type

Returns

Transmitters implemented on the child class.

abstract classmethod default_type_uid() → UUID

Default unique identifier. Implemented on the child class.

abstract property default_units: list[str]

List of accepted units.

edit_metadata(*entries: dict[str, Any]*)

Utility function to edit or add metadata fields and trigger an update on the receiver and transmitter entities.

Parameters

entries – Metadata key value pairs.

property input_type: str | None

Data input type. Must be one of 'Rx', 'Tx' or 'Tx and Rx'

property metadata

Metadata attached to the entity.

property receivers: *BaseEMSurvey* | None

The associated TEM receivers.

property survey_type: str | None

Data input type. Must be one of 'Rx', 'Tx' or 'Tx and Rx'

property transmitters

The associated TEM transmitters (sources).

abstract property type

Survey element type

property unit: float | None

Default channel units for time or frequency defined on the child class.

class geoh5py.objects.surveys.electromagnetics.base.**BaseTEMSurvey**(*object_type:* ObjectType, ***kwargs*)

Bases: *BaseEMSurvey*, ABC

abstract property default_input_types: list[str]

Input types for the survey element.

property default_units: list[str]

Accepted time units. Must be one of "Seconds (s)", "Milliseconds (ms)", "Microseconds (us)" or "Nanoseconds (ns)"

property timing_mark: float | None

Timing mark from the beginning of the discrete *waveform*. Generally used as the reference (time=0.0) for the provided (-) on-time an (+) off-time `channels`.

property waveform: np.ndarray | None

Discrete waveform of the TEM source provided as `numpy.array` of type `float`, shape(n, 2)

```
waveform = [
    [time_1, current_1],
    [time_2, current_2],
    ...
]
```

property waveform_parameters: dict | None

Access the waveform parameters stored as a dictionary.

geoh5py.objects.surveys.electromagnetics.magnetotellurics

class geoh5py.objects.surveys.electromagnetics.magnetotellurics.**MTReceivers**(*object_type:* ObjectType, *name='Magnetotellurics rx'*, ***kwargs*)

Bases: *BaseEMSurvey*, *Points*

A magnetotellurics survey object.

property default_input_types: list[str]

Choice of survey creation types.

property default_metadata: dict

Returns

Default unique identifier

property default_receiver_type

Returns
Transmitter class

property default_transmitter_type

Returns
Transmitter class

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property default_units: list[str]

Accepted time units. Must be one of "Seconds (s)", "Milliseconds (ms)", "Microseconds (us)" or "Nanoseconds (ns)"

property type

Survey element type

geoh5py.objects.surveys.electromagnetics.tipper

class geoh5py.objects.surveys.electromagnetics.tipper.**BaseTipper**(*object_type:* ObjectType, *base_stations:* TipperBaseStations | *None* = *None*, ***kwargs*)

Bases: *BaseEMSurvey*

Base tipper survey class.

property base_stations: *TipperBaseStations* | None

The base station entity

property default_input_types: list[str]

Choice of survey creation types.

property default_metadata: dict

Returns
Default unique identifier

property default_receiver_type

Returns
Transmitter class

property default_transmitter_type

Returns
Transmitter class

property default_units: list[str]

Accepted time units. Must be one of "Seconds (s)", "Milliseconds (ms)", "Microseconds (us)" or "Nanoseconds (ns)"

class geoh5py.objects.surveys.electromagnetics.tipper.**TipperBaseStations**(*object_type: ObjectType*, *name='Tipper base'*, ***kwargs*)

Bases: *BaseTipper*, *Points*

A z-tipper EM survey object.

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property type

Survey element type

class geoh5py.objects.surveys.electromagnetics.tipper.**TipperReceivers**(*object_type: ObjectType*, *name='Tipper rx'*, ***kwargs*)

Bases: *BaseTipper*, *Curve*

A z-tipper EM survey object.

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property type

Survey element type

geoh5py.objects.surveys.direct_current

class geoh5py.objects.surveys.direct_current.**CurrentElectrode**(*object_type: ObjectType*, ***kwargs*)

Bases: *PotentialElectrode*

Ground direct current electrode (transmitter).

add_default_ab_cell_id()

Utility function to set ab_cell_id's based on curve cells.

copy(*parent=None*, *copy_children: bool = True*, ***kwargs*)

Function to copy a survey to a different parent entity.

Parameters

- **parent** – Target parent to copy the entity under. Copied to current *parent* if None.
- **copy_children** – Create copies of all children entities along with it.

Return entity
Registered Entity to the workspace.

property current_electrodes

The associated current electrode object (sources).

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property potential_electrodes: *PotentialElectrode* | None

The associated potential_electrodes (receivers)

class geoh5py.objects.surveys.direct_current.**PotentialElectrode**(*object_type:* ObjectType, ***kwargs*)

Bases: *Curve*

Ground potential electrode (receiver).

property ab_cell_id: *ReferencedData* | None

Reference data entity mapping cells to a unique current dipole.

property ab_map: dict | None

Get the ReferenceData.value_map of the ab_value_id

copy(*parent=None*, *copy_children: bool = True*, ***kwargs*)

Function to copy a survey to a different parent entity.

Parameters

- **parent** – Target parent to copy the entity under. Copied to current *parent* if None.
- **copy_children** – Create copies of all children entities along with it.

Return entity
Registered Entity to the workspace.

property current_electrodes

The associated current electrode object (sources).

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property metadata

Metadata attached to the entity.

property potential_electrodes

The associated potential_electrodes (receivers)

geoh5py.objects.surveys.magnetics

class geoh5py.objects.surveys.magnetics.**AirborneMagnetics**(*object_type:* ObjectType, *name='Curve'*, ***kwargs*)

Bases: *Curve*

An airborne magnetic survey object.

Warning: Partially implemented.

classmethod default_type_uid() → UUID

Returns
Default unique identifier

geoh5py.objects.block_model

class geoh5py.objects.block_model.**BlockModel**(*object_type:* ObjectType, ***kwargs*)

Bases: *ObjectBase*

Rectilinear 3D tensor mesh defined by three perpendicular axes. Each axis is divided into discrete intervals that define the cell dimensions. Nodal coordinates are determined relative to the origin and the sign of cell delimiters. Negative and positive cell delimiters are accepted to denote relative offsets from the origin.

property cell_delimiters

property centroids: np.ndarray | None

numpy.array, shape (*n_cells*, 3): Cell center locations in world coordinates.

```
centroids = [
    [x_1, y_1, z_1],
    ...,
    [x_N, y_N, z_N]
]
```

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property n_cells: int | None

int: Total number of cells

property origin: ndarray

numpy.array of float, shape (3,): Coordinates of the origin.

property rotation: float

float: Clockwise rotation angle (degree) about the vertical axis.

property shape: tuple | None

list of int, len (3,): Number of cells along the u, v and z-axis

property u_cell_delimiters: np.ndarray | None

numpy.array of float: Nodal offsets along the u-axis relative to the origin.

property u_cells: np.ndarray | None

numpy.array of float, shape (*shape* [0],): Cell size along the u-axis.

property v_cell_delimiters: np.ndarray | None

numpy.array of float: Nodal offsets along the v-axis relative to the origin.

property v_cells: np.ndarray | None

numpy.array of float, shape (*shape* [1],): Cell size along the v-axis.

property z_cell_delimiters: np.ndarray | None

numpy.array of float: Nodal offsets along the z-axis relative to the origin (positive up).

property z_cells: np.ndarray | None

numpy.array of float, shape (*shape* [2],): Cell size along the z-axis

geoh5py.objects.curve

class geoh5py.objects.curve.**Curve**(*object_type:* ObjectType, *name='Curve'*, ***kwargs*)

Bases: CellObject

Curve object defined by a series of line segments (*cells*) connecting *vertices*.

property cells: np.ndarray | None

numpy.ndarray of int, shape (*, 2): Array of indices defining segments connecting vertices. Defined based on *parts* if set by the user.

property current_line_id: uuid.UUID | None

classmethod default_type_uid() → UUID

Returns

Default unique identifier

property parts

numpy.array of int, shape (*n_vertices*, 2): Group identifiers for vertices connected by line segments as defined by the *cells* property. The definition of the *cells* property get modified by the setting of parts.

property unique_parts

list of int: Unique *parts* identifiers.

geoh5py.objects.drape_model

class geoh5py.objects.drape_model.**DrapeModel**(*object_type:* ObjectType, ***kwargs*)

Bases: *ObjectBase*

Drape (curtain) model object made up of layers and prisms.

property centroids

numpy.array of float, shape (n_cells, 3): Cell center locations in world coordinates.

```
centroids = [
    [x_1, y_1, z_1],
    ...,
    [x_N, y_N, z_N]
]
```

clip_by_extent(*bounds: np.ndarray*) → *ObjectBase* | None

Find indices of cells within a rectangular bounds.

Parameters

- **bounds** – shape(2, 2) Bounding box defined by the South-West and North-East coordinates. Extents can also be provided as 3D coordinates with shape(2, 3) defining the top and bottom limits.
- **attributes** – Dictionary of attributes to clip by extent.

classmethod default_type_uid() → UUID

property layers: np.ndarray | None

layers

property n_cells

int: Number of cells.

property prisms: np.ndarray | None

prisms

geoh5py.objects.drillhole

class geoh5py.objects.drillhole.**Drillhole**(*object_type:* ObjectType, ***kwargs*)

Bases: *Points*

Drillhole object class defined by

> **Warning:** Not yet implemented.

add_data(*data: dict*, *property_group: str* | PropertyGroup | *None = None*, *collocation_distance=None*) → *Data* | list[*Data*]

Create *Data* specific to the drillhole object from dictionary of name and arguments. A keyword 'depth' or 'from-to' with corresponding depth values is expected in order to locate the data along the well path.

Parameters

data – Dictionary of data to be added to the object, e.g.

```
data_dict = {
    "data_A": {
        'values', [v_1, v_2, ...],
        "from-to": numpy.ndarray,
        },
    "data_B": {
        'values', [v_1, v_2, ...],
        "depth": numpy.ndarray,
        },
}
```

Parameters

property_group – Name or PropertyGroup used to group the data.

Returns

List of new Data objects.

add_vertices(*xyz*)

Function to add vertices to the drillhole

property cells: np.ndarray | None

numpy.ndarray of int, shape (*, 2): Array of indices defining segments connecting vertices.

property collar

numpy.array of float, shape (3,): Coordinates of the collar

property cost

`float`: Cost estimate of the drillhole

property default_collocation_distance

Minimum collocation distance for matching depth on merge

classmethod default_type_uid() → UUID

property depths: *FloatData* | None

desurvey(*depths*)

Function to return x, y, z coordinates from depth.

property end_of_hole: float | None

End of drillhole in meters

property from_

Depth data corresponding to the tops of the interval values.

property locations: np.ndarray | None

Lookup array of the well path in x, y, z coordinates.

property planning: str

Status of the hole on of "Default", "Ongoing", "Planned", "Completed" or "No status"

sort_depths()

Read the 'DEPTH' data and sort all Data.values if needed

property surveys: ndarray

Coordinates of the surveys

property to_

Depth data corresponding to the bottoms of the interval values.

property trace: np.ndarray | None

`numpy.array`: Drillhole trace defining the path in 3D

property trace_depth: np.ndarray | None

`numpy.array`: Drillhole trace depth from top to bottom

validate_data(*attributes: dict*, *property_group=None*, *collocation_distance=None*) → tuple

Validate input drillhole data attributes.

Parameters

- **attributes** – Dictionary of data attributes.
- **property_group** – Input property group to validate against.

validate_interval_data(*from_to: np.ndarray | list*, *values: np.ndarray*, *collocation_distance: float = 0.0001*)

Compare new and current depth values, append new vertices if necessary and return an augmented values vector that matches the vertices indexing.

validate_log_data(*depth: ndarray*, *input_values: ndarray*, *collocation_distance=0.0001*) → ndarray

Compare new and current depth values. Append new vertices if necessary and return an augmented values vector that matches the vertices indexing.

geoh5py.objects.drillhole.**compute_deviation**(*surveys: ndarray*) → ndarray

Compute deviation distances from survey parameters.

Parameters
surveys – Array of azimuth, dip and depth values.

geoh5py.objects.drillhole.**deviation_x**(*azimuth*, *dip*)

Compute the easting deviation.

Parameters

- **azimuth** – Degree angle clockwise from North
- **dip** – Degree angle positive down from horizontal

Return deviation
Change in easting distance.

geoh5py.objects.drillhole.**deviation_y**(*azimuth*, *dip*)

Compute the northing deviation.

Parameters

- **azimuth** – Degree angle clockwise from North
- **dip** – Degree angle positive down from horizontal

Return deviation
Change in northing distance.

geoh5py.objects.drillhole.**deviation_z**(*_*, *dip*)

Compute the vertical deviation.

Parameters
dip – Degree angle positive down from horizontal

Return deviation
Change in vertical distance.

geoh5py.objects.geo_image

class geoh5py.objects.geo_image.**GeoImage**(*object_type: ObjectType*, ***kwargs*)

Bases: *ObjectBase*

Image object class.

> **Warning:** Not yet implemented.

property cells: np.ndarray | None

numpy.ndarray of int, shape (*, 2): Array of indices defining segments connecting vertices. Defined based on *parts* if set by the user.

classmethod default_type_uid() → UUID

property default_vertices

Assign the default vertices based on image pixel count

georeference(*reference: np.ndarray | list*, *locations: np.ndarray | list*)

Georeference the image vertices (corners) based on input reference and corresponding world coordinates.

Parameters

- **reference** – Array of integers representing the reference used as reference points.
- **locations** – Array of floats for the corresponding world coordinates for each input pixel.

Return vertices
Corners (vertices) in world coordinates.

georeferencing_from_tiff()

Get the geographic information from the PIL Image to georeference it. Run the georeference() method of the object.

property image

Get the image as a `PIL.Image` object.

property image_data

Get the FilenameData entity holding the image.

property image_georeferenced: Image.Image | None

Get the image as a georeferenced `PIL.Image` object.

save_as(*name: str*, *path: str | Path = ''*)

Function to save the geoimage into an image file. It the name ends by '.tif' or '.tiff' and the tag is not None then the image is saved as georeferenced tiff image ; else, the image is save with PIL.Image's save function. :param name: the name to give to the image. :param path: the path of the file of the image, default: ''.

set_tag_from_vertices()

If tag is None, set the basic tag values based on vertices in order to export as a georeferenced .tiff. WARNING: this function must be used after georeference().

property tag: dict | None

Georeferencing information of a tiff image stored in the header. :return: a dictionary containing the PIL.Image.tag information.

to_grid2d(*transform: str = 'GRAY'*, ***grid2d_kwargs*) → *Grid2D*

Create a geoh5py :obj:geoh5py.objects.grid2d.Grid2D from the geoimage in the same workspace. :param transform: the type of transform ; if "GRAY" convert the image to grayscale ; if "RGB" every band is sent to a data of a grid. :return: the new created *geoh5py.objects.grid2d.Grid2D*.

property vertices: np.ndarray | None

vertices: Defines the four corners of the geo_image

geoh5py.objects.grid2d

class geoh5py.objects.grid2d.**Grid2D**(*object_type:* ObjectType, ***kwargs*)

Bases: *ObjectBase*

Rectilinear 2D grid of uniform cell size. The grid can be oriented in 3D space through horizontal *rotation* and *dip* parameters. Nodal coordinates are determined relative to the origin and the sign of cell delimiters.

property cell_center_u: np.ndarray | None

`numpy.array` of `float`, shape(*u_count*,): Cell center local coordinate along the u-axis.

property cell_center_v: np.ndarray | None

numpy.array of float shape(*u_count*,): The cell center local coordinate along the v-axis.

property centroids: np.ndarray | None

numpy.array of float, shape (*n_cells*, 3): Cell center locations in world coordinates.

```
centroids = [
    [x_1, y_1, z_1],
    ...,
    [x_N, y_N, z_N]
]
```

classmethod default_type_uid() → UUID

Returns
Default unique identifier

property dip: float

float: Dip angle from horizontal (positive down) in degrees.

property n_cells: int | None

int: Total number of cells.

property origin: ndarray

numpy.array of float, shape (3,): Coordinates of the origin.

property rotation: float

float: Clockwise rotation angle (degree) about the vertical axis.

property shape: tuple | None

list of int, len (2,): Number of cells along the u and v-axis.

to_geoimage(*keys: list | str*, ***geoimage_kwargs*) → objects.GeoImage

Create a :obj:geoh5py.objects.geo_image.GeoImage object from the current Grid2D. :param keys: the list of the data name to pass as band in the image. Warning: The len of the list can only be 1, 3, 4 (Pillow restrictions). :return: a new georeferenced *geoh5py.objects.geo_image.GeoImage*.

property u_cell_size: np.ndarray | None

np.ndarray: Cell size along the u-axis.

property u_count: int | None

int: Number of cells along u-axis

property v_cell_size: np.ndarray | None

np.ndarray: Cell size along the v-axis

property v_count: int | None

int: Number of cells along v-axis

property vertical: bool | None

bool: Set the grid to be vertical.

geoh5py.objects.integrator

class geoh5py.objects.integrator.**IntegratorPoints**(*object_type:* ObjectType, ***kwargs*)

Bases: *Points*

INTEGRATOR Points object. Sub-class of *geoh5py.objects.points.Points*.

classmethod default_type_uid() → UUID

class geoh5py.objects.integrator.**NeighbourhoodSurface**(*object_type:* ObjectType, ***kwargs*)

Bases: *Surface*

Points object made up of vertices.

classmethod default_type_uid() → UUID

Default type uid.

geoh5py.objects.label

class geoh5py.objects.label.**Label**(*object_type:* ObjectType, ***kwargs*)

Bases: *ObjectBase*

Label object for annotation in viewport.

> **Warning:** Not yet implemented.

classmethod default_type_uid() → UUID

geoh5py.objects.notype_object

class geoh5py.objects.notype_object.**NoTypeObject**(*object_type:* ObjectType, ***kwargs*)

Bases: *ObjectBase*

Generic Data object without a registered type

classmethod default_type_uid() → UUID

geoh5py.objects.object_base

class geoh5py.objects.object_base.**ObjectBase**(*object_type:* ObjectType, ***kwargs*)

Bases: *Entity*

Object base class.

add_comment(*comment: str*, *author: str | None = None*)

Add text comment to an object.

