Version 8.04 (May 14, 2018)

Caelus Python Library (CPL)

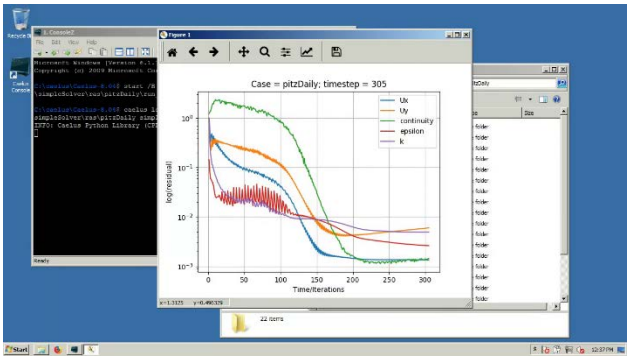
The Caelus Python Library is a companion package for interacting with Caelus. The library provides utilities for pre and post-processing, as well as automating various aspects of the CFD simulation workflow. Written in Python, it provides a consistent user-interface across the three major operating systems Linux, Windows, and Mac OS X ensuring that the scripts written in one platform can be quickly copied and used on other platforms. CPL documentation is available at: http://caelus.readthedocs.io. It is released under the Apache License Version 2.0 license.

The primary motivation for CPL is to provide a platform-agnostic capability to automate the CFD simulation workflow with Caelus CML package. The package is configurable to adapt to different user needs and system configurations and can interact with multiple CML versions simultaneous without the need to source environment files (e.g., using caelus-bashrc on Unix systems).

Some highlights of CPL include:

- The library is built using Python programming language and uses scientific python libraries (e.g., NumPy, Matplotlib). Capable of running on both Python 2.7 as well as Python 3.x versions.
- Uses YAML format for configuration files and input files. The YAML files can be read, manipulated, and written out to disk using libraries available in several programming languages, not just Python.
- Provides modules and python classes to work with Caelus case directories, process and plot logs, etc. The API is documented to allow users to build custom workflows that are currently not part of CPL.
- A YAML-based task workflow capable of automating the mesh, pre-process, solve, post-process workflow on both local workstations as well as high-performance computing (HPC) systems with job schedulers.

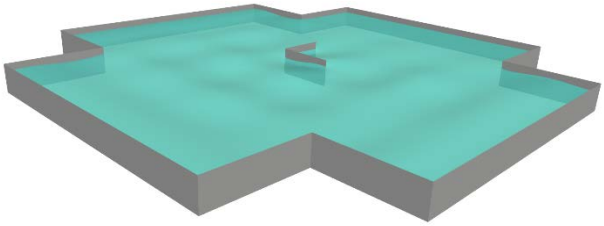
CPL is an open-source project and welcomes the contributions from the user community. Users wishing to contribute should submit pull requests to the public git repository.



Live plotting solver residuals with CPL on Windows

waves library

The *waves* library is a port of Niels Gjoel Jacobsen's waves2Foam library to Caelus. It is a toolbox used to generate and absorb free surface water waves. The waves library implements relaxation zones (aka numerical beaches) of arbitrary shapes along with a wide range of wave theories.
More information about waves2Foam is available at: https://openfoamwiki.net/index.php/Contrib/waves2Foam



1st order Stokes waves with relaxation zones using waves library and solver

Solvers

simpleSolver

- The `SIMPLEC` variant can be enabled by adding `consistent True;` to the `SIMPLE` dictionary in the `fvSolution`. [Applied CCM]
- The original `simpleFoam` solver provided in OpenFOAM uses the full pressure in the predictor

corrector pressure-velocity coupling scheme. The original SIMPLE algorithm instead used a pressure correction. This formulation can be enabled by adding `correctionForm True;` to the `SIMPLE` dictionary in the `fvSolution`. [Applied CCM]

Dynamic

- Previously, static and dynamic mesh capabilities were available in separate solvers. These capabilities are merged into unified solvers and controlled with the presence of a `dynamicMeshDict` [OpenFOAM Foundation]

Utilities

checkMesh

- `-meshBandwidth`: calculate matrix bandwidth without requiring `renumberMesh`. [OpenCFD]
- `-writeAllFields`: write volumetric fields for mesh quality metrics. [OpenCFD]
- `-writeFields <wordlist>`: write volumetric fields for selected mesh quality metrics. [OpenCFD]

Models

Turbulences

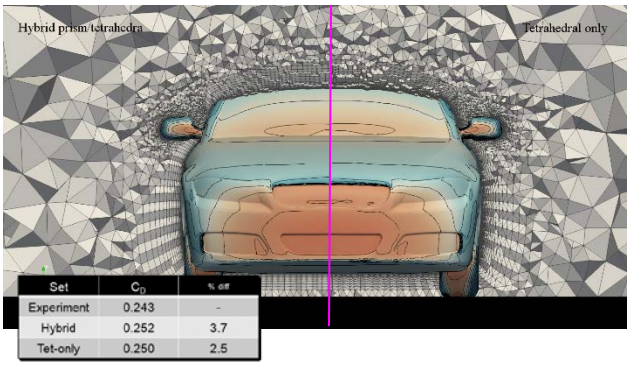
- Add WALES LES model (compressible and incompressible) [Applied CCM]

Verification and Validation

Two papers concerning the V&V of Caelus were published and presented at the ASME Fluids Engineering Division Summer Meeting, July 2017 in Waikaloa, HI, USA.

- A. Jemcov, D.W. Stephens, C. Sideroff "Verification and Validation of the Caelus Library – Incompressible Flow Solvers" ASME 2017, July 31 - Aug 02, Waikoloa, HI, USA FEDSM2017-69174
- D.W. Stephens, A. Jemcov, C. Sideroff "Verification and Validation of the Caelus Library – Incompressible Turbulence Models" ASME 2017, July 31 - Aug 02, Waikoloa, HI, USA FEDSM2017-69175

Contact Applied CCM to request copies of the papers. Cases and data generated for the papers exist as validation cases in the Caelus tutorials directory.



Steady-state RANS solutions on the DrivAer model using Caelus. LEFT: Hybrid prism/tet mesh; RIGHT: Tet-only mesh