
Pythomac

Release latest

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The open-source software Telemac for numerical modeling already comes with a suite of powerful Python scripts. But running Telapy scripts often only works in the Telemac environment, which might not be necessary for post-processing of simulation results. This Python3 package comes with light-weight requirements to extract and manage data generated with and for Telemac.

Important: Extended Python installation instructions are provided on hydro-informatics.com.

INSTALLATION

1.1 Requirements

- NumPy
- Pandas

```
pip install numpy, pandas
```

1.2 Installation

```
pip install pythomac
```


CONVERGENCE ANALYSIS

Find more background information on hydro-informatics.com.

2.1 Usage Example

2.1.1 Minimal

```
from pythomac import extract_fluxes

simulation_dir = "/home/telemac-user/simulations/rhine/"
cas_name = "steady2d.cas"
extract_fluxes(simulation_dir, cas_name, plotting=False)
```

2.1.2 Full application

```
1  """
2  This script features an example for flux extraction and convergence analysis with
3  ↳ pythomac. It requires that a
4    simulation ran with ``telemac2d.py steady2d.cas -s`` and that the .cas file contained
5  ↳ the keyword
6    ``PRINTING CUMULATED FLOWRATES : YES``.
7
8  @author: Sebastian Schwindt
9  @year: 2023
10
11  Usage:
12    This script should be placed relative to a Telemac simulation as follows:
13    + Simulation: HOME/hytelemac/steady2d-tutorial/steady2d.cas
14    + This script: HOME/postpro/example_flux_convergence.py
15    + To change this behavior, modify the variable simulation_dir
16
17  Example:
18    Visit https://hydro-informatics.com/numerics/telemac/convergence.html
19
20  """
21  import os
```

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```

20 from pathlib import Path
21 from pythomac import extract_fluxes, calculate_convergence, get_convergence_time
22
23 # set directories and define steering (cas) file name
24 simulation_dir = str(Path(__file__).parents[1]) + "{0}hytelemac{0}steady2d-tutorial".
    ↪format(os.sep)
25 telemac_cas = "steady2d-conv.cas"
26 print(simulation_dir)
27
28 # extract fluxes across boundaries
29 fluxes_df = extract_fluxes(
30     model_directory=simulation_dir,
31     cas_name=telemac_cas,
32     plotting=True
33 )
34
35 # back-calculate Telemac timestep size
36 timestep_in_cas = int(max(fluxes_df.index.values) / (len(fluxes_df.index.values) - 1))
37
38 # plot convergence
39 iota_t = calculate_convergence(
40     series_1=fluxes_df["Fluxes Boundary 1"][1:], # remove first zero-entry
41     series_2=fluxes_df["Fluxes Boundary 2"][1:], # remove first zero-entry
42     cas_timestep=timestep_in_cas,
43     plot_dir=simulation_dir
44 )
45
46 # write the result to a CSV file
47 iota_t.to_csv(os.path.join(simulation_dir, "convergence-rate.csv"))
48
49 # identify the timestep at which convergence was reached at a desired precision
50 convergence_time_iteration = get_convergence_time(
51     convergence_rate=iota_t["Convergence rate"],
52     convergence_precision=1.0E-6
53 )
54
55 if not("nan" in str(convergence_time_iteration).lower()):
56     print("The simulation converged after {0} simulation seconds ({1}th printout)".
    ↪format(
57         str(timestep_in_cas * convergence_time_iteration), str(convergence_time_
    ↪iteration))

```

2.2 Script and Function docs

2.2.1 Flux Analyst

Extract data from a Telemac simulation that has already been running. The codes are inspired by the following jupyter notebook:

HOMETEL/notebooks/data_manip/extraction/output_file_extraction.ipynb

which uses the following example case:

/examples/telemac2d/bump/t2d_bump_FE.cas

@author: Sebastian Schwindt (July 2023)

```
pythomac.flux_analyst.calculate_convergence(series_1, series_2, conv_constant=1.0, cas_timestep=1,
                                             plot_dir=None)
```

Approximate convergence according to

<https://hydro-informatics.com/numerics/telemac/convergence.html#tm-calculate-convergence>

Parameters

- **series_1** (*list* or *np.array*) – series_1 should converge toward series_2 (both must have the same length)
- **series_2** (*list* or *np.array*) – series_2 should converge toward series_1 (both must have the same length)
- **conv_constant** (*float*) – a convergence constant to reach (default is 1.0)
- **cas_timestep** (*int*) – the timestep defined in the cas file
- **plot_dir** (*str*) – if a directory is provided, a convergence plot will be saved here

Return pandas.DataFrame

with one column, notably the convergence_rate as np.array

```
pythomac.flux_analyst.extract_fluxes(model_directory="", cas_name='steady2d.cas', plotting=True)
```

This function writes a .csv file and an x-y plot of fluxes across the boundaries of a Telemac2d model. It automatically place the .csv and .png plot files into the simulation directory (i.e., where the .cas file is).

Notes

- The Telemac simulation must have been running with the '-s' flag (telemac2d.py my.cas -s).
- Make sure to activate the .cas keyword PRINTING CUMULATED FLOWRATES : YES
- This script skips volume errors (search tags are not implemented).

- **Read more about this script at**

<https://hydro-informatics.com/numerics/telemac/telemac2d-steady.html#verify-steady-tm2d>

Parameters

- **model_directory** (*str*) – the file directory where the simulation lives
- **cas_name** (*str*) – name of the .cas steering file (without directory)

- **plotting** (*bool*) – default (True) will place a figure called flux-convergence.png in the simulation directory

Return pandas.DataFrame

time series of fluxes across boundaries (if Error int: -1)

```
pythomac.flux_analyst.get_convergence_time(convergence_rate, convergence_precision=0.0001)
```

Calculate at which simulation time the simulation converged at a desired level of convergence precision

Parameters

- **convergence_rate** (*numpy.array*) – iota calculated with calculate_convergence
- **convergence_precision** (*float*) – define the desired level of convergence precision

Return numpy.int64

the time iteration number

2.2.2 Plotting

Plot functions based on matplotlib

```
pythomac.utils.plots.plot_df(df, file_name, x_label=None, y_label=None, column_keyword="",  
                             legend=True)
```

Plot a pandas DataFrame as lines with markers. The dataframe index is used for the x-axis. The function can handle a maximum of twelve columns

Parameters

- **df** (*pandas.DataFrame*) – index serves for x-axis, columns containing a particular keyword are plotted on the y-axis (make sure these columns have the same units)
- **file_name** (*str*) – full path and name of the plot to be created
- **x_label** (*str*) – label for the x-axis
- **y_label** (*str*) – label for the y-axis
- **column_keyword** (*str*) – define a keyword that columns must contain to be plotted. The default "" (empty string) plots all columns.
- **legend** (*bool*) – place a legend (default is True).

Returns

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