Parameters

- **comment** – Text to be added as comment.
- **author** – Name of author or defaults to *contributors*.

add_data(*data: dict*, *property_group: str* | PropertyGroup | *None = None*) → *Data* | list[*Data*]

Create *Data* from dictionary of name and arguments. The provided arguments can be any property of the target Data class.

Parameters

data – Dictionary of data to be added to the object, e.g.

```
data = {
    "data_A": {
        'values': [v_1, v_2, ...],
        'association': 'VERTEX'
        },
    "data_B": {
        'values': [v_1, v_2, ...],
        'association': 'CELLS'
        },
}
```

Returns

List of new Data objects.

add_data_to_group(*data: list* | Data | *uuid.UUID*, *property_group: str* | PropertyGroup) → *PropertyGroup*

Append data children to a *PropertyGroup* All given data must be children of the parent object.

Parameters

- **data** – *Data* object, *uid* or *name* of data.
- **property_group** – Name or *PropertyGroup*. A new group is created if none exist with the given name.

Returns

The target property group.

property cells

numpy.array of int: Array of indices defining the connection between *vertices*.

clip_by_extent(*bounds: np.ndarray*) → *ObjectBase* | None

Find indices of cells within a rectangular bounds.

Parameters

- **bounds** – shape(2, 2) Bounding box defined by the South-West and North-East coordinates. Extents can also be provided as 3D coordinates with shape(2, 3) defining the top and bottom limits.
- **attributes** – Dictionary of attributes to clip by extent.

property comments

Fetch a *CommentsData* entity from children.

property converter

Returns

The converter for the object.

copy_from_extent(*bounds: np.ndarray*, *parent=None*, *copy_children: bool = True*) → *ObjectBase* | None

Find indices of vertices within a rectangular bounds.

Parameters

- **bounds** – shape(2, 2) Bounding box defined by the South-West and North-East coordinates. Extents can also be provided as 3D coordinates with shape(2, 3) defining the top and bottom limits.
- **attributes** – Dictionary of attributes to clip by extent.

abstract classmethod default_type_uid() → UUID

property entity_type: *ObjectType*

EntityType: Object type.

property extent

property faces

find_or_create_property_group(***kwargs*) → *PropertyGroup*

Find or create *PropertyGroup* from given name and properties.

Parameters
kwargs – Any arguments taken by the *PropertyGroup* class.

Returns
A new or existing *PropertyGroup*

classmethod find_or_create_type(*workspace:* workspace.Workspace, ***kwargs*) → *ObjectType*

Find or create a type instance for a given object class.

Parameters
workspace – Target *Workspace*.

Returns
The ObjectType instance for the given object class.

get_data(*name: str | uuid.UUID*) → list[*Data*]

Get a child *Data* by name.

Parameters
name – Name of the target child data

Returns
A list of children Data objects

get_data_list(*attribute='name'*) → list[str]

Get a list of names of all children *Data*.

Returns
List of names of data associated with the object.

property last_focus: str

bool: Object visible in camera on start.

property n_cells: int | None

int: Number of cells.

property n_vertices: int | None

int: Number of vertices.

property property_groups: list[*PropertyGroup*] | None

List of *PropertyGroup*.

remove_children_values(*indices: list[int]*, *association: str*)

remove_property_groups(*property_groups:* PropertyGroup | *list[*PropertyGroup*]*)

validate_data_association(*attribute_dict*)

Get a dictionary of attributes and validate the data 'association' keyword.

static validate_data_type(*attribute_dict*)

Get a dictionary of attributes and validate the type of data.

property vertices

`numpy.array` of `float`, shape (*, 3): Array of x, y, z coordinates defining the position of points in 3D space.

geoh5py.objects.object_type

class geoh5py.objects.object_type.**ObjectType**(*workspace:* workspace.Workspace, ***kwargs*)

Bases: *EntityType*

Object type class

static create_custom(*workspace:* workspace.Workspace) → *ObjectType*

Creates a new instance of ObjectType for an unlisted custom Object type with a new auto-generated UUID.

Parameters
workspace – An active Workspace class

classmethod find_or_create(*workspace:* workspace.Workspace, *entity_class*, ***kwargs*) → *ObjectType*

Find or creates an EntityType with given `uuid.UUID` that matches the given Group implementation class.

It is expected to have a single instance of EntityType in the Workspace for each concrete Entity class.

Parameters

- **workspace** – An active Workspace class
- **entity_class** – An Group implementation class.

Returns
A new instance of GroupType.

geoh5py.objects.octree

class geoh5py.objects.octree.**Octree**(*object_type:* ObjectType, ***kwargs*)

Bases: *ObjectBase*

Octree mesh class that uses a tree structure such that cells can be subdivided it into eight octants.

base_refine()

Refine the mesh to its base octree level resulting in a single cell along the shortest dimension.

property centroids

`numpy.array` of `float`, shape (*n_cells*, 3): Cell center locations in world coordinates.

```
centroids = [
    [x_1, y_1, z_1],
    ...,
    [x_N, y_N, z_N]
]
```

classmethod default_type_uid() → UUID

property n_cells: int | None

`int`: Total number of cells in the mesh

property octree_cells: np.ndarray | None

`numpy.ndarray` of `int`, shape (*n_cells*, 4): Array defining the i, j, k position and size of each cell. The size defines the width of a cell in number of base cells.

```
cells = [
    [i_1, j_1, k_1, size_1],
    ...,
    [i_N, j_N, k_N, size_N]
]
```

property origin

`numpy.array` of `float`, shape (3,): Coordinates of the origin

property rotation: float

`float`: Clockwise rotation angle (degree) about the vertical axis.

property shape: tuple | None

`list` of `int`, len (3,): Number of cells along the u, v and w-axis.

property u_cell_size: float | None

`float`: Base cell size along the u-axis.

property u_count: int | None

`int`: Number of cells along u-axis.

property v_cell_size: float | None

`float`: Base cell size along the v-axis.

property v_count: int | None

`int`: Number of cells along v-axis.

property w_cell_size: float | None

`float`: Base cell size along the w-axis.

property w_count: int | None

`int`: Number of cells along w-axis.

geoh5py.objects.points

class geoh5py.objects.points.**Points**(*object_type:* ObjectType, *name='Points'*, ***kwargs*)

Bases: *ObjectBase*

Points object made up of vertices.

clip_by_extent(*bounds: np.ndarray*) → *Points* | None

Find indices of vertices within a rectangular bounds.

Parameters

bounds – shape(2, 2) Bounding box defined by the South-West and North-East coordinates. Extents can also be provided as 3D coordinates with shape(2, 3) defining the top and bottom limits.

classmethod default_type_uid() → UUID

remove_vertices(*indices: list[int]*)

Safely remove vertices and corresponding data entries.

property vertices: np.ndarray | None

vertices

geoh5py.objects.surface

class geoh5py.objects.surface.**Surface**(*object_type:* ObjectType, ***kwargs*)

Bases: `CellObject`

Surface object defined by vertices and cells

property cells: np.ndarray | None

Array of vertices index forming triangles :return cells: `numpy.array` of `int`, shape ("*", 3)

classmethod default_type_uid() → UUID

Default type uid.

2.3.5 geoh5py.shared

geoh5py.shared.concatenation

class geoh5py.shared.concatenation.**Concatenated**(*entity_type*, ***kwargs*)

Bases: *Entity*

Base class modifier for concatenated objects and data.

property concat_attr_str: str

String identifier for the concatenated attributes.

property concatenator: *Concatenator*

Parental Concatenator entity.

class geoh5py.shared.concatenation.**ConcatenatedData**(*entity_type*, ***kwargs*)

Bases: *Concatenated*

property parent: *ConcatenatedObject*

property property_group

Get the property group containing the data interval.

class geoh5py.shared.concatenation.**ConcatenatedDrillhole**(*entity_type*, ***kwargs*)

Bases: *ConcatenatedObject*

property from_: list[*Data*]

Depth data corresponding to the tops of the interval values.

sort_depths()

Bypass sort_depths from previous version.

property to_: list[*Data*]

Depth data corresponding to the bottoms of the interval values.

validate_data(*attributes: dict*, *property_group=None*, *collocation_distance=None*) → tuple

Validate input drillhole data attributes.

Parameters

- **attributes** – Dictionary of data attributes.
- **property_group** – Input property group to validate against.

validate_interval_data(*name: str | None*, *from_to: list | np.ndarray | None*, *values: np.ndarray*, *property_group: str | ConcatenatedPropertyGroup | None = None*, *collocation_distance=0.0001*) → *ConcatenatedPropertyGroup*

Compare new and current depth values and re-use the property group if possible. Otherwise a new property group is added.

Parameters

- **from_to** – Array of from-to values.
- **values** – Data values to be added on the from-to intervals.
- **property_group** – Property group name

Collocation_distance
Threshold on the comparison between existing depth values.

class geoh5py.shared.concatenation.**ConcatenatedObject**(*entity_type*, ***kwargs*)

Bases: *Concatenated*, *ObjectBase*

find_or_create_property_group(***kwargs*) → *ConcatenatedPropertyGroup*

Find or create *PropertyGroup* from given name and properties.

Parameters
kwargs – Any arguments taken by the *PropertyGroup* class.

Returns
A new or existing *PropertyGroup*

get_data(*name: str | uuid.UUID*) → list[*Data*]

Generic function to get data values from object.

get_data_list(*attribute='name'*)

Get list of data names.

property parent: *Concatenator*

property property_groups: list | None

List of *PropertyGroup*.

class geoh5py.shared.concatenation.**ConcatenatedPropertyGroup**(*parent: ConcatenatedObject*, ***kwargs*)

Bases: *PropertyGroup*

property from_

Return the data entities definind the 'from' depth intervals.

property parent

The parent *ObjectBase*

property to_

Return the data entities definind the 'to' depth intervals.

class geoh5py.shared.concatenation.**Concatenator**(*group_type:* GroupType, ***kwargs*)

Bases: *Group*

Class modifier for concatenation of objects and data.

add_save_concatenated(*child*) → None

Add or save a concatenated entity.

Parameters
child – Concatenated entity

property attributes_keys: list | None

List of uuids present in the concatenated attributes.

property concat_attr_str: str

String identifier for the concatenated attributes.

property concatenated_attributes: dict | None

Dictionary of concatenated objects and data attributes.

property concatenated_object_ids: list[bytes] | None

Dictionary of concatenated objects and data concatenated_object_ids.

copy(*parent=None*, *copy_children: bool = True*, ***kwargs*)

Function to copy an entity to a different parent entity.

Parameters

- **parent** – Target parent to copy the entity under. Copied to current *parent* if None.
- **copy_children** – Create copies of all children entities along with it.

Return entity
Registered Entity to the workspace.

property data: dict

Concatenated data values stored as a dictionary.

delete_index_data(*label: str*, *index: int*) → None

fetch_concatenated_data_index()

Extract concatenation arrays.

fetch_concatenated_objects() → dict

Load all concatenated children.

fetch_index(*entity:* Concatenated, *field: str*) → int | None

Fetch the array index for specific concatenated object and data field.

Parameters

- **entity** – Parent entity with data
- **field** – Name of the target data.

fetch_start_index(*entity:* Concatenated, *label: str*) → int

Fetch starting index for a given entity and label. Existing date is removed such that new entries can be appended.

Parameters

- **entity** – Concatenated entity to be added.

- **label** – Name of the attribute requiring an update.

fetch_values(*entity:* Concatenated, *field: str*) → np.ndarray | None

Get an array of values from concatenated data.

Parameters

- **entity** – Parent entity with data
- **field** – Name of the target data.

get_concatenated_attributes(*uid: bytes | str | uuid.UUID*) → dict

Fast reference index to concatenated attribute keys.

property index: dict

Concatenated index stored as a dictionary.

property property_group_ids: list | None

Dictionary of concatenated objects and data property_group_ids.

remove_entity(*entity:* Concatenated)

Remove a concatenated entity.

save_attribute(*field: str*)

Save a concatenated attribute.

Parameters
field – Name of the attribute

update_array_attribute(*entity:* Concatenated, *field: str*, *remove=False*) → None

Update values stored as data. Row data and indices are first remove then appended.

Parameters

- **entity** – Concatenated entity with array values.
- **field** – Name of the valued field.

update_attributes(*entity:* Concatenated, *label: str*) → None

Update a concatenated entity.

update_concatenated_attributes(*entity:* Concatenated) → None

Update the concatenated attributes. :param entity: Concatenated entity with attributes.

geoh5py.shared.entity

class geoh5py.shared.entity.**Entity**(*uid: uuid.UUID | None = None*, *name='Entity'*, ***kwargs*)

Bases: ABC

Base Entity class

add_children(*children: list[shared.Entity]*)

Parameters
children – Add a list of entities as *children*

add_file(*file: str*)

Add a file to the object or group stored as bytes on a FilenameData

Parameters
file – File name with path to import.

property allow_delete: bool

bool Entity can be deleted from the workspace.

property allow_move: bool

bool Entity can change *parent*

property allow_rename: bool

bool Entity can change name

property attribute_map: dict

dict Correspondence map between property names used in geoh5py and geoh5.

property children

list Children entities in the workspace tree

property clipping_ids: list[uuid.UUID] | None

List of clipping uuids

copy(*parent=None*, *copy_children: bool = True*, ***kwargs*)

Function to copy an entity to a different parent entity.

Parameters

- **parent** – Target parent to copy the entity under. Copied to current *parent* if None.
- **copy_children** – (Optional) Create copies of all children entities along with it.
- **kwargs** – Additional keyword arguments to pass to the copy constructor.

Return entity

Registered Entity to the workspace.

classmethod create(*workspace*, ***kwargs*)

Function to create an entity.

Parameters

- **workspace** – Workspace to be added to.
- **kwargs** – List of keyword arguments defining the properties of a class.

Return entity

Registered Entity to the workspace.

abstract property entity_type: shared.EntityType

classmethod fix_up_name(*name: str*) → str

If the given name is not a valid one, transforms it to make it valid :return: a valid name built from the given name. It simply returns the given name if it was already valid.

get_entity(*name: str | uuid.UUID*) → list[*Entity*]

Get a child *Data* by name.

Parameters

- **name** – Name of the target child data
- **entity_type** – Sub-select entities based on type.

Returns

A list of children Data objects

get_entity_list(*entity_type=<class 'abc.ABC'>*) → list[str]

Get a list of names of all children *Data*.

Parameters
entity_type – Option to sub-select based on type.

Returns
List of names of data associated with the object.

property metadata: dict | None

Metadata attached to the entity.

property name: str

`str` Name of the entity

property on_file: bool

Whether this Entity is already stored on *h5file*.

property parent

property partially_hidden: bool

Whether this Entity is partially hidden.

property public: bool

Whether this Entity is accessible in the workspace tree and other parts
of the the user interface in ANALYST.

reference_to_uid(*value:* Entity | *str* | *uuid.UUID*) → list[uuid.UUID]

General entity reference translation.

Parameters
value – Either an *Entity*, string or uuid

Returns
List of unique identifier associated with the input reference.

remove_children(*children: list[shared.Entity]*)

Remove children from the list of children entities.

Parameters
children – List of entities

> **Warning:** Removing a child entity without re-assigning it to a different parent may cause it to become inactive. Inactive entities are removed from the workspace by *remove_none_referents()*.

remove_data_from_group(*data: list* | Entity | *uuid.UUID* | *str*, *name: str* | *None = None*) → None

Remove data children to a *PropertyGroup* All given data must be children of the parent object.

Parameters

- **data** – *Data* object, *uid* or *name* of data.
- **name** – Name of a *PropertyGroup*. A new group is created if none exist with the given name.

save(*add_children: bool = True*)

Alias method of `save_entity()`.

Parameters
add_children – Option to also save the children.

property uid: UUID

property visible: bool

Whether the Entity is visible in camera (checked in ANALYST object tree).

property workspace: *Workspace*

Workspace to which the Entity belongs to.

geoh5py.shared.entity_type

class geoh5py.shared.entity_type.**EntityType**(*workspace: ws.Workspace*, *uid: uuid.UUID | None = None*, ***kwargs*)

Bases: ABC

property attribute_map

dict Correspondence map between property names used in geoh5py and geoh5.

property description: str | None

classmethod find(*workspace: ws.Workspace*, *type_uid: uuid.UUID*) → EntityTypeT | None

Finds in the given Workspace the EntityType with the given UUID for this specific EntityType implementation class.

