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# **Python-Relion Documentation**

***Release 0.6.1***

**Diamond Light Source - Scientific Software**

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Documentation: <https://python-relion.readthedocs.io>.

This package provides a python interface to the information contained in a Relion project folder. It does not run Relion itself.

Currently it caters for specific fields from the Motion Correction, CTF Find, 2D Classification and 3D Classification stages of the Relion pipeline, but this could readily be expanded to more stages and fields.



## USAGE

To access a Relion project folder you first need to create a `relion.Project` object (c.f. [API](#) for more information):

```
import relion
proj = relion.Project("/path/to/relion/project/directory")
proj = relion.Project(pathlib.Path("/project/directory")) # path objects are s
↳ supported
```

The directory structure inside a Relion directory is built up of stages and jobs. Each stage folder will contain one or more job folders. The job folder(s) contain files related to the stage, including the `*.star` files from which values can be read:

```
project_root
├── MotionCorr
│   └── job002
│       ├── corrected_micrographs.star
│       └── ...
├── CTFFind
│   └── job003
│       ├── micrographs_ctf.star
│       └── ...
├── Class2D
│   ├── job008
│   │   ├── run_it025_data.star
│   │   ├── run_it025_model.star
│   │   └── ...
│   └── job013
│       ├── run_it_025_data.star
│       ├── run_it_025_model.star
│       └── ...
└── Class3D
    └── job016
        ├── run_it_025_data.star
        ├── run_it_025_model.star
        └── ...
```

The desired EM values are extracted from `*.star` files. For example, a snippet from `MotionCorr/job002/corrected_micrographs.star` is shown below:

```
...
loop_
_rlnCtfPowerSpectrum #1
_rlnMicrographName #2
_rlnMicrographMetadata #3
```

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```
_rlnOpticsGroup #4
_rlnAccumMotionTotal #5
_rlnAccumMotionEarly #6
_rlnAccumMotionLate #7
MotionCorr/job002/Movies/20170629_00021_frameImage_PS.mrc MotionCorr/job002/Movies/
↪20170629_00021_frameImage.mrc MotionCorr/job002/Movies/20170629_00021_frameImage.
↪star      1      16.420495      2.506308      13.914187
MotionCorr/job002/Movies/20170629_00022_frameImage_PS.mrc MotionCorr/job002/Movies/
↪20170629_00022_frameImage.mrc MotionCorr/job002/Movies/20170629_00022_frameImage.
↪star      1      19.551677      2.478968      17.072709
MotionCorr/job002/Movies/20170629_00023_frameImage_PS.mrc MotionCorr/job002/Movies/
↪20170629_00023_frameImage.mrc MotionCorr/job002/Movies/20170629_00023_frameImage.
↪star      1      17.547827      1.941103      15.606724
MotionCorr/job002/Movies/20170629_00024_frameImage_PS.mrc MotionCorr/job002/Movies/
↪20170629_00024_frameImage.mrc MotionCorr/job002/Movies/20170629_00024_frameImage.
↪star      1      18.100817      1.722567      16.378250
...
```

To access the `_rlnAccumMotionTotal` column in this file you can use:

```
>>> [micrograph.total_motion for micrograph in proj.motioncorrection["job002"]]
['16.420495', '19.551677', '17.547827', '18.100817', ...]
```

Stages are dictionary-like objects, so can discover the list of all known jobs by:

```
>>> list(proj.class2D)
['job008', 'job013']
```

and use the other standard dictionary accessors (`.values()`, `.keys()`, `.items()`), too. You can also convert the stages into normal dictionaries:

```
>>> dict(p.ctffind)
{'job003': [CTFMicrograph(...), ...]}
```

For a list of supported stages and a list of supported values per stage please have a look at the [API](#) page.



## 2.1 Project object

**class** `relion.Project` (*path*)

Reads information from a Relion project directory and makes it available in a structured, object-oriented, and pythonic fashion.

**property** `class2D`

access the 2D classification stage of the project. Returns a dictionary-like object with job names as keys, and lists of `Class2DParticleClass` namedtuples as values.

**property** `class3D`

access the 3D classification stage of the project. Returns a dictionary-like object with job names as keys, and lists of `Class3DParticleClass` namedtuples as values.

**property** `ctffind`

access the CTFFind stage of the project. Returns a dictionary-like object with job names as keys, and lists of `CTFMicrograph` namedtuples as values.

**property** `motioncorrection`

access the motion correction stage of the project. Returns a dictionary-like object with job names as keys, and lists of `MCMicrograph` namedtuples as values.

The individual stage accessors `.ctffind`, `.class2D`, etc. return a dictionary-like object that allows you to access individual Relion jobs within that particular stage. The dictionary key names are the relion job names (usually `jobXXX`), the dictionary value is a list of stage-specific named tuples, listed below.

## 2.2 Stage-specific information

**class** `relion._parser.ctffind.CTFMicrograph` (*micrograph\_name*, *astigmatism*, *defocus\_u*,  
*defocus\_v*, *defocus\_angle*, *max\_resolution*,  
*fig\_of\_merit*, *amp\_contrast*, *diagnostic\_plot\_path*)

Contrast Transfer Function stage.

**property** `amp_contrast`

Amplitude contrast.

**property** `astigmatism`

Estimated astigmatism. Units angstrom (A).

**property** `defocus_angle`

Estimated angle of astigmatism.

**property defocus\_u**

Averaged with Defocus V to give estimated defocus. Units angstrom (A).

**property defocus\_v**

Averaged with Defocus U to give estimated defocus. Units angstrom (A).

**property diagnostic\_plot\_path**

Path to the CTF diagnostic (fit/data comparison) plot (jpeg).

**property fig\_of\_merit**

Figure of merit/CC/correlation value. Confidence of the defocus estimation.

**property max\_resolution**

Maximum resolution that the software can detect. Units angstrom (A).

**property micrograph\_name**

Micrograph name. Useful for reference.

```
class relion._parser.motioncorrection.MCMicrograph(micrograph_name,          micro-
                                                    graph_snapshot_full_path,  mi-
                                                    crograph_number,  total_motion,
                                                    early_motion,          late_motion,
                                                    drift_data)
```

Motion Correction stage.

**property drift\_data**

Alias for field number 6

**property early\_motion**

Early motion.

**property late\_motion**

Late motion.

**property micrograph\_name**

Micrograph name. Useful for reference.

**property micrograph\_number**

Micrograph number: sequential in time.

**property micrograph\_snapshot\_full\_path**

Path to jpeg of the motion corrected micrograph.

**property total\_motion**

Total motion. The amount the sample moved during exposure. Units angstrom (A).

```
class relion._parser.class2D.Class2DParticleClass(particle_sum,          reference_image,
                                                    class_distribution,          ac-
                                                    curacy_rotations,          accu-
                                                    racy_translations_angst,  es-
                                                    timated_resolution,          over-
                                                    all_fourier_completeness)
```

2D Classification stage.

**property accuracy\_rotations**

Accuracy rotations.

**property accuracy\_translations\_angst**

Accuracy translations angst.

**property class\_distribution**

Class Distribution. Proportional to the number of particles per class.

**property estimated\_resolution**

Estimated resolution.

**property overall\_fourier\_completeness**

Overall Fourier completeness.

**property particle\_sum**

Sum of all particles in the class. Gives a tuple with the class number first, then the particle sum.

**property reference\_image**

Reference image.

```
class relion._parser.class3D.Class3DParticleClass (particle_sum,      reference_image,  
                                                class_distribution,      ac-  
                                                curacy_rotations,      accu-  
                                                racy_translations_angst, es-  
                                                timated_resolution,    over-  
                                                all_fourier_completeness, ini-  
                                                tial_model_num_particles)
```

3D Classification stage.

**property accuracy\_rotations**

Accuracy rotations.

**property accuracy\_translations\_angst**

Accuracy translations angst.

**property class\_distribution**

Class Distribution. Proportional to the number of particles per class.

**property estimated\_resolution**

Estimated resolution.

**property initial\_model\_num\_particles**

The number of particles used to generate the initial model.

**property overall\_fourier\_completeness**

Overall Fourier completeness.

**property particle\_sum**

Sum of all particles in the class. Gives a tuple with the class number first, then the particle sum.

**property reference\_image**

Reference image.



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**CHAPTER  
THREE**

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**CREDITS**

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