Returns
EntityType of None

property name: str | None

property on_file: bool

bool Entity already present in *h5file*.

property uid: UUID

uuid.UUID The unique identifier of an entity, either as stored in geoh5 or generated in uuid4() format.

property workspace: ws.Workspace

Workspace registering this type.

geoh5py.shared.exceptions

exception geoh5py.shared.exceptions.**AssociationValidationError**(*name: str*, *value:* Entity | PropertyGroup | *UUID*, *validation:* Entity | Workspace)

Bases: *BaseValidationError*

Error on association between child and parent entity validation.

static message(*name*, *value*, *validation*)

Builds custom error message.

exception geoh5py.shared.exceptions.**AtLeastOneValidationError**(*name: str*, *value: list[str]*)

Bases: *BaseValidationError*

static message(*name*, *value*, *validation=None*)

Builds custom error message.

exception geoh5py.shared.exceptions.**BaseValidationError**

Bases: ABC, Exception

Base class for custom exceptions.

abstract static message(*name*, *value*, *validation*)

Builds custom error message.

exception geoh5py.shared.exceptions.**Geoh5FileClosedError**

Bases: ABC, Exception

Error for closed geoh5 file.

exception geoh5py.shared.exceptions.**JSONParameterValidationError**(*name: str*, *err: str*)

Bases: Exception

Error on uuid validation.

static message(*name*, *err*)

exception geoh5py.shared.exceptions.**OptionalValidationError**(*name: str*, *value: Any | None*, *validation: bool*)

Bases: *BaseValidationError*

Error if None value provided to non-optional parameter.

static message(*name*, *value*, *validation*)

Builds custom error message.

exception geoh5py.shared.exceptions.**PropertyGroupValidationError**(*name: str*, *value:* PropertyGroup, *validation: str*)

Bases: *BaseValidationError*

Error on property group validation.

static message(*name*, *value*, *validation*)

Builds custom error message.

exception geoh5py.shared.exceptions.**RequiredValidationError**(*name: str*)

Bases: *BaseValidationError*

static message(*name*, *value=None*, *validation=None*)

Builds custom error message.

exception geoh5py.shared.exceptions.**ShapeValidationError**(*name: str*, *value: tuple[int]*, *validation: tuple[int] | str*)

Bases: *BaseValidationError*

Error on shape validation.

static message(*name*, *value*, *validation*)

Builds custom error message.

exception geoh5py.shared.exceptions.**TypeValidationError**(*name: str*, *value: str*, *validation: str | list[str]*)

Bases: *BaseValidationError*

Error on type validation.

static message(*name*, *value*, *validation*)

Builds custom error message.

exception geoh5py.shared.exceptions.**UUIDValidationError**(*name: str*, *value: str*)

Bases: *BaseValidationError*

Error on uuid string validation.

static message(*name*, *value*, *validation=None*)

Builds custom error message.

exception geoh5py.shared.exceptions.**ValueValidationError**(*name: str*, *value: Any*, *validation: list[Any]*)

Bases: *BaseValidationError*

Error on value validation.

static message(*name*, *value*, *validation*)

Builds custom error message.

geoh5py.shared.utils

geoh5py.shared.utils.**as_str_if_utf8_bytes**(*value*) → str

Convert bytes to string

geoh5py.shared.utils.**as_str_if_uuid**(*value: UUID | Any*) → str | Any

Convert UUID to string used in geoh5.

geoh5py.shared.utils.**bool_value**(*value: int8*) → bool

Convert logical int8 to bool.

geoh5py.shared.utils.**compare_entities**(*object_a*, *object_b*, *ignore: list | None = None*, *decimal: int = 6*) → None

geoh5py.shared.utils.**dict_mapper**(*val*, *string_funcs: list[Callable]*, **args*, *omit: dict | None = None*) → dict

Recursion through nested dictionaries and applies mapping functions to values.

Parameters

- **val** – Value (could be another dictionary) to apply transform functions.
- **string_funcs** – Functions to apply on values within the input dictionary.
- **omit** – Dictionary of functions to omit.

Return val

Transformed values

geoh5py.shared.utils.**entity2uuid**(*value: Any*) → UUID | Any

Convert an entity to its UUID.

geoh5py.shared.utils.**fetch_active_workspace**(*workspace: Workspace | None*, *mode: str = 'r'*)

Open a workspace in the requested 'mode'. If receiving an opened Workspace instead, merely return the given workspace.

Parameters

- **workspace** – A Workspace class
- **mode** – Set the h5 read/write mode

Return h5py.File
Handle to an opened Workspace.

geoh5py.shared.utils.**fetch_h5_handle**(*file: str | h5py.File | Path*, *mode: str = 'r'*) → h5py.File

Open in read+ mode a geoh5 file from string. If receiving a file instead of a string, merely return the given file.

Parameters

- **file** – Name or handle to a geoh5 file.
- **mode** – Set the h5 read/write mode

Return h5py.File
Handle to an opened h5py file.

geoh5py.shared.utils.**get_attributes**(*entity*, *omit_list=()*, *attributes=None*)

Extract the attributes of an object with omissions.

geoh5py.shared.utils.**is_uuid**(*value: str*) → bool

Check if a string is UUID compliant.

geoh5py.shared.utils.**iterable**(*value: Any*, *checklen: bool = False*) → bool

Checks if object is iterable.

Parameters

value
[Object to check for iterableness.]

checklen
[Restrict objects with __iter__ method to len > 1.]

Returns

True if object has __iter__ attribute but is not string or dict type.

geoh5py.shared.utils.**iterable_message**(*valid: list[Any] | None*) → str

Append possibly iterable valid: "Must be (one of): {valid}.".

geoh5py.shared.utils.**mask_by_extent**(*locations: np.ndarray*, *extent: np.ndarray | list[list]*) → np.ndarray

Find indices of locations within a rectangular extent.

Parameters

- **locations** – shape(*, 3) or shape(*, 2) Coordinates to be evaluated.
- **extent** – shape(2, 2) Limits defined by the South-West and North-East corners. Extents can also be provided as 3D coordinates with shape(2, 3) defining the top and bottom limits.

geoh5py.shared.utils.**match_values**(*vec_a*, *vec_b*, *collocation_distance=0.0001*) → ndarray

Find indices of matching values between two arrays, within collocation_distance.

Param
vec_a, list or numpy.ndarray Input sorted values

Param
vec_b, list or numpy.ndarray Query values

Returns
indices, numpy.ndarray Pairs of indices for matching values between the two arrays such that vec_a[ind[:, 0]] == vec_b[ind[:, 1]].

geoh5py.shared.utils.**merge_arrays**(*head*, *tail*, *replace='A->B'*, *mapping=None*, *collocation_distance=0.0001*, *return_mapping=False*) → ndarray

Given two numpy.arrays of different length, find the matching values and append both arrays.

Param
head, numpy.array of float First vector of shape(M,) to be appended.

Param
tail, numpy.array of float Second vector of shape(N,) to be appended

Param
mapping=None, numpy.ndarray of int Optional array where values from the head are replaced by the tail.

Param
collocation_distance=1e-4, float Tolerance between matching values.

Returns
numpy.array shape(O,) Unique values from head to tail without repeats, within collocation_distance.

geoh5py.shared.utils.**overwrite_kwargs**(*to_overwrite: dict*, *kwargs_to_add: dict*) → dict

Overwrite kwargs with overwrite. :param to_overwrite: Dictionary of kwargs to overwrite. :param kwargs_to_add: Dictionary of kwargs to modify to_overwrite.

geoh5py.shared.utils.**str2uuid**(*value: Any*) → UUID | Any

Convert string to UUID

geoh5py.shared.utils.**uuid2entity**(*value: UUID*, *workspace:* Workspace) → *Entity* | Any

Convert UUID to a known entity.

geoh5py.shared.validators

class geoh5py.shared.validators.**AssociationValidator**(***kwargs*)

Bases: *BaseValidator*

Validate the association between data and parent object.

classmethod validate(*name: str*, *value:* Entity | PropertyGroup | *UUID* | *None*, *valid:* Entity | Workspace) → None

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter value.
- **valid** – Expected value shape

validator_type = 'association'

class geoh5py.shared.validators.**AtLeastOneValidator**(***kwargs*)

Bases: *BaseValidator*

classmethod validate(*name*, *value*, *valid*)

Custom validation function.

validator_type = 'one_of'

class geoh5py.shared.validators.**BaseValidator**(***kwargs*)

Bases: ABC

Concrete base class for validators.

abstract classmethod validate(*name: str*, *value: Any*, *valid: Any*)

Custom validation function.

abstract property validator_type: str

Validation type identifier.

class geoh5py.shared.validators.**OptionalValidator**(***kwargs*)

Bases: *BaseValidator*

Validate that forms contain optional parameter if None value is given.

classmethod validate(*name: str*, *value: Any | None*, *valid: bool*) → None

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter value.
- **valid** – True if optional keyword in form for parameter.

validator_type = 'optional'

class geoh5py.shared.validators.**PropertyGroupValidator**(***kwargs*)

Bases: *BaseValidator*

Validate property_group from parent entity.

classmethod validate(*name: str*, *value:* PropertyGroup, *valid: str*) → None

Custom validation function.

validator_type = 'property_group_type'

class geoh5py.shared.validators.**RequiredValidator**(***kwargs*)

Bases: *BaseValidator*

Validate that required keys are present in parameter.

classmethod validate(*name: str*, *value: Any*, *valid: bool*) → None

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter value.
- **valid** – Assert to be required

validator_type = 'required'

class geoh5py.shared.validators.**ShapeValidator**(***kwargs*)

Bases: *BaseValidator*

Validate the shape of provided value.

classmethod validate(*name: str*, *value: Any*, *valid: tuple[int]*) → None

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter value.
- **valid** – Expected value shape

validator_type = 'shape'

class geoh5py.shared.validators.**TypeValidator**(***kwargs*)

Bases: *BaseValidator*

Validate the value type from a list of valid types.

classmethod validate(*name: str*, *value: Any*, *valid: list[type] | type*) → None

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter value.
- **valid** – List of accepted value types

validator_type = 'types'

class geoh5py.shared.validators.**UUIDValidator**(***kwargs*)

Bases: *BaseValidator*

Validate a uuui.UUID value or uuid string.

classmethod validate(*name: str*, *value: Any*, *valid: None = None*) → None

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter uuid.
- **valid** – [Optional] Validate uuid from parental entity or known uuids

validator_type = 'uuid'

class geoh5py.shared.validators.**ValueValidator**(***kwargs*)

Bases: *BaseValidator*

Validator that ensures that values are valid entries.

classmethod validate(*name: str*, *value: Any*, *valid: list[float | str]*) → None

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter value.
- **valid** – List of accepted values

validator_type = 'values'

geoh5py.shared.weakref_utils

geoh5py.shared.weakref_utils.**get_clean_ref**(*some_dict: dict[K, ReferenceType[T]]*, *key: K*) → T | None

Gets the referent value for the given `key` in a `some_dict` of `weakref` values. In case `key` points to a reference to a deleted value, remove that key from `some_dict` on the fly, and returns None.

Parameters

- **some_dict** – The dictionary of `weakref` values.
- **key** – The key

Returns

the referent value for `key` if found in the the dictionary, else None.

geoh5py.shared.weakref_utils.**insert_once**(*some_dict: dict[K, ReferenceType]*, *key: K*, *value*)

Check if the reference to an Entity with uuid is already in use.

Parameters

- **some_dict** – Dictionary of UUID keys and weakref values.
- **key** – UUID key to be checked.
- **value** – Entity to be checked

Returns

Dictionary with clean weakref

geoh5py.shared.weakref_utils.**remove_none_referents**(*some_dict: dict[K, ReferenceType]*)

Removes any key from the given `some_dict` where the value is a reference to a deleted value (that is where referent of the `weakref` value is None).

Parameters

some_dict – The dictionary to be cleaned up.

2.3.6 geoh5py.ui_json

geoh5py.ui_json.constants

geoh5py.ui_json.input_file

class geoh5py.ui_json.input_file.**InputFile**(*data: dict[str, Any] | None = None*, *ui_json: dict[str, Any] | None = None*, *validations: dict | None = None*, *validation_options: dict | None = None*)

Bases: `object`

Handles loading ui.json input files.

Attributes

data

[Input file content parsed to flat dictionary of key:value.]

ui_json: User interface serializable as ui.json format
workspace: Target :obj:`geoh5py.workspace.Workspace`
validations: Dictionary of validations for parameters in the input file

Methods

write_ui_json()	Writes a ui.json formatted file from 'data' attribute contents.
read_ui_json()	Reads a ui.json formatted file into 'data' attribute dictionary. Optionally filters ui.json fields other than 'value'.

association_validator = <geoh5py.shared.validators.AssociationValidator object>

property data

load(*input_dict: dict[str, Any]*)

Load data from dictionary and validate.

property name: str | None

Name of ui.json file.

classmethod numify(*ui_json: dict[str, Any]*) → dict[str, Any]

Convert inf, none and list strings to numerical types within a dictionary

Parameters

ui_json
dictionary containing ui.json keys, values, fields

Returns

Dictionary with inf, none and list string representations converted numerical types.

property path: str | None

Directory for the input/output ui.json file.

property path_name: str | None

static read_ui_json(*json_file: str*, ***kwargs*)

Read and create an InputFile from ui.json

property ui_json: dict | None

Dictionary representing the ui.json file with promoted values.

classmethod ui_validation(*ui_json: dict[str, Any]*)

Validation of the ui_json forms

update_ui_values(*data: dict*, *none_map=None*)

Update the ui.json values and enabled status from input data.

Parameters

- **data** – Key and value pairs expected by the ui_json.
- **none_map** – Map parameter 'None' values to non-null numeric types. The parameters in the dictionary are mapped to optional and disabled.

Raises

UserWarning – If attempting to set None value to non-optional parameter.

property validation_options

Pass validation options to the validators.

property validations: dict | None

property validators

property workspace

write_ui_json(*name: str | None = None*, *none_map: dict[str, Any] | None = None*, *path: str | None = None*)

Writes a formatted ui.json file from InputFile data

Parameters

- **name** – Name of the file
- **none_map** – Map parameter None values to non-null numeric types.
- **path** – Directory to write the ui.json to.

geoh5py.ui_json.templates

geoh5py.ui_json.templates.**bool_parameter**(*main: bool = True*, *label: str = 'Logical data'*, *value: bool = False*) → dict

Checkbox for true/false choice.

Parameters

- **main** – Show ui in main.
- **label** – Label identifier.
- **value** – Input value.

Returns

Ui_json compliant dictionary.

geoh5py.ui_json.templates.**choice_string_parameter**(*main: bool = True*, *label: str = 'String data'*, *choice_list: tuple = ('Option A', 'Option B')*, *value: str = 'Option A'*, *optional: str | None = None*) → dict

Dropdown menu of string choices.

Parameters

- **main** – Show form in main.
- **label** – Label identifier.
- **value** – Input value.
- **choice_list** – List of options.
- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns

Ui_json compliant dictionary.

geoh5py.ui_json.templates.**data_parameter**(*main: bool = True*, *label: str = 'Data channel'*, *association: str = 'Vertex'*, *data_type: str = 'Float'*, *data_group_type: str | None = None*, *parent: str = ''*, *value: str = ''*, *optional: str | None = None*) → dict

Dropdown menu of data from parental object.

Parameters

- **main** – Show form in main.

- **label** – Label identifier.
- **value** – Input value.
- **association** – Data association type from 'Vertex' or 'Cell'.
- **data_type** – Type of data selectable from 'Float', 'Integer' or 'Reference'.
- **data_group_type** – [Optional] Select from property_groups of type. '3D vector', 'Dip direction & dip', 'Strike & dip', or 'Multi-element'.
- **parent** – Parameter name corresponding to the parent object.
- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns

Ui_json compliant dictionary.

geoh5py.ui_json.templates.**data_value_parameter**(*main: bool = True*, *label: str = 'Data channel'*, *association: str = 'Vertex'*, *data_type: str = 'Float'*, *parent: str = ''*, *value: float = 0.0*, *is_value: bool = True*, *prop: UUID | Entity | None = None*, *optional: str | None = None*) → dict

Dropdown of data or input box.

Parameters

- **main** – Show form in main.
- **label** – Label identifier.
- **value** – Input value.
- **association** – Data association type from 'Vertex' or 'Cell'.
- **data_type** – Type of data selectable from 'Float', 'Integer' or 'Reference'.
- **data_group_type** – [Optional] Select from property_groups of type. '3D vector', 'Dip direction & dip', 'Strike & dip', or 'Multi-element'.
- **parent** – Parameter name corresponding to the parent object.
- **is_value** – Display the input box or dropdown menu.
- **prop** – Data entity selected in the dropdown menu if 'is_value=False'.
- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns

Ui_json compliant dictionary.

geoh5py.ui_json.templates.**file_parameter**(*main: bool = True*, *label: str = 'File choices'*, *file_description: tuple = ()*, *file_type: tuple = ()*, *value: str = ''*, *optional: str | None = None*) → dict

File loader for specific extensions.

Parameters

- **main** – Show form in main.
- **label** – Label identifier.
- **value** – Input value.

- **file_description** – Title used to describe each type.
- **file_type** – Extension of files to display.
- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns
Ui_json compliant dictionary.

geoh5py.ui_json.templates.**float_parameter**(*main: bool = True*, *label: str = 'Float data'*, *value: float = 1.0*, *vmin: float = 0.0*, *vmax: float = 100.0*, *precision: int = 2*, *line_edit: bool = True*, *optional: str | None = None*) → dict

Input box for float value.

Parameters

- **main** – Show form in main.
- **label** – Label identifier.
- **value** – Input value.
- **vmin** – Minimum value allowed.
- **vmax** – Maximum value allowed.
- **line_edit** – Allow line edit or spin box
- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns
Ui_json compliant dictionary.

geoh5py.ui_json.templates.**integer_parameter**(*main: bool = True*, *label: str = 'Integer data'*, *value: int = 1*, *vmin: int = 0*, *vmax: int = 100*, *optional: str | None = None*) → dict

Input box for integer value.

Parameters

- **main** – Show ui in main.
- **label** – Label identifier.
- **value** – Input value.
- **vmin** – Minimum value allowed.
- **vmax** – Maximum value allowed.
- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns
Ui_json compliant dictionary.

geoh5py.ui_json.templates.**object_parameter**(*main: bool = True*, *label: str = 'Object'*, *mesh_type: tuple = (UUID('4b99204c-d133-4579-a916-a9c8b98cfccb'), UUID('19730589-fd28-4649-9de0-ad47249d9aba'), UUID('58c4849f-41e2-4e09-b69b-01cf4286cded'), UUID('b020a277-90e2-4cd7-84d6-612ee3f25051'), UUID('9b08bb5a-300c-48fe-9007-d206f971ea92'), UUID('6a057fdc-b355-11e3-95be-fd84a7ffcb88'), UUID('c94968ea-cf7d-11eb-b8bc-0242ac130003'), UUID('7caebf0e-d16e-11e3-bc69-e4632694aa37'), UUID('77ac043c-fe8d-4d14-8167-75e300fb835a'), UUID('48f5054a-1c5c-4ca4-9048-80f36dc60a06'), UUID('deebe11a-b57b-4a03-99d6-8f27b25eb2a8'), UUID('17dbbfbb-3ee4-461c-9f1d-1755144aac90'), UUID('6832acf3-78aa-44d3-8506-9574a3510c44'), UUID('e79f449d-74e3-4598-9c9c-351a28b8b69e'), UUID('b99bd6e5-4fe1-45a5-bd2f-75fc31f91b38'), UUID('88087fb8-76ae-445b-9cdf-68dbce530404'), UUID('849d2f3e-a46e-11e3-b401-2776bdf4f982'), UUID('4ea87376-3ece-438b-bf12-3479733ded46'), UUID('202c5db1-a56d-4004-9cad-baafd8899406'), UUID('275ecee9-9c24-4378-bf94-65f3c5fbe163'), UUID('f26feba3-aded-494b-b9e9-b2bbcbe298e1'), UUID('f495cd13-f09b-4a97-9212-2ea392aeb375'), UUID('0b639533-f35b-44d8-92a8-f70ecff3fd26'))*, *value: str | None = None*, *optional: str | None = None*) → dict

Dropdown menu of objects of specific types.

Parameters

- **main** – Show form in main.
- **label** – Label identifier.
- **value** – Input value.
- **mesh_type** – Type of selectable objects.
- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns

Ui_json compliant dictionary.

geoh5py.ui_json.templates.**optional_parameter**(*state: str*) → dict[str, bool]

Returns dictionary to make existing ui optional via .update() method.

Parameters

state – Initial state of optional parameter. Can be 'enabled' or 'disabled'.

geoh5py.ui_json.templates.**string_parameter**(*main: bool = True*, *label: str = 'String data'*, *value: str = 'data'*, *optional: str | None = None*) → dict

Input box for string value.

Parameters

- **main** – Show form in main.
- **label** – Label identifier.
- **value** – Input string value.

- **optional** – Make optional if not None. Initial state provided by not None value. Can be either 'enabled' or 'disabled'.

Returns
Ui_json compliant dictionary.

geoh5py.ui_json.utils

geoh5py.ui_json.utils.**collect**(*ui_json: dict[str, dict]*, *member: str*, *value: Any = None*) → dict[str, Any]
Collects ui parameters with common field and optional value.

geoh5py.ui_json.utils.**container_group2name**(*value*)

geoh5py.ui_json.utils.**dependency_requires_value**(*ui_json: dict[str, dict]*, *parameter: str*) → bool
Handles dependency and optional requirements.

If dependency doesn't require a value then the function returns False. But if the dependency does require a value, the return value is either True, or will take on the enabled state if the dependent parameter is optional.

Parameters

- **ui_json** – UI.json dictionary
- **parameter** – Name of parameter to check type.

geoh5py.ui_json.utils.**find_all**(*ui_json: dict[str, dict]*, *member: str*, *value: Any = None*) → list[str]
Returns names of all collected parameters.

geoh5py.ui_json.utils.**flatten**(*ui_json: dict[str, dict]*) → dict[str, Any]
Flattens ui.json format to simple key/value pair.

geoh5py.ui_json.utils.**group_enabled**(*group: dict[str, dict]*) → bool
Return true if groupOptional and enabled are both true.

Parameters
group – UI.json dictionary

geoh5py.ui_json.utils.**group_optional**(*ui_json: dict[str, dict]*, *group_name: str*) → bool
Returns groupOptional bool for group name.

geoh5py.ui_json.utils.**group_requires_value**(*ui_json: dict[str, dict]*, *parameter: str*) → bool
True is groupOptional and group is enabled else False

Parameters

- **ui_json** – UI.json dictionary
- **parameter** – Name of parameter to check type.

geoh5py.ui_json.utils.**inf2str**(*value*)

geoh5py.ui_json.utils.**is_form**(*var*) → bool
Return true if dictionary 'var' contains both 'label' and 'value' members.

geoh5py.ui_json.utils.**is_uijson**(*ui_json: dict[str, dict]*)
Returns True if dictionary contains all the required parameters.

geoh5py.ui_json.utils.**list2str**(*value*)

geoh5py.ui_json.utils.**monitored_directory_copy**(*directory: str*, *entity:* ObjectBase, *copy_children: bool = True*)

Create a temporary geoh5 file in the monitoring folder and export entity for update.

Parameters

- **directory** – Monitoring directory
- **entity** – Entity to be updated
- **copy_children** – Option to copy children entities.

geoh5py.ui_json.utils.**none2str**(*value*)

geoh5py.ui_json.utils.**optional_requires_value**(*ui_json: dict[str, dict]*, *parameter: str*) → bool

True if enabled else False.

Parameters

- **ui_json** – UI.json dictionary
- **parameter** – Name of parameter to check type.

geoh5py.ui_json.utils.**path2workspace**(*value*)

geoh5py.ui_json.utils.**requires_value**(*ui_json: dict[str, dict]*, *parameter: str*) → bool

Check if a ui.json parameter requires a value (is not optional).

The required status of a parameter depends on a hierarchy of ui switches. At the top is the groupOptional switch, below that is the dependency switch, and on the bottom is the optional switch. When group optional is disabled all parameters in the group are not required, When the groupOptional is enabled the required status of a parameter depends first any dependencies and lastly on it's optional status.

Parameters

- **ui_json** – UI.json dictionary
- **parameter** – Name of parameter to check type.

geoh5py.ui_json.utils.**set_enabled**(*ui_json: dict*, *parameter: str*, *value: bool*)

Set enabled status for an optional or groupOptional parameter.

Parameters

- **ui_json** – UI.json dictionary
- **parameter** – Parameter name.
- **value** – Boolean value set to parameter's enabled member.

geoh5py.ui_json.utils.**str2inf**(*value*)

geoh5py.ui_json.utils.**str2list**(*value*)

geoh5py.ui_json.utils.**str2none**(*value*)

geoh5py.ui_json.utils.**truth**(*ui_json: dict[str, dict]*, *name: str*, *member: str*) → bool

Return parameter's 'member' value with default value for non-existent members.

geoh5py.ui_json.utils.**workspace2path**(*value*)

geoh5py.ui_json.validation

class geoh5py.ui_json.validation.**InputValidation**(*validators: dict[str, BaseValidator] | None = None*, *validations: dict[str, Any] | None = None*, *workspace: Workspace | None = None*, *ui_json: dict[str, Any] | None = None*, *validation_options: dict[str, Any] | None = None*)

Bases: `object`

Validations on dictionary of parameters.

Attributes

validations
[Validations dictionary with matching set of input parameter keys.]

workspace (optional)
[Workspace instance needed to validate uuid types.]

ignore_requirements (optional): Omit raising error on 'required' validator.

Methods

validate_data(data)	Validates data of params and contents/type/shape/keys/reqs of values.

static infer_validations(*ui_json: dict[str, Any] | None*, *validations: dict[str, dict] | None = None*) → dict

Infer necessary validations from ui json structure.

validate(*name: str*, *value: Any*, *validations: dict[str, Any] | None = None*)

Run validations on a given key and value.

Parameters

- **name** – Parameter identifier.
- **value** – Input parameter value.
- **validations** – [Optional] Validations provided on runtime

validate_data(*data: dict[str, Any]*) → None

Calls validate method on individual key/value pairs in input.

Parameters
data – Input data with known validations.

property validations

property validators

property workspace

2.3.7 geoh5py.workspace

geoh5py.workspace.workspace

class geoh5py.workspace.workspace.**Workspace**(*h5file: str | Path | io.BytesIO = 'Analyst.geoh5'*, *mode='a'*, ***kwargs*)

Bases: `AbstractContextManager`

The Workspace class manages all Entities created or imported from the *geoh5* structure.

The basic requirements needed to create a Workspace are:

Parameters

geoh5 – File name of the target *geoh5* file. A new project is created if the target file cannot by found on disk.

activate()

Makes this workspace the active one.

In case the workspace gets deleted, Workspace.active() safely returns None.

static active() → *Workspace*

Get the active workspace.

property attribute_map: dict

Mapping between names used in the geoh5 database.

close()

Close the file and clear properties for future open.

property contributors: ndarray

`numpy.array` of `str` List of contributors name.

classmethod copy_property_groups(*entity:* ObjectBase, *propery_groups: list[*PropertyGroup*]*, *data_map: dict*)

copy_to_parent(*entity*, *parent*, *copy_children: bool = True*, *omit_list: tuple = ()*, *extent: np.ndarray | None = None*, ***kwargs*)

Copy an entity to a different parent with copies of children.

Parameters

- **entity** – Entity to be copied.
- **parent** – Target parent to copy the entity under.
- **copy_children** – Copy all children of the entity.
- **omit_list** – List of property names to omit on copy
- **extent** – Clip object's copy by extent defined by a South-West and North-East corners.
- **kwargs** – Additional keyword arguments passed to the copy constructor.

Returns

The Entity registered to the workspace.

create_data(*entity_class*, *entity_kwargs: dict*, *entity_type_kwargs: dict | DataType*) → *Data* | None

Create a new Data entity with attributes.

Parameters

- **entity_class** – *Data* class.
- **entity_kwargs** – Properties of the entity.
- **entity_type_kwargs** – Properties of the entity_type.

Returns
The newly created entity.

create_entity(*entity_class*, *save_on_creation: bool = True*, ***kwargs*) → *Entity* | None

Function to create and register a new entity and its entity_type.

Parameters

- **entity_class** – Type of entity to be created
- **save_on_creation** – Save the entity to geoh5 immediately

Return entity
Newly created entity registered to the workspace

create_from_concatenation(*attributes*)

create_object_or_group(*entity_class*, *entity_kwargs: dict*, *entity_type_kwargs: dict*) → *Group* | *ObjectBase* | None

Create an object or a group with attributes.

Parameters

- **entity_class** – *ObjectBase* or *Group* class.
- **entity_kwargs** – Attributes of the entity.
- **entity_type_kwargs** – Attributes of the entity_type.

Returns
A new Object or Group.

property data: list[*data.Data*]

Get all active Data entities registered in the workspace.

deactivate()

Deactivate this workspace if it was the active one, else does nothing.

property distance_unit: str

`str` Distance unit used in the project.

fetch_array_attribute(*entity: Entity*, *key: str = 'cells'*) → ndarray

Fetch attribute stored as structured array from the source geoh5.

Parameters

- **entity** – Unique identifier of target entity.
- **file** – `h5py.File` or name of the target geoh5 file
- **key** – Field array name

Returns
Structured array.

fetch_children(*entity: Entity | None*, *recursively: bool = False*) → list

Recover and register children entities from the geoh5.

Parameters

- **entity** – Parental entity.
- **recursively** – Recover all children down the project tree.
- **file** – `h5py.File` or name of the target geoh5 file.

Return list
List of children entities.

fetch_concatenated_attributes(*entity:* Concatenator | ConcatenatedObject) → dict | None

Fetch attributes of Concatenated entity.

Parameters
entity – Concatenator group or ConcatenateObject.

Returns
Dictionary of attributes.

fetch_concatenated_list(*entity:* Group | ObjectBase, *label: str*) → list | None

Fetch list of data or indices of ConcatenatedData entities.

Parameters

- **entity** – Concatenator group.
- **label** – Label name of the h5py.Group

Returns
List of concatenated Data names.

fetch_concatenated_values(*entity:* Group | ObjectBase, *label: str*) → tuple | None

Fetch data under the ConcatenatedData Data group of an entity.

Parameters

- **entity** – Concatenator group.
- **label** – Name of the target data.

Returns
Index array and data values for the target label.

fetch_file_object(*uid: uuid.UUID*, *file_name: str*) → bytes | None

Fetch an image from file name.

Parameters
uid – Unique identifier of target data object.

Returns
Array of values.

fetch_metadata(*uid: uuid.UUID*, *argument='Metadata'*) → dict | None

Fetch the metadata of an entity from the source geoh5.

Parameters

- **uid** – Entity uid containing the metadata.
- **argument** – Optional argument for other json-like attributes.

Returns
Dictionary of values.

fetch_or_create_root()

fetch_property_groups(*entity:* Entity) → list[*PropertyGroup*]

Fetch all property_groups on an object from the source geoh5

Parameters
entity – Target object

Returns
List of PropertyGroups

fetch_type(*uid: UUID*, *entity_type: str*) → dict

Fetch attributes of a specific entity type. :param uid: Unique identifier of the entity type. :param entity_type: One of 'Data', 'Object' or 'Group'

fetch_values(*entity:* Entity) → np.ndarray | str | float | None

Fetch the data values from the source geoh5.

Parameters
entity – Entity with 'values'.

Returns
Array of values.

finalize() → None

Deprecate method finalize

Parameters
file – `h5py.File` or name of the target geoh5 file

find_data(*data_uid: uuid.UUID*) → *Entity* | None

Find an existing and active Data entity.

find_entity(*entity_uid: uuid.UUID*) → *Entity* | None

Get all active entities registered in the workspace.

find_group(*group_uid: uuid.UUID*) → *group.Group* | None

Find an existing and active Group object.

find_object(*object_uid: uuid.UUID*) → *object_base.ObjectBase* | None

Find an existing and active Object.

find_type(*type_uid: uuid.UUID*, *type_class: type[*EntityType*]*) → *EntityType* | None

Find an existing and active EntityType

Parameters
type_uid – Unique identifier of target type

property ga_version: str

`str` Version of Geoscience Analyst software.

property geoh5: File

Instance of h5py.File.

get_entity(*name: str | uuid.UUID*) → list[*Entity* | None]

Retrieve an entity from one of its identifier, either by name or `uuid.UUID`.

Parameters
name – Object identifier, either name or uuid.

Returns
List of entities with the same given name.

property groups: list[groups.Group]

Get all active Group entities registered in the workspace.

property h5file: str | Path | io.BytesIO

Str
Target *geoh5* file name with path.

property list_data_name: dict[uuid.UUID, str]

`dict` of `uuid.UUID` keys and name values for all registered Data.

property list_entities_name: dict[uuid.UUID, str]

Returns
`dict` of `uuid.UUID` keys and name values for all registered Entities.

property list_groups_name: dict[uuid.UUID, str]

`dict` of `uuid.UUID` keys and name values for all registered Groups.

property list_objects_name: dict[uuid.UUID, str]

`dict` of `uuid.UUID` keys and name values for all registered Objects.

load_entity(*uid: uuid.UUID*, *entity_type: str*, *parent:* Entity | *None = None*) → *Entity* | None

Recover an entity from geoh5.

Parameters

- **uid** – Unique identifier of entity
- **entity_type** – One of entity type 'group', 'object', 'data' or 'root'

Return entity
Entity loaded from geoh5

property name: str

`str` Name of the project.

property objects: list[objects.ObjectBase]

Get all active Object entities registered in the workspace.

open(*mode: str | None = None*) → *Workspace*

Open a geoh5 file and load the tree structure.

Parameters
mode – Optional mode of h5py.File. Defaults to 'r+'.

Returns
self

remove_children(*parent*, *children: list*)

Remove a list of entities from a parent. The target entities remain present on file.

remove_entity(*entity:* Entity)

Function to remove an entity and its children from the workspace.

remove_none_referents(*referents: dict[uuid.UUID, ReferenceType]*, *rtype: str*)

Search and remove deleted entities

remove_recursively(*entity:* Entity)

Delete an entity and its children from the workspace and geoh5 recursively

property repack: bool

Flag to repack the file after data deletion

property root: *Entity* | None

RootGroup entity.

save_entity(*entity:* Entity, *add_children: bool = True*) → None

Save or update an entity to geoh5.

Parameters

- **entity** – Entity to be written to geoh5.
- **add_children** – Add children entities to geoh5.
- **file** – `h5py.File` or name of the target geoh5

save_entity_type(*entity_type:* EntityType) → None

Save or update an entity_type to geoh5.

Parameters

entity_type – Entity to be written to geoh5.

static str_from_type(*entity*) → str | None

property types: list[*EntityType*]

Get all active entity types registered in the workspace.

update_attribute(*entity:* Entity | EntityType, *attribute: str*, *channel: str | None = None*, ***kwargs*) → None

Save or update an entity to geoh5.

Parameters

- **entity** – Entity to be written to geoh5.
- **attribute** – Name of the attribute to get updated to geoh5.
- **channel** – Optional channel argument for concatenated data and index.

property version: float

`float` Version of the geoh5 file format.

property workspace: *Workspace*

This workspace instance itself.

`geoh5py.workspace.workspace.`**active_workspace**(*workspace:* Workspace)

2.4 GEOH5 Format

2.4.1 Abou

The GEOH5 for- mat aims to

provide a robust means of handling large quantities of diverse data required in geoscience. The file structure builds on the generic qualities of the Geoscience ANALYST data model, and attempts to maintain a certain level of simplicity and consistency throughout. It is based entirely on free and open HDF5 technology. Given that this specification is public, the file format could, with further investment and involvement, become a useful exchange format for the broader geoscientific community.

Why GEOH5?

- **Leverages propertie**
  Fast I/O, compression, cross-platform
- **Content readable ar**
  We recom-

mend using HDFView, along with Geoscience ANALYST, when learning the format.

- **Easily extensible to**
  It is intended for Geoscience ANALYST to preserve data it does not understand (and generally be very tolerant with regards to miss-

ing information) when loading and saving geoh5 files. This will allow third parties to write to this format fairly easily, as well as include additional information not included in this spec for their own purposes. In the current implementation, Geoscience ANALYST automatically removes unnecessary information on save.

2.4.2 Defin

The following sections define the structure and components making up the GEOH5 file format.

Workspace

The bulk of the data is accessible both directly by

UUID through the flat HDF5 groups or through a **hierarchy of hard links** structured as follow:

Data
: Flat container for all data entities

Groups
: Flat container for all group entities

Objects
: Flat container for all object entities

Root
Optional hard link to `workspace` group, top of group hierarchy.

Types

- *Data Types*: Flat container for all data types
- *Group Types*: Flat container for all group types
- *Object Types*: Flat container for all object types

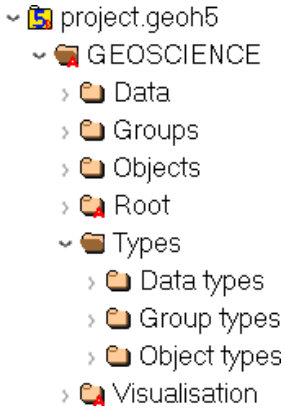
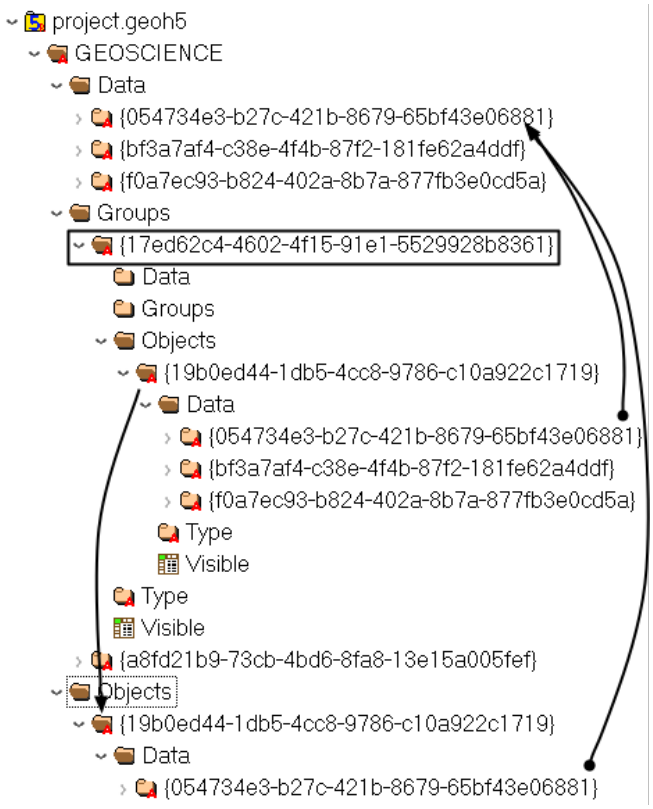


Fig. 2.1: As seen in HD-FView

While all groups, objects and data entities are written into their respective base folder, they also hold links to their children entities to allow for traversals. There is no data duplication, merely multiple references (pointers) to the data storage on file. Types are shared (and thus generally written to file first). All groups, objects and data must include a hard link to their type.



Attributes

Version
`double` Version of specification used by this file

Distance unit
`str` *feet* or (default) *metres* Distance unit of all data enclosed

Contributors
1D array of `str` (Optional) List of users who contributed to this workspace

Groups

Groups are simple container for other groups and objects. They are often used to assign special meanings to a collection of entities or to create specialized software functionality.

Attributes

Name
: `str` Name of the object displayed in the project tree.

ID
: `str`, *UUID* Unique identifier of the group.

Visible
: `int`, 0 or (default) 1 Set visible in the 3D camera (checked in the object tree).

Public
: `int`, 0 or (default) 1 Set accessible in the object tree and other parts of the the user interface.

Clipping IDs
: 1D array of *UUID* (Optional) List of unique identifiers of clipping plane objects.

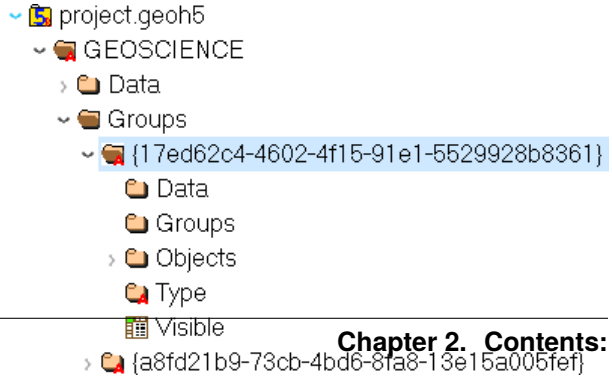
Allow delete
: `int`, 0 or (default) 1 (Optional) User interface allows deletion.

Allow move
: `int`, 0 or (default) 1 (Optional) User interface allows moving to another parent group.

Allow rename
: `int`, 0 or (default) 1 (Optional) User interface allows renaming.

Metadata
: (`int`, optional) (Optional) Any additional text attached to the group.

The following section describes the supported group types.



Group Types

To be further documented

Container

UUID : {61FBB4E8-A480-11E3-8D5A-2776BDF4F982}

Simple container with no special meaning. Default in Geoscience ANALYST.

Drillholes

UUID : {825424FB-C2C6-4FEA-9F2B-6CD00023D393}

Container restricted to containing drillhole objects, and which may provide convenience functionality for the drillholes within.

No Type (Root)

UUID : {dd99b610-be92-48c0-873c-5b5946ea2840}

The `Root` group defines the tree structure used in Geoscience ANALYST describing the parent-child relationships of entities. If absent, any Groups/Objects/Data will be brought into Geoscience ANALYST under the workspace group, still respecting any defined hierarchy links.

SimPEG

UUID : {55ed3daf-c192-4d4b-a439-60fa987fe2b8}

Container group for SimPEG inversions. Contains

Datasets

Metadata
: json formatted `string`

  Dictionary of inversion options.

options
: ui.json formatted `string`

  Dictionary holding the corresponding ui.json.

Tools

UUID : {a2befc38-3207-46aa-95a2-16b40117a5d8}

Group for slicer and label objects.

Not yet geoh5py implemented

To be further documented

Maxwell

UUID : {1c4122b2-8e7a-4ec3-8d6e-c818495adac7}

Group for Maxwell plate modeling application.

Not yet geoh5py implemented

To be further documented

GIFTools

GIFtools group containers

GIFtools Project

UUID : {585b3218-c24b-41fe-ad1f-24d5e6e8348a}

Not yet geoh5py implemented

To be documented

GIF Executables

UUID : {afae95ef-c2a7-4aec-9800-0d19bd2c2c07}

Not yet geoh5py implemented

To be documented

gzinv3d

UUID : {20eb4ff8-bdfe-43f3-8745-f418dcc9e14a}

Not yet geoh5py implemented

To be documented

gzfor3d

UUID : {a4857df0-d175-4824-ac5d-cecfdcc2f20b}

Not yet geoh5py implemented

To be documented

magfor3d

UUID : {6b8189ac-a479-4fe7-b4fc-92279aee5a41}

Not yet geoh5py implemented

To be documented

maginv3d

UUID : {b99e8db8-e118-4042-864e-9e1128f2d1e6}

Not yet geoh5py implemented

To be documented

mvifwd

UUID : {14c41f47-bcee-4a63-8192-fa42a1741052}

Not yet geoh5py implemented

To be documented

ggfor3d

UUID : {c8a8424d-ab12-482e-82ee-b198fcfd5859}

Not yet geoh5py implemented

To be documented

gginv3d

UUID : {0f080369-b3a3-464c-83fa-9b3c1efa9895}

Not yet geoh5py implemented

To be documented

mviinv

UUID : {9472b5cb-a285-4257-a2e8-68a3d33aa1f2}

Not yet geoh5py implemented

To be documented

octgrvde

UUID : {4e043415-a0ea-4cef-bf89-2771e27b346c}

Not yet geoh5py implemented

To be documented

octmagde

UUID : {f8217512-296d-4cc0-afcb-6c07a20581fe}

Not yet geoh5py implemented

To be documented

dcinv3d

UUID : {ae416ab8-0e72-4f37-8873-5cc0909433bb}

Not yet geoh5py implemented

To be documented

ipinv3d

UUID : {9f9543a0-e857-4a56-ab66-9f21e2b002c6}

Not yet geoh5py implemented

To be documented

e3dmt

UUID : {8cf239e3-63a6-4813-adf8-9714293b602e}

Not yet geoh5py implemented

To be documented

dcoctree_inv

UUID : {54d296de-0588-472c-9a62-480098303394}

Not yet geoh5py implemented

To be documented

dcoctree_fwd

UUID : {A522D641-6CB7-421B-836B-A14C0D9C7801}

Not yet geoh5py implemented

To be documented

ipoctree_inv

UUID : {d9fd455e-ea94-40f5-9d86-e7c49c7b5005}

Not yet geoh5py implemented

To be documented

dcipf3d

UUID : {59b5338d-596c-4049-9aa4-6979700e00ff}

Not yet geoh5py implemented

To be documented

Geoscience INTEGRATOR Groups

Geoscience INTEGRATOR

UUID : {61449477-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Project

UUID : {56f6f03e-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Query Group

UUID : {85756113-592a-4088-b374-f32c8fac37a2}

Not yet geoh5py implemented

To be documented

Neighbourhoods

UUID : {2a5b7faa-41d1-4437-afac-934933eae6eb}

Not yet geoh5py implemented

To be documented

Map File Group

UUID : {1f684938-2baf-4a01-ac71-e50c30cc0685}

Not yet geoh5py implemented

To be documented

Maps Group

UUID : {4d65f8c3-a015-4c01-b411-412c0f4f0884}

Not yet geoh5py implemented

To be documented

Airborne

UUID : {812f3b2a-fdae-4752-8391-3b657953a983}

Not yet geoh5py implemented

To be documented

Ground

UUID : {a9d05630-7a80-4bda-89a2-feca0dc7a83e}

Not yet geoh5py implemented

To be documented

Borehole

UUID : {f6f011a9-2e52-4f99-b842-a524ad9fdf03}

Not yet geoh5py implemented

To be documented

Geoscience INTEGRATOR Themes

Data

UUID : {51fdf764-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Interpretation

UUID : {05e96011-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Microseismic

UUID : {2bddbaaf-3829-11e4-8654-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Ground Deformation

UUID : {7ade974c-3829-11e4-9cce-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Production Area

UUID : {55ccb6d9-016c-47cd-824f-077214dc44db}

Not yet geoh5py implemented

To be documented

Blasting

UUID : {e2040afa-3829-11e4-a70e-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Stress

UUID : {460e31c8-3829-11e4-a70e-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Drillholes and Wells

UUID : {5d9b6a8c-3829-11e4-93fc-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Mobile Equipment

UUID : {e7f63d21-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Fixed Plant

UUID : {fad14ac4-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Earth Model Points

UUID : {fcd708da-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Earth Model Regular 3D Grids

UUID : {79b41607-ffa2-4825-a270-44dd48807a03}

Not yet geoh5py implemented

To be documented

Observation Points

UUID : {f65e521c-a763-427b-97bf-d0b4e5689e0d}

Not yet geoh5py implemented

To be documented

Targets & Anomalies

UUID : {e41c2308-0f35-47dd-8562-d0fd354406f8}

Not yet geoh5py implemented

To be documented

Targets

UUID : {af0925ba-3dc5-4fe6-ab35-9e0ef568023f}

Not yet geoh5py implemented

To be documented

Anomalies

UUID : {51bcc3e9-1d66-4c83-847e-5c852fc9de58}

Not yet geoh5py implemented

To be documented

Fusion Model

UUID : {3d69be5b-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Deformation

UUID : {5caf35fa-3d0e-11e4-939f-f5f83219c4e0}

Not yet geoh5py implemented

To be documented

Mine Production

UUID : {7508bc11-3829-11e4-9cce-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Earth Models

UUID : {adee3b2a-3829-11e4-a70e-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Mine Models

UUID : {e53a8b3e-3829-11e4-a70e-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Samples

UUID : {1cde9996-cda7-40f0-8c20-faeb4e926748}

Not yet geoh5py implemented

To be documented

Geochemistry & Mineralogy

UUID : {ed00094f-3da1-485f-8c4e-b52f6f171ea4}

Not yet geoh5py implemented

To be documented

Rock Properties

UUID : {cbeb3920-a1a9-46f8-ab2b-7dfdf79c8a00}

Not yet geoh5py implemented

To be documented

Incidents

UUID : {136cb431-c7d2-4992-a5ab-46a6e16b6726}

Not yet geoh5py implemented

To be documented

Mine Infrastructure

UUID : {cff33bb0-ef43-4b06-8070-266940ab9d06}

Not yet geoh5py implemented

To be documented

3D Structural Surfaces

UUID : {a246f9e0-2b67-4efd-bd3d-742bfe06178b}

Not yet geoh5py implemented

To be documented

3D Domains

UUID : {f69979b0-5ba1-417a-93d4-778146049014}

Not yet geoh5py implemented

To be documented

3D Geological Contact Surfaces

UUID : {0bf96ee1-7fa4-41a2-bc8a-7cd76426ba18}

Not yet geoh5py implemented

To be documented

Remote Sensing and Air Pohotos

UUID : {386f2c57-1893-40bb-bd1c-95552b90e514}

Not yet geoh5py implemented

To be documented

Inversions

UUID : {7a7b14af-23d9-4897-9cdb-8d586fefa025}

Not yet geoh5py implemented

To be documented

Topography

UUID : {c162ddd2-a9de-4dac-b6a2-3cc6e011d7c3}

Not yet geoh5py implemented

To be documented

Culture

UUID : {dd51ca09-34d7-4c30-a0d0-ef9e61ea5e9d}

Not yet geoh5py implemented

To be documented

Claims, boundaries

UUID : {6e430b33-4ab8-45c1-896d-c47525185ce0}

Not yet geoh5py implemented

To be documented

Ventilation

UUID : {d049e5a0-aadb-4448-a0f1-fe560c6d26f9}

Not yet geoh5py implemented

To be documented

Gas Monitoring

UUID : {bc8540b0-d814-46ac-b897-b5a528d5d1d6}

Not yet geoh5py implemented

To be documented

Ventilation & Gas Monitoring

UUID : {8ebd9b52-801e-4461-b7e6-e1aa0a8742b3}

Not yet geoh5py implemented

To be documented

Other

UUID : {79b61598-7385-4b63-8513-636ecde9c150}

Not yet geoh5py implemented

To be documented

Airborne

UUID : {3d0e8578-7764-48cf-8db8-6c83d6411762}

Not yet geoh5py implemented

To be documented

Ground

UUID : {47d6f059-b56a-46c7-8fc7-a0ded87360c3}

Not yet geoh5py implemented

To be documented

Integrator Borehole

UUID : {9c69ef80-b45c-4f5c-ac55-996a99dc299f}

Not yet geoh5py implemented

To be documented

Geophysics

UUID : {151778d9-6cc0-4e72-ba08-2a80a4fb967f}

Not yet geoh5py implemented

To be documented

Geotechnical

UUID : {391a616b-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Equipment

UUID : {8beac9ff-3829-11e4-8654-fcddabfddab1}

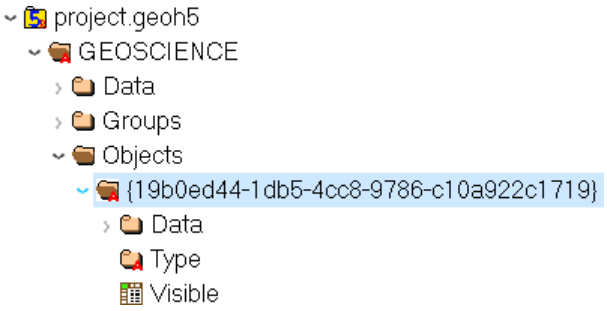
Not yet geoh5py implemented

To be documented

Note: Though this file format technically allows objects/groups to appear within multiple groups simultaneously (overlapping lists), this is not currently supported by `Geoscience ANALYST`.

Objects

Objects are containers for `Data` with spatial information. Most (not all) object geometry is described in terms of vertices (3D locations) and cells (groupings of vertices such as triangles or segments). The exact requirements and interpretation depends on the type.



Attributes

Name
: `str` Name of the object displayed in the project tree.

ID
: `str` Unique identifier (*UUID*) of the group.

Visible
: `int`, 0 or (default) 1 Set visible in the 3D camera (checked in the object tree).

Public
: `int`, 0 or (default) 1 Set accessible in the object tree and other parts of the the user interface.

Clipping IDs
1D array of `UUID` (Optional) List of unique identifiers of clipping plane objects.

Allow delete
`int`, 0 or (default) 1 (Optional) User interface allows deletion.

Allow move
`int`, 0 or (default) 1 (Optional) User interface allows moving to another parent group.

Allow rename
`int`, 0 or (default) 1 (Optional) User interface allows renaming.

Metadata
(`int`, optional) (Optional) Any additional text attached to the group.

The following section describes the supported object types and their specific attributes.

ANALYST Objects

Entities with spatial information used to store data.

Points

UUID : {202C5DB1-A56D-4004-9CAD-BAAFD8899406}

3-D scatter points object defined by vertices with fixed coordinates in Cartesian system (x, y and z).

Datasets

Vertices
1D composite array

[x `double`, y `double`, z `double`]

Curve

UUID : {6A057FDC-B355-11E3-95BE-FD84A7FFCB88}

Polyline object defined by a series of line segments (cells) connecting vertices. Data can be associated to either the vertices or cells.

Attributes

Current line property ID
`str`, *UUID*

Unique identifier of a reference data for naming of curve parts.

Datasets

Cells
Array of `int32`, shape(N, 2)

Array defining the connection (line segment) between pairs of vertices.

Surface

UUID : {F26FEBA3-ADED-494B-B9E9-B2BBCBE298E1}

Triangulated mesh object defined by cells (triangles) and vertices.

Datasets

Cells
Array of `int32`, shape(N, 3)

Array defining the connection between triplets of vertices, representing triangles.

Block model

UUID : {B020A277-90E2-4CD7-84D6-612EE3F25051}

Rectilinear grid of cells defined along three orthogonal axes (U,V and Z) of length nU, nV and nZ respectively. The conversion between the array coordinates of a cell to a 1-D vector index can be calculated from

```
cell index = k + i*nZ + j*nU*nZ
```

Without rotation angles, U points eastwards, V points northwards, and Z points upwards. Since their geometry is defined entirely by the additional data described below, block models do not require a `Vertices` or `Cells` dataset.

Datasets

U cell delimiters
array of `double`, shape(nU,)

Distances of cell edges from origin along the U axis (first value should be 0)

V cell delimiters
array of `double`, shape(nV,)

Distances of cell edges from origin along the V axis (first value should be 0)

Z cell delimiters
array of `double`, shape(nZ,)

Distances of cell edges from origin upwards along the vertical axis (first value should be 0)

Attributes

Origin
composite type

[*X* `double`, *Y* `double`, *Z* `double`]

Origin point of grid

Rotation
`double` (default) 0 Counterclockwise angle (degrees) of rotation around the vertical axis in degrees.

2D Grid

UUID : {48f5054a-1c5c-4ca4-9048-80f36dc60a06}

Rectilinear grid of cells defined along two orthogonal axes (U and V) of length nU and nV. The conversion between the grid coordinates of a cell to its 1-D vector index can be calculated from

```
cell index = i + j*nU
```

Without rotation angles, U points eastwards and V points northwards. Since their geometry is defined entirely by the additional data described below, 2D grids do not require a Vertices or Cells dataset.

Attributes

Origin
composite type

[*X* `double`, *Y* `double`, *Z* `double`]

Origin point of the grid.

U Size
`double` Length of U axis

U Count
`double` Number of cells along U axis

V Size
`double` Length of V axis

V Count
`double` Number of cells along V axis

Rotation
`double` (Optional) Counterclockwise angle (degrees) of rotation around the vertical axis at the Origin.

Vertical
`char`, 0(false, default) or 1(true)) (Optiona) If true, V axis is vertical (and rotation defined around the V axis)

Drillhole

UUID : {7CAEBF0E-D16E-11E3-BC69-E4632694AA37}

Object representing boreholes defined by a collar location and survey parameters. Vertices represent points along the drillhole path (support for data rather than the drillhole geometry itself) and must have a `Depth` property value. Cells contain two vertices and represent intervals along the drillhole path (and are a support for interval data as well). Cells may overlap with each other to accommodate the different sampling intervals of various data.

Attributes

Collar
composite type, shape(3,)

[*X* `double`, *Y* `double`, *Z* `double`]

Collar location

Datasets

Surveys
composite array, shape(3,)

[*Depth* `double`, *Dip* `double`, *Azimuth* `double`]

Survey locations

Trace
1D composite array

[*X* `double`, *Y* `double`, *Z* `double`]

Points forming the drillhole path from collar to end of hole. Must contain at least two points.

Geoimage

UUID : {77AC043C-FE8D-4D14-8167-75E300FB835A}

Not yet geoh5py implemented

To be further documented

Vertices represent the four corners of the geolocated image. No cell data. An object-associated file-type data containing the image to display is expected to exist under this object.

Note: Should be arranged as a rectangle currently, since Geoscience ANALYST does not currently support skewed images.

Label

UUID : {E79F449D-74E3-4598-9C9C-351A28B8B69E}

Not yet geoh5py implemented

To be further documented

Has no vertices nor cell data

Attributes

Target position
composite type, shape(3,)

[*X* `double`, *Y* `double`, *Z* `double`]

The target location of the label

Label position
composite type, shape(3,)

[*X* `double`, *Y* `double`, *Z* `double`] (Optional - Defaults to same as target position) The location where the text of the label is displayed

Slicer

UUID : {238f961d-ae63-43de-ab64-e1a079271cf5}

Not yet geoh5py implemented

To be further documented

Target

UUID : {46991a5c-0d3f-4c71-8661-354558349282}

Not yet geoh5py implemented

To be further documented

ioGAS Points

UUID : {d133341e-a274-40e7-a8c1-8d32fb7f7eaf}

Not yet geoh5py implemented

To be further documented

Maxwell Plate

UUID : {878684e5-01bc-47f1-8c67-943b57d2e694}

Not yet geoh5py implemented

To be further documented

Octree

UUID : {4ea87376-3ece-438b-bf12-3479733ded46}

Semi-structured grid that stores cells in a tree structure with eight octants.

Datasets

Octree Cells
composite type, shape(N, 4)

[*I* `integer`, *J* `integer`, *K* `integer`, *NCells* `integer`]

Array defining the position (I, J, K) and size (NCells) of every cell within the base octree grid.

Attributes

NU
`integer` Number of base cells along the U-axis.

NV
`integer` Number of base cells along the V-axis.

NW
`integer` Number of base cells along the W-axis.

Origin
composite type, shape(3,)

[*X* `double`, *Y* `double`, *Z* `double`]

Origin point of the grid.

Rotation
`double` (default) 0 Counterclockwise angle (degrees) of rotation around the vertical axis in degrees.

U Cell Size
`double` Base cell dimension along the U-axis.

V Cell Size
`double` Base cell dimension along the V-axis.

W Cell Size
`double` Base cell dimension along the W-axis.

Text Object

UUID : {c00905d1-bc3b-4d12-9f93-07fcf1450270}

Not yet geoh5py implemented

To be further documented

Potential Electrode

UUID : {275ecee9-9c24-4378-bf94-65f3c5fbe163}

Curve object representing the receiver electrodes of a direct-current resistivity survey.

Datasets

Metadata
: json formatted `string`

Dictionary defining the link between the source and receiver objects.

- "Current Electrodes" `uuid`: Identifier for the linked *Current Electrode*
- "Potential Electrodes" `uuid`: Identifier for the linked *Potential Electrode*

Requirements

A-B Cell ID
: Data entity

Reference data named "A-B Cell ID" with `association=CELL` expected. The values define the source dipole (cell) from the *Current Electrode* to every potential measurement.

Current Electrode

UUID : {9b08bb5a-300c-48fe-9007-d206f971ea92}

Curve object representing the transmitter electrodes of a direct-current resistivity survey.

Datasets

Metadata
: json formatted `string`

Dictionary defining the link between the source and receiver objects. Same definition as the *Potential Electrode* object.

Requirements

A-B Cell ID
Data entity

Reference data named "A-B Cell ID" with `association=CELL` defining a unique identifier to every unique dipole sources. For "pole" sources, the `cell` attribute references twice to the same vertex.

VP Model

UUID : {7d37f28f-f379-4006-984e-043db439ee95}

Not yet geoh5py implemented

To be further documented

Airborne EM

UUID : {fdf7d01e-97ab-43f7-8f2c-b99cc10d8411}

Not yet geoh5py implemented

To be further documented

Airborne TEM Rx

UUID : {19730589-fd28-4649-9de0-ad47249d9aba}

Curve object representing an array of time-domain electromagnetic receiver dipoles.

Attributes

Target position
composite type

Datasets

Metadata
json formatted `string`

Dictionary of survey parameters shared with the *Transmitters*. The following items are core parameters stored under the "EM Dataset" key.

- **"Channels": `list` of `double`**
  Time channels at which data are recorder.
- **"Input type": `string`**
  Type of survey from "Rx", "Tx" or "Tx and Rx"
- **"Loop radius": `double`**
  Transmitter loop radius.
- **"Property groups": `list` of `uuid`**
  Reference to property groups containing data at every channel.

- **"Receivers"**: `uuid`
  Unique identifier referencing to itself.
- **"Survey type"**: `string`
  Defaults to "Airborne TEM".
- **"Transmitters"**: `uuid`
  Unique identifier referencing to the linked transmitters entity.
- **"Unit"**: `string`
  Sampling units, must be one of "Seconds (s)", "Milliseconds (ms)", "Microseconds (us)" or "Nanoseconds (ns)".
- **"Crossline offset property" `uuid` OR "Crossline offset value" `double`:**
  Offline offset between the receivers and transmitters, either defined locally on vertices as a `property` OR globally as a constant `value`.
- **"Inline offset property" `uuid` OR "Crossline offset value" `double`:**
  Inline offset between the receivers and transmitters, either defined locally on vertices as a `property` OR globally as a constant `value`.
- **"Inline offset property" `uuid` OR "Crossline offset value" `double`:**
  Vertical offset between the receivers and transmitters, either defined locally on vertices as a `property` OR globally as a constant `value`.
- **"Yaw property" `uuid` OR "Yaw value" `double`:**
  Rotation (angle) of the transmitter loop as measured on the UV-plane (+ clockwise), either defined locally on vertices as a `property` OR globally as a constant `value`.
- **"Pitch property" `uuid` OR "Pitch value" `double`:**
  Tilt angle of the transmitter loop as measured on the VW-plane (+ nose up), either defined locally on vertices as a `property` OR globally as a constant `value`.
- **"Roll property" `uuid` OR "Roll value" `double`:**
  Banking angle of the transmitter loop as measured on the UW-plane (+ right-wing down), either defined locally on vertices as a `property` OR globally as a constant `value`.
- **"Waveform" `dict`:**
  - **"Discretization" array of `double`, shape(N, 2):**
    Array of times and normalized currents (Amp) describing the source impulse over a discrete interval (e.g. [[t_1, c_1], [t_2, c_2], ..., [t_N, c_N]])
  - **"Timing mark" `double`:**
    Reference timing mark measured from the beginning of the "Discretization". Generally used as the reference (t_i=0.0) for the provided data channels: (-) on-time an (+) off-time.

Airborne TEM Tx

UUID : {58c4849f-41e2-4e09-b69b-01cf4286cded}

Curve object representing an array of time-domain electromagnetic transmitter loops.

Datasets

Metadata
: json formatted `string`

  See definition from the *Airborne TEM Rx* object. The "Transmitters" `uuid` value should point to itself, while the "Receivers" `uuid` refers the linked *Airborne TEM Rx* object.

Airborne FEM Rx

UUID : {b3a47539-0301-4b27-922e-1dde9d882c60}

Not yet geoh5py implemented

To be further documented

Airborne FEM Tx

UUID : {a006cf3e-e24a-4c02-b904-2e57b9b5916d}

Not yet geoh5py implemented

To be further documented

Airborne Gravity

UUID : {b54f6be6-0eb5-4a4e-887a-ba9d276f9a83}

Not yet geoh5py implemented

To be further documented

Airborne Magnetics

UUID : {4b99204c-d133-4579-a916-a9c8b98cfccb}

Not yet geoh5py implemented

To be further documented

Ground Gravity

UUID : {5ffa3816-358d-4cdd-9b7d-e1f7f5543e05}

Not yet geoh5py implemented

To be further documented

Ground Magnetics

UUID : {028e4905-cc97-4dab-b1bf-d76f58b501b5}

Not yet geoh5py implemented

To be further documented

Ground Gradient IP

UUID : {68b16515-f424-47cd-bb1a-a277bf7a0a4d}

Not yet geoh5py implemented

To be further documented

Ground EM

UUID : {09f1212f-2bdd-4dea-8bbd-f66b1030dfcd}

Not yet geoh5py implemented

To be further documented

Ground TEM Rx

UUID : {41018a45-01a0-4c61-a7cb-9f32d8159df4}

Not yet geoh5py implemented

To be further documented

Ground TEM Tx

UUID : {98a96d44-6144-4adb-afbe-0d5e757c9dfc}

Not yet geoh5py implemented

To be further documented

Ground TEM Rx (large-loop)

UUID : {deebe11a-b57b-4a03-99d6-8f27b25eb2a8}

Not yet geoh5py implemented

To be further documented

Ground TEM Tx (large-loop)

UUID : {17dbbfbb-3ee4-461c-9f1d-1755144aac90}

Not yet geoh5py implemented

To be further documented

Ground FEM Rx

UUID : {a81c6b0a-f290-4bc8-b72d-60e59964bfe8}

Not yet geoh5py implemented

To be further documented

Ground FEM Tx

UUID : {f59d5a1c-5e63-4297-b5bc-43898cb4f5f8}

Not yet geoh5py implemented

To be further documented

Magnetotellurics

UUID : {b99bd6e5-4fe1-45a5-bd2f-75fc31f91b38}

Points object representing a magnetotelluric survey.

Metadata
: json formatted `string`

  Dictionary of survey parameters. The following items are core parameters stored under the "EM Dataset" key.

  - **"Channels": `list of double`**
    Frequency channels at which data are recorder.
  - **"Input type": `string`**
    Static field set to "Rx only"
  - **"Property groups": `list of uuid`**
    Reference to property groups containing data at every channel.
  - **"Receivers": `uuid`**
    Reference to itself.
  - **"Survey type": `string`**
    Static field set to "Magnetotellurics"
  - **"Unit": `string`**
    Sampling units, must be one of "Hertz (Hz)", "KiloHertz (kHz)", "MegaHertz (MHz)" or "Gigahertz (GHz)".

Tipper Rx

UUID : {0b639533-f35b-44d8-92a8-f70ecff3fd26}

Curve object representing a tipper survey.

Metadata
json formatted `string`

Dictionary of survey parameters. The following items are core parameters stored under the "EM Dataset" key.

- **"Channels": `list` of `double`**
  Frequency channels at which data are recorder.
- **"Input type": `string`**
  Static field set to "Rx and base stations"
- **"Property groups": `list` of `uuid`**
  Reference to property groups containing data at every channel.
- **"Receivers": `uuid`**
  Reference to itself.
- **"Base stations: `uuid`**
  Reference to *Tipper Base stations*
- **"Survey type": `string`**
  Static field set to "Magnetotellurics"
- **"Unit": `string`**
  Sampling units, must be one of "Hertz (Hz)", "KiloHertz (kHz)", "MegaHertz (MHz)" or "Gigahertz (GHz)".

Tipper Base stations

UUID : {f495cd13-f09b-4a97-9212-2ea392aeb375}

Points object representing a tipper survey.

Metadata
json formatted `string`

See definition from the *Tipper Rx* object. The "Base stations" `uuid` value should point to itself, while the "Receivers" `uuid` refers the linked *Tipper Rx* object.

Geoscience INTEGRATOR Objects

List object types specific to INTEGRATOR.

Points

UUID : {6832acf3-78aa-44d3-8506-9574a3510c44}

Not yet geoh5py implemented

To be documented

Microseismic

UUID : {b1388138-5463-11e4-93e8-d3b5f5e17625}

Not yet geoh5py implemented

To be documented

Ground Deformation

UUID : {65a66246-59f7-11e4-aa15-123b93f75cba}

Not yet geoh5py implemented

To be documented

Production Area

UUID : {fc560104-9898-4dbf-9711-07519eb1fc84}

Not yet geoh5py implemented

To be documented

Fixed Plant

UUID : {2dda99b0-9980-4f25-820c-01eb7053b42d}

Not yet geoh5py implemented

To be documented

Blasting

UUID : {20cfa317-e98c-4612-9016-414fb1d9375d}

Not yet geoh5py implemented

To be documented

Mobile Equipment

UUID : {53108442-1664-41ed-99ea-ff4dd273e86c}

Not yet geoh5py implemented

To be documented

Stress

UUID : {60ce697d-59f7-42e0-bb58-88374f1d303a}

Not yet geoh5py implemented

To be documented

Earth Model

UUID : {c4268ef8-6b55-11e4-ab63-ca5fbc5c6e8b}

Not yet geoh5py implemented

To be documented

Mine Model

UUID : {ffd1ae8a-70bc-11e4-bf08-53db6953e95a}

Not yet geoh5py implemented

To be documented

Incidents

UUID : {aca8b138-634e-444c-8698-697b91f4cff9}

Not yet geoh5py implemented

To be documented

Mine infrastructures

UUID : {d15ef4a2-6fc4-40c9-ab3e-11647a81dbe1}

Not yet geoh5py implemented

To be documented

3D Structural Surfaces

UUID : {a69aca26-79d8-4074-bd58-dc2202674071}

Not yet geoh5py implemented

To be documented

3D Domains

UUID : {3ecb7f52-b32c-470d-b2f5-c8b0c2b6dff4}

Not yet geoh5py implemented

To be documented

3D Geological Contact Surfaces

UUID : {46d697f1-50a4-4905-a467-04d5c1e7634c}

Not yet geoh5py implemented

To be documented

Remote Sensing and Air Photos

UUID : {b952c7c5-b636-4f6d-9a59-0cbacd84a332}

Not yet geoh5py implemented

To be documented

Inversions

UUID : {b062ffb4-c57d-49a3-9e96-fa26e7b06e7e}

Not yet geoh5py implemented

To be documented

Topography

UUID : {849635b9-1362-40f1-9edd-f45039ff89ac}

Not yet geoh5py implemented

To be documented

Culture

UUID : {849635b9-1362-40f1-9edd-f45039ff89ac}

Not yet geoh5py implemented

To be documented

Claims, boundaries

UUID : {849635b9-1362-40f1-9edd-f45039ff89ac}

Not yet geoh5py implemented

To be documented

Geophysics

UUID : {80413650-58f0-4c99-94af-48f70affbb65}

Not yet geoh5py implemented

To be documented

Ventilation

UUID : {1cc34f3d-fc50-41d9-8210-d93a73b2c7b4}

Not yet geoh5py implemented

To be documented

Gas Monitoring

UUID : {27e44723-9787-48be-9b0e-67f14d60890b}

Not yet geoh5py implemented

To be documented

Other

UUID : {4ed901bb-0303-43cd-9618-a481f5688844}

Not yet geoh5py implemented

To be documented

Airborne

UUID : {c9f70e63-a30f-428b-bee2-02eed5dde43d}

Not yet geoh5py implemented

To be documented

Ground

UUID : {d9f91038-c7a1-4b72-b3f1-ac7760da16ac}

Not yet geoh5py implemented

To be documented

Borehole

UUID : {0bf977b4-bda8-45d7-9c89-9a41d50849bd}

Not yet geoh5py implemented

To be documented

Neighbourhood Surface

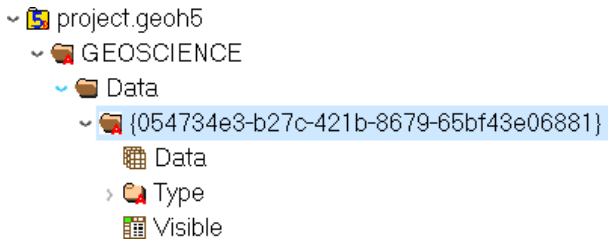
UUID : {88087fb8-76ae-445b-9cdf-68dbce530404}

Not yet geoh5py implemented

To be documented

Data

Containers for data values of various types. Data are currently **always stored as a 1D array**, even in the case of single-value data with the `Object` association (in which case it is a 1D array of length 1). See the *Data Types* section for the list of supported data types.



Attributes

Association
: `str` Describes which part the property is tied to. Must be one of: *Unknown*, *Object*, *Cell*, *Vertex*, *Face* or *Group*

Name
: `str` Name of the data displayed in the project tree.

ID
: `str` Unique identifier (*UUID*) of the group.

Visible
`int`, 0 or 1 (Optional) Set visible in the 3D camera (checked in the object tree).

Clipping IDs
1D array of `UUID` (Optional) List of unique identifiers of clipping plane objects.

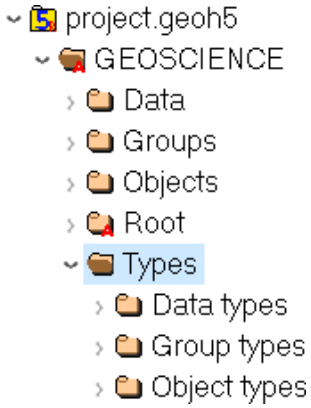
Allow delete
`int`, 0 or (default) 1 (Optional) User interface allows deletion.

Allow rename
`int`, 0 or (default) 1 (Optional) User interface allows renaming.

Public
`int`, 0 or (default) 1 (Optional) Set accessible in the object tree and other parts of the the user interface.

Types

While they are structured similarly, **each group, object or set of data has a type that defines how its HDF5 datasets should be interpreted**. This type is shared among any number of entities (groups/objects/data sets).



Group Types

Attributes

Name
`str` Name of the group displayed in the project tree.

ID
`str` Unique identifier (*UUID*) of the group type.

Description
`str` (Optional) Description of the type.

Allow move contents
`int`, 0 or (default) 1 (Optional) User interface allows deletion of the content.

Allow delete contents
`int`, 0 or (default) 1 (Optional) User interface allows deletion of the content.

Object Types

Objects are containers for data values with spatial information.

Attributes

Name
`str` Name of the object displayed in the project tree.

ID
`str` Unique identifier (*UUID*) of the group type.

Description
`str` (Optional) Description of the type.

Data Types

New data types can be created at will by software or users to describe object or group properties. Data of the same type can exist on any number of objects or groups of any type, and each instance can be associated with vertices, cells or the object/group itself. Some data type identifiers can also be reserved as a means of identifying a specific kind of data.

Attributes

Name
`str` Name of the object displayed in the project tree.

ID
`str` Unique identifier (*UUID*) of the data type.

Unlike `Groups` and `Objects`, `Data` entities do not generally have fixed identifier `Type`. Multiple data entities linked by a type will share common properties (color map, units, etc.). Exceptions to this rule are the fixed:

Geoscience INTEGRATOR Data Set

Microseismic

UUID : {9f9cfec8-3829-11e4-8654-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Ground Deformation

UUID : {c455c010-3829-11e4-9cce-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Production Area

UUID : {a8c95123-349f-4461-b9a4-74f76e659a56}

Not yet geoh5py implemented

To be documented

Blasting

UUID : {f55d8ae4-3829-11e4-a70e-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Stress

UUID : {f8324cdc-3829-11e4-a70e-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Fixed Plant

UUID : {31fc7ef1-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Mobile Equipment

UUID : {75eafc96-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Drillholes & Wells

UUID : {faf65f94-3829-11e4-93fc-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Earth Model Points

UUID : {f38a481f-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Earth Model Regular Grid

UUID : {f1a5e5a6-e651-40dc-b184-7827e792ffb3}

Not yet geoh5py implemented

To be documented

Observation Points

UUID : {d89f963d-16ba-4c6b-87d7-9b95410ab2fb}

Not yet geoh5py implemented

To be documented

Targets

UUID : {528e278e-529c-4d95-b8d1-731cf6ae6b5f}

Not yet geoh5py implemented

To be documented

Anomalies

UUID : {b83ac7a5-5217-4ff1-b0bc-2e8d514655ae}

Not yet geoh5py implemented

To be documented

Fusion Model

UUID : {bc99c8a9-3833-11e4-a7fb-fcddabfddab1}

Not yet geoh5py implemented

To be documented

Samples

UUID : {433ab253-1a73-4414-9159-031cdbf7a9e1}

Not yet geoh5py implemented

To be documented

Geochemistry & Mineralogy

UUID : {72f29283-a4f6-4fc0-a1a8-1417ce5fcbec}

Not yet geoh5py implemented

To be documented

Rock Properties

UUID : {4a067ffb-9d20-46b7-8bd8-a6dde20e8b89}

Not yet geoh5py implemented

To be documented

Incidents

UUID : {016dfd26-7d9b-49a6-97d8-cb31c37e404b}

Not yet geoh5py implemented

To be documented

Mine Infrastructure

UUID : {5e34fb33-86ec-49bb-a3d4-5b21fb158a14}

Not yet geoh5py implemented

To be documented

3D Structural Surfaces

UUID : {0a7fef75-26ba-4e80-9d38-89a76044f908}

Not yet geoh5py implemented

To be documented

3D Domains

UUID : {97909249-8584-40d5-9378-a1fb5b86a3ab}

Not yet geoh5py implemented

To be documented

3D Geological Contact Surfaces

UUID : {c63403e2-b635-4b23-998b-1748fe503f81}

Not yet geoh5py implemented

To be documented

Remote Sensing & Air Photos

UUID : {db53c93a-c57a-4911-92f2-9d0c811268b8}

Not yet geoh5py implemented

To be documented

Inversions

UUID : {57a84d8d-6a33-4dfa-a9f2-66b32e495c7f}

Not yet geoh5py implemented

To be documented

Topography

UUID : {5923bd49-6302-4f8b-963a-cba57ac757ae}

Not yet geoh5py implemented

To be documented

Culture

UUID : {bbccf928-d410-4d59-b737-4b4c1f8c84ca}

Not yet geoh5py implemented

To be documented

Claims, boundaries

UUID : {1bcba5c4-c33a-4682-ac47-88694ca67905}

Not yet geoh5py implemented

To be documented

Geophysics

UUID : {9b097cc1-66cb-4088-83dd-c447cba542df}

Not yet geoh5py implemented

To be documented

Ventilation

UUID : {b716d06a-8104-4086-a029-b10d1a545b49}

Not yet geoh5py implemented

To be documented

Gas Monitoring

UUID : {844354fa-41ae-416c-b33f-bf5bfbedc8f5}

Not yet geoh5py implemented

To be documented

Other

UUID : {7bebe936-2e04-4bd6-b050-b128ec5c078d}

Not yet geoh5py implemented

To be documented

Primitive type

`str`

Specifies the kind of data values stored as `HDF5 dataset`. Must be one of:

Primitive Types

To be further documented

Float

- Stored as a 1D array of 32-bit float type
- No data value: 1.175494351e-38 (FLT_MIN, considering use of NaN)

Integer

- Stored as a 1D array of 32-bit integer type
- No data value: –2147483648 (INT_MIN, considering use of NaN)

Text

- Stored as a 1D array of UTF-8 encoded, variable-length string type
- No data value : empty string

Referenced

- Stored as a 1D array of 32-bit unsigned integer type (native)
- Value map : (1D composite type array dataset - Key (unsigned int), Value (variable-length utf8 string)) must exist under type
- No data value : 0 (key is tied to value "Unknown")

DateTime

- Stored as a 1D array of variable-length strings formatted according to the ISO 8601 extended specification for representations of UTC dates and times (Qt implementation), taking the form YYYY-MM-DDTHH:mm:ss[Z|[+|-]HH:mm]
- No data value : empty string

Filename

- Stored as a 1D array of UTF-8 encoded, variable-length string type designating a file name
- For each file name within "Data", an opaque dataset named after the filename must be added under the Data instance, containing a complete binary dump of the file
- Different files (under the same object/group) must be saved under different names
- No data value : empty string

Blob

- Stored as a 1D array of 8-bit char type (native) (value '0' or '1')
- For each index set to 1, an opaque dataset named after the index (e.g. "1", "2", etc) must be added under the Data instance, containing the binary data tied to that index
- No data value : 0

Description
`str` (Optional) Description of the type.

Units
`str` (Optional) Data units

Color map
1D compound array

[*Value* `double`, *Red* `uint`, *Green* `uint`, *Blue* `uint`, *Alpha* `uint`]

(Optional) Records colors assigned to value ranges. The *Value* mark the start of the range)

Value map
(1D compound array dataset)

[*Key* `uint`, *Value* `str`]

Required only for reference data types (classifications)

Transparent no data
`int`, 0 or (default) 1 (Optional) Whether or not absence of data/filtered data should be hidden in the viewport.

Hidden
`int`, 0 or (default) 1 (Optional) Whether or not the data type should appear in the data type list.

Scientific notation
`int`, 0 or (default) 1 (Optional) Whether or not the data values of this type should be displayed in scientific notation.

Precision
`int` (Optional) The number of decimals (or significant digits in case of scientific notation) used when displayed data values of this type.

Number of bins
`int`, default=50 (Optional) Number of bins used when displaying histogram

Duplicate type on copy
`int`, 0 or (default) 1 (Optional) When enabled, a separate copy of this data type will be created and used when data of this type is copied.

2.4.3 Standards

General notes on formatting.

- All text data and attributes are variable-length and use UTF-8 encoding
- All numeric data uses INTEL PC native types
- Boolean values are stored using char (0:false, 1:true)
- Anything found in a geoh5 v1.0 file which is not mentioned in this document is optional information

2.4.4 External Links

- HDFView.
- Precompiled binaries for multiple platforms
- **Libraries for accessing HDF5 data**
  - C, C, .NET
  - Python
  - Matlab

2.5 UI.JSON Format

2.5.1 About

The **ui.json** format provides a schema to create a simple User Interface (UI) between geoh5py and Geoscience ANALYST Pro. The format uses JSON objects to represent *script parameters* used in the UI, and pass those parameters to an accompanying python script.

Each ui.json object requires at least a **label** and **value** member, however additional members can be used to define different types of input and additional dependencies between parameters.

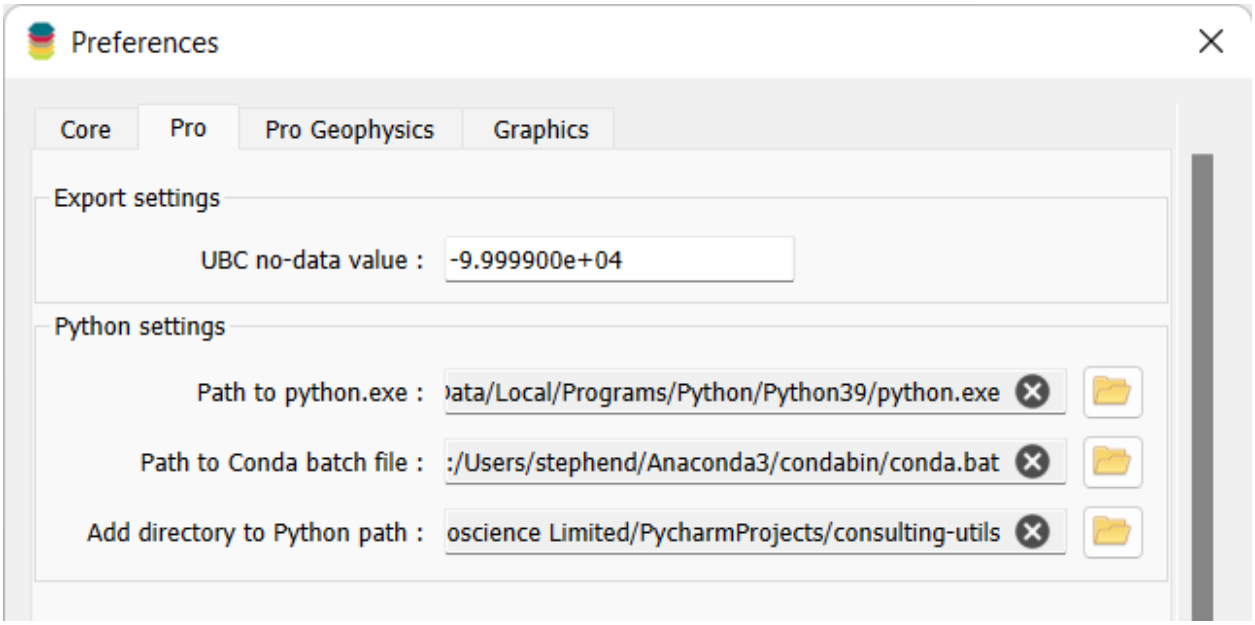
For example, a simple ui.json below describes a single parameter called 'grid_object', which is used to select a block model within a geoh5 file.

```
{
"grid_object": {
"meshType": ["{B020A277-90E2-4CD7-84D6-612EE3F25051}"],
"main": true,
"label": "Select Block Model",
"value": ""
}
}
```

Note: The **meshType** used to select the grid object is defined by a list of UUID. A complete list of UUID's for geoh5 object types are available in the geoh5 objects documentation.

2.5.2 Usage with Geoscience ANALYST Pro

A ui.json file contains the parameters that reference a Python script to run. Geoscience ANALYST must be configured prior to running the application by setting the path to Python scripts or to a Conda environment as defined by the **conda_environment** parameter.



run_command `str`
: Name of python script excluding the .py extension (i.e., "run_me" for run_me.py) required for Geoscience ANALYST Pro to run on save or auto-load.

conda_environment `str`
: Optional name of conda environment to activate when running the python script in *run_command*

title `str`
: Title of user interface window

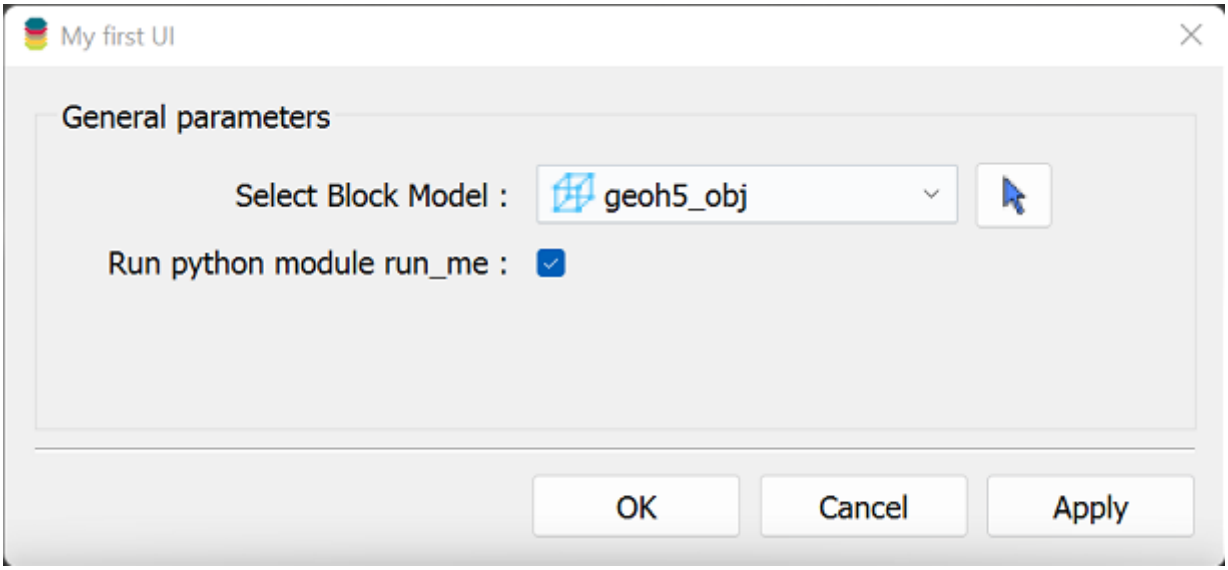
To complete the example above, add the **run_command**, and **title** parameter to the ui.json file.

```
{
"grid_object": {
"meshType": ["{B020A277-90E2-4CD7-84D6-612EE3F25051}"],
"main": true,
"label": "Select Block Model",
"value": ""
},
"title":"My first UI",
"run_command": "run_me"
}
```

Within the accompanying python script, the parameters from the ui.json is passed to the python script as a dictionary of arguments, and can be accessed using the InputFile module of geoh5py as shown below:

```
import sys
from geoh5py.ui_json import InputFile
```

(continues on next page)



(continued from previous page)

```
ui_json = sys.argv[1]
ifile = InputFile.read_ui_json(ui_json)
params = ifile.data

# Get the block model grid object
bm = params["grid_object"]
print(f"The selected object name is {bm.name}")
```

When a **ui.json** is run within Geoscience ANALYST Pro, the following parameters are updated or added:

- The **value** member is updated with the UUID of the object selected in the UI
- The **enabled** member `bool` is set for whether the parameter is enabled
- The *Data parameter* will also have updated **isValue** and **property** members. The **isValue** `bool` member is *true* if the **value** member was selected and *false* if the **property** member was selected.

The following JSON objects will be written (and overwritten if given) upon running a ui.json from Geoscience ANALYST Pro:

- **monitoring_directory** `str` the absolute path of a monitoring directory. Workspace files written to this folder will be automatically processed by Geoscience ANALYST.
- **workspace_geoh5** `str` (Optional) Path to the source geoh5 file (for reference only)
- **geoh5** `str` the absolute path to the geoh5 written containing all the objects of the workspace within the parameters of the **ui.json**. One only needs to use this workspace along with the JSON file to access the objects with geoh5py.

2.5.3 Parameters available for all ui.json objects

The following members are available to all input parameters in the ui.json schema.

label `str`
: Required string describing parameter. A colon will automatically be added within Geoscience ANALYST, so this should be omitted.

value `str`, `int`, `bool` , or `float`
: This required member takes a different form, including the empty string '', depending on the *parameter type*. The value is updated when written from Geoscience ANALYST.

main `bool`
: If set to true, the parameter is shown in the first tab of the UI and will throw an error if not present (and not optional). Optional parameters may be set to main. When main is not given or is false, the parameter will be under the *Optional Parameters* tab.

tooltip `str`
: String describing the parameter in detail that appears when the mouse hovers over it.

optional `bool`
: *true* or *false* on whether the parameter is optional. On output, check if *enabled* is set to true.

enabled `bool`
: *true* or *false* if the parameter is enabled. The default is true. If a parameter is optional and not enabled, it will start as disabled (grey and inactive in the UI).

group `str`
: Name of the group to which the parameter belongs. Adds a box and name around the parameters with the same case-sensitive group name.

groupOptional `bool`
: If true, adds a checkbox in the top of the group box next to the name. The group parameters will be disabled if not checked. The initial statedpends on the **groupDependency** and **groupDependencyType** members and the **enabled** member of the group's parameters.

dependency `str`
: The name of the parameter which this parameter is dependent upon. The dependency parameter should be optional or boolean parameter (i.e., has a checkbox).

dependencyType `str`
: What happens when the dependency member is checked. Options are `enabled` or `disabled`

groupDependency `str`
: The name of the object of which the group of the parameter is dependent upon. This member will also require the **groupOptional** member to be present and set to `true`. Be sure that the object is not within the group.

groupDependencyType `str`
: What happens when the group's dependency parameter is checked. Options are `enabled` or `disabled`.

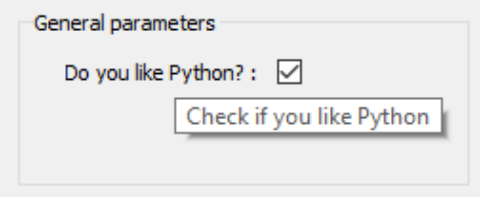
2.5.4 Additional Parameters

The following sections define different object specific parameters that can be used in the **ui.json** schema.

Boolean Parameter

A parameter named "input" that has a `bool` value.

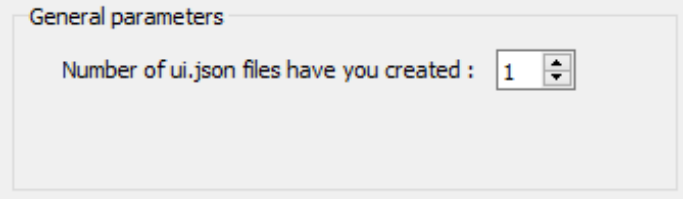
```
{
"input":{
"main": true,
"label": "Do you like Python?",
"value": true,
"tooltip": "Check if you like Python"
}
}
```



Integer Parameter

A parameter that has an `int` value. The optional parameters `min` and `max` invoke a validator to insure the bound(s) are enforced.

```
{
"file_xp":{
"main": true,
"label": "Number of ui.json files have you created",
"value": 1,
"min": 0,
"max": 100
}
}
```



Float Parameter

A parameter that has a `float` value. The optional parameters are:

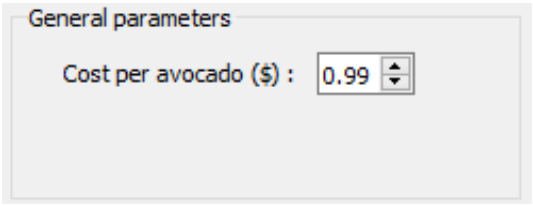
min `float`
: Minimum value allowed for validator of the **value** member. The default is the minimum numeric limits of float.

max `float`
: Maximum value allowed for validator of the **value** member. The default is the maximum numeric limits of float.

lineEdit `bool`
: Boolean whether to use a line edit (**true**) or a spin box (**false**). The default is true.

precision `int`
: Number of decimal places in the line edit or spin box

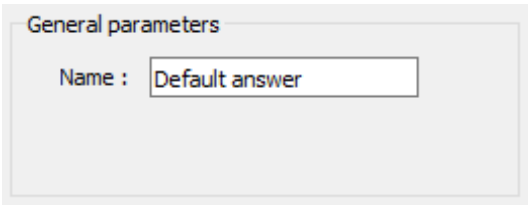
```
{
"avacado": {
"main": true,
"label": "Cost per avocado ($)",
"value": 0.99,
"min": 0.29,
"precision": 2,
"lineEdit": false,
"max": 2.79
}
}
```



String Parameter

For a simple string parameter, use an empty `str` value to have an empty string. Only a `label` and `value` is required.

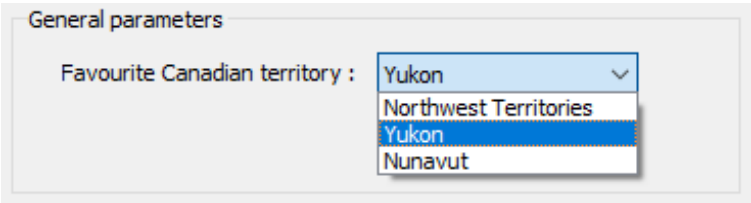
```
{
"my_string": {
"main": true,
"label": "Name",
"value": "Default answer"
}
}
```



Multi-choice string Parameter

For a drop-down selection, add a `choiceList` member with an array of strings (`str`)

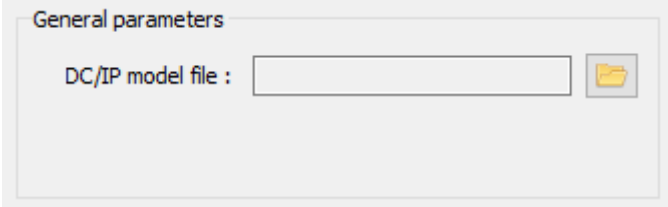
```
{
"favourites":
{
"choiceList": ["Northwest Territories",
"Yukon",
"Nunavut"],
"main": true,
"label": "Favourite Canadian territory",
"value": "Yukon"
}
}
```

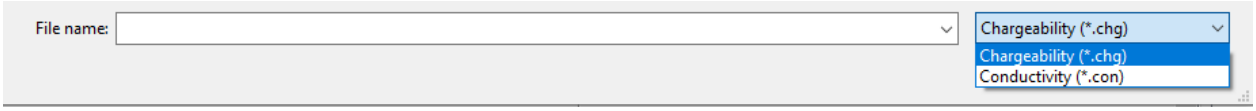


File Parameter

A file parameter comes with an icon to choose the file, with a `str` value. Extra members of the file object parameter are **fileDescription** and **fileType**. Both of these are `str` types and can be arrays, but must be of the same length

```
{
"model_file": {
"fileDescription": ["Chargeability", "Conductivity"],
"fileType": ["chg", "con"],
"main": true,
"label": "DC/IP model file",
"value": ""
}
}
```

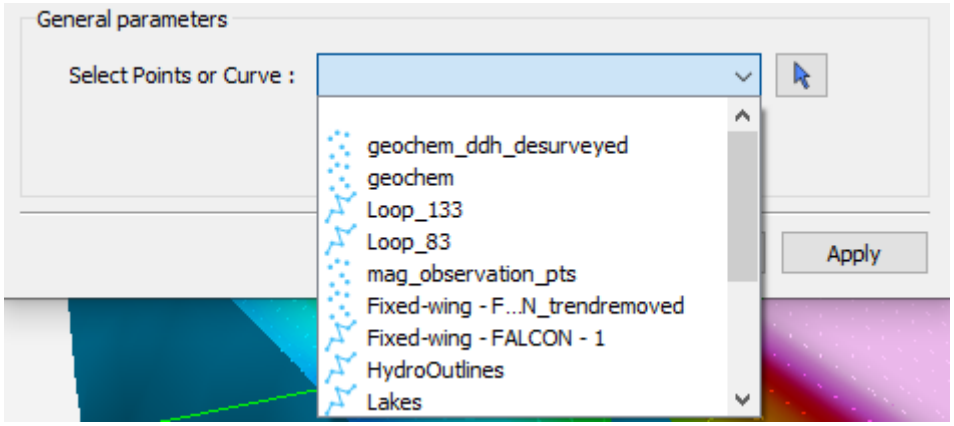




Geoscience ANALYST Object Parameter

To choose an object from a dropdown menu, the universally unique identifier (UUID) of the *Object Type*: is required for the filtering of objects. This is given as a single or array of `str` in the member **meshType**. The icon to pick the object comes with this parameter. The value returned is the *UUID* of the Geoscience ANALYST object selected.

```
{
"interesting_object": {
"meshType": ["{202C5DB1-A56D-4004-9CAD-BAAFD8899406}" ,
   "{6A057FDC-B355-11E3-95BE-FD84A7FFCB88}"],
"main": true,
"label": "Select Points or Curve",
"value": ""
}
}
```



Geoscience ANALYST Data parameter

Creating a parameter to choose a Geoscience ANALYST object's data requires extra members:

dataType `str`
: Describes the type of data to filter. One or more (as an array) of these key words: `Integer`, `Float`, `Text`, `Referenced`, `Vector`, `DataTime`, `Geometric`, `Boolean`, or `Text`.

association `str`
: Describes the geometry of the data. One or more of these key words: `Vertex`, `Cell`, or `Face`.

parent `str`
: Either a *UUID* of the parent or the name of the *Object parameter* JSON object to allow the user to choose the mesh.

isValue `bool`
: Describes whether to read the **value** (`float`) or **property** (`str`) member. If not given, the value member is an *UUID* and is considered a *drop-down data parameter*. If this member is given along with **property**, then an icon is added to the UI element, which switches between te **value** (line edit) and **property** (drop-down) choices. This value is updated on export depending on the style choice (`float` or `str`)

property `str`.
: Data *UUID* that is selected when **isValue** is present. Geoscience ANALYST Pro will update this value on export.

min `float`
: Optional minimum value allowed for validator of the **value** member. The default is the minimum numeric limits of float.

max `float`
: Optional maximum value allowed for validator of the **value** member. The default is the maximum numeric limits of float.

precision `int`
: Optional number of decimal places for the value.

Drop-down Parameter

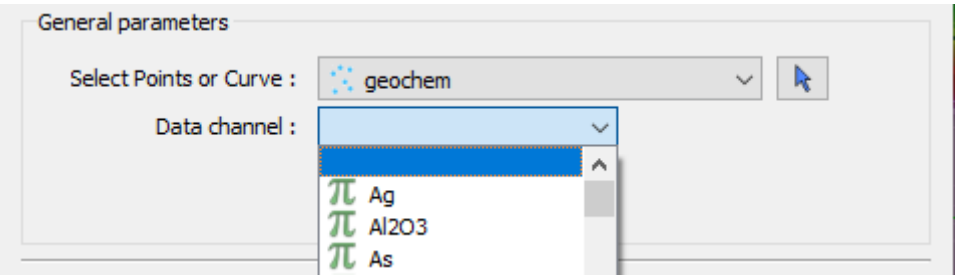
In this example, the object parameter *data_mesh* is also given for reference.

```
{
"data_channel": {
"main": true,
"association": "Vertex",
"dataType": "Float",
"label": "Data channel",
"parent": "data_mesh",
"value": ""
},
"data_mesh": {
"main": true,
 "meshType": ["{202C5DB1-A56D-4004-9CAD-BAAFD8899406}" ,
   "{6A057FDC-B355-11E3-95BE-FD84A7FFCB88}"],
"main": true,
"label": "Select Points or Curve",
```

(continues on next page)

(continued from previous page)

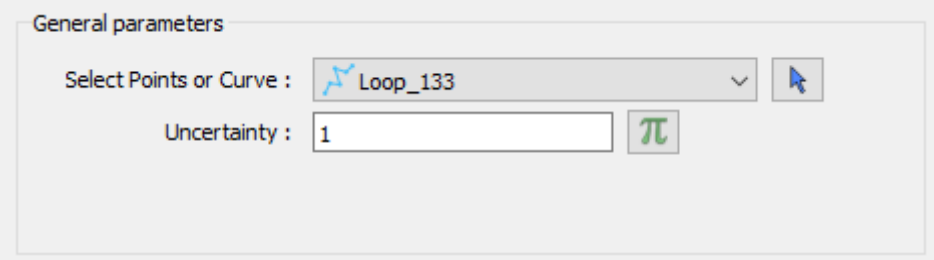
```
"value": ""
}
}
```

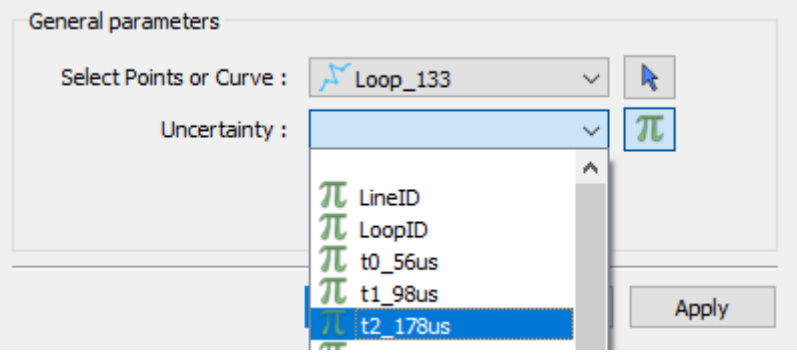


Data or value Parameter

In some cases, a parameter may take its data from a Geoscience ANALYST object or simply a `float` value. The use of the member **isValue** and **property** together allows for the UI to switch between these two cases. In the top image, the **isValue** is true, so the **value** member of 1.0 will initially be active. When the icon is clicked, the type of input is switched to the **property** member (bottom image). The **uncertainty channel** object also depends on the **data_mesh** object. The drop-down selection will filter data from the chosen object that is located on the vertices and is float. The **isValue** is set to false upon export in this case.

```
{
"uncertainty_channel": {
"main": true,
"association": "Vertex",
"dataType": "Float",
"isValue": true,
"property": "",
"min": 0.001,
"label": "Uncertainty",
"parent": "data_mesh",
"value": 1.0
},
"data_mesh": {
"main": true,
 "meshType": ["{202C5DB1-A56D-4004-9CAD-BAAFD8899406}" ,
   "{6A057FDC-B355-11E3-95BE-FD84A7FFCB88}"],
"main": true,
"label": "Select Points or Curve",
"value": ""
}
}
```

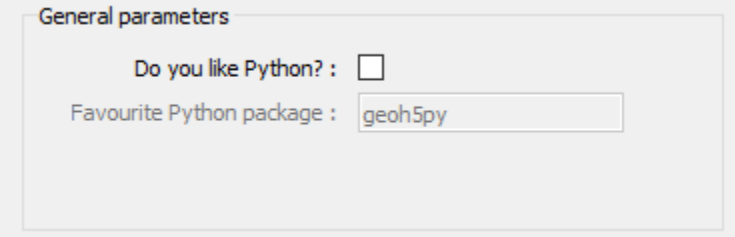




Dependencies on other parameters

Use the **dependency** and **dependencyType** members to create dependencies. The parameter driving the dependency should set **optional** to true or be a *Boolean parameter'*. Below are a couple of examples. The first initializes the *favourite_package* parameter as disabled until the *python_interest* parameter is checked. The second shows the opposite when the **enabled** member is set to true.

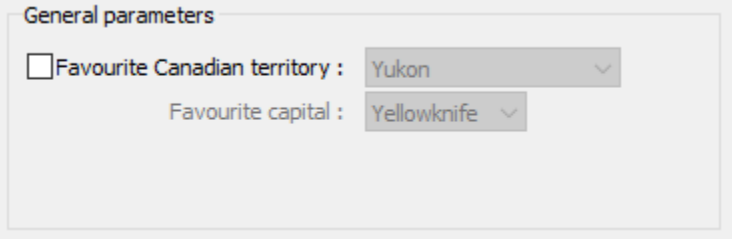
```
{
"python_interest": {
"main": true,
"label": "Do you like Python?",
"value": false,
"tooltip": "Check if you like Python"
},
"favourite_package": {
"main": true,
"label": "Favourite Python package",
"value": "geoh5py",
"dependency": "python_interest",
"dependencyType": "enabled"
}
}
```

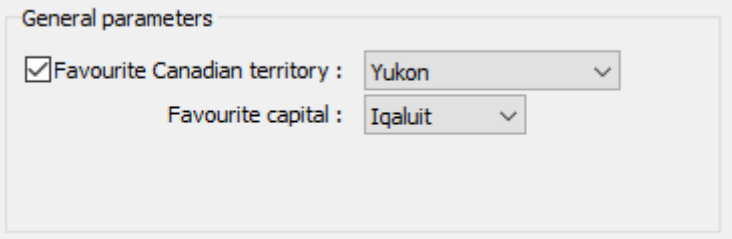


The next example has a dependency on an optional parameter. The **enabled** member is set to false so

that it is not automatically checked. The *city* and *territory* parameters will be enabled when the *territory* checkbox is checked.

```
{
"territory": {
"choiceList": ["Northwest Territories",
"Yukon",
"Nunavut"],
"main": true,
"label": "Favourite Canadian territory",
"value": "Yukon",
"optional": true,
"enabled": false
},
"city": {
"main": true,
"choiceList": ["Yellowknife",
"Whitehorse",
"Iqaluit"],
"label": "Favourite capital",
"value": "",
"dependency": "territory",
"dependencyType": "enabled"
}
}
```





2.5.5 Tips on creating UIs

- Keep labels concise
- Write detailed tooltips
- Group related attributes
- Don't include the **main** member with every parameter. "Non-main" members are designated to a second page under *Optional parameters*
- Utilize **optional** object members and dependencies.

2.5.6 External Links

- JSON Schema
- Universally Unique IDentifier (UUID)

2.6 Release Notes

2.6.1 Release 0.6.0 - 2023/01/26

- GEOPY-700, 701, 721, 726: Add functionality to convert between Grid2D and GeoImages.
- GEOPY-843: Update drillhole group compatibility with ANALYST v4.2
- GEOPY-746: Implement ground TEM (large-loop) survey type.

2.6.2 Release 0.5.0 - 2022/10/26

- GEOPY-624: Add functionality to remove vertices and cells
- GEOPY-644: Functionality to copy object within box extent. Only implemented for vertex-based object.
- **Bug fixes:**
  - GEOPY-650: Deal with INTEGRATOR text data in byte format.
  - GEOPY-615: Fix de-survey method for older geoh5 v1 format.

2.6.3 Release 0.4.0 - 2022/08/26

Major release adding new classes and fixing issues with the DrillholeGroup class.

- **Fixes for concatenated DrillHoleGroup**
  - GEOPY-598: Implement IntegratorDrillholeGroup class
  - GEOPY-583: Better handling of adding and removing concatenaned drillholes and data intervals.
- GEOPY-584: Preserve integer values on IntegerData class.
- GEOPY-548: Allow TextData values on vertices and cells.
- GEOPY-329: API implementation of DrapeModel object class.
- GEOPY-462: Documentation fixes

2.6.4 Release 0.3.1 - 2022/08/26

This release addresses issues encountered after the 0.3.0 release.

- GEOPY-608: Check for 'allow_delete' status before removing.
- GEOPY-600: Fix crash on missing 'Group types' group from project written by ANALYST.
- GEOPY-587: Increase PEP8 compliance after pylint update.
- GEOPY-575: Improve ui.json documentation.

2.6.5 Release 0.3.0 - 2022/06/30

This release addresses changes introduced by the geoh5 v2.0 standard.

- Drillhole objects and associated data are stored as Concatenated entities under the DrillholeGroup.
- Use of context manager for the Workspace with options for read/write mode specifications added.
- Implementation of a SimPEGGroup entity.

2.6.6 Release 0.2.0 - 2022/04/18

- Add MT, tipper and airborne time-domain survey objects.
- Add ui.json read/write with validations
- Bug fixes and documentation.

2.6.7 Release 0.1.6 - 2021/12/09

- Fix StatsCache on value changes.
- Fix crash if data values are None.
- Clean up for linters

2.6.8 Release 0.1.5 - 2021/11/05

- Fix for copying of direct-current survey.
- Fix documentation.

2.6.9 Release 0.1.4 - 2021/08/31

- Add direct_current survey type and related documentation.
- Fix for drillholes with single survey location anywhere along the borehole.
- Fix for entity.parent setter. Changes are applied directly to the target workspace.
- Improve Typing.

2.7 Feedback

Have comments or suggestions? Submit feedback. All the content can be found on our github repository.

2.7.1 Contributors

- Mira Geoscience

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