FEMhub, a Free Distribution of Open Source Finite Element Codes with Unified Python Interface

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http://femhub.org

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Open-source distribution of Finite Element (FEM) codes with a unified Python interface

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- Open source FEM codes scarcely used outside of academia.
- 95% of all FEM simulations are done using commercial FEM software.
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Our Goal: Establish Fidelity for Open Source FEM Software
- Reduce heterogeneity in installation and usage
- Make them widely available (to masses, not only to scientists)
- Facilitate interoperability and comparisons
- Improve reproducibility of results
Open Source FEM Codes

- ALBERTA
- CalculiX
- deal.II
- GetFEM++
- Freefem++
- FEMM
- FETK
- FEMPACK
- FiPy
- OOF
- OFELI
- Phaml
- libMesh
- Code Aster
- DUNE
- FEBio
- Elmer
- FEniCS
- Hermes
- OOFEM
- OpenSees
- OpenFOAM
- ...

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Heterogeneity I:

- Operation systems
  - Linux
  - Windows
  - Mac

- Programming languages
  - C/C++
  - Java
  - Fortran
  - Python
  - (even functional languages)

- Download formats
  - *.tgz
  - svn
  - Mercurial
  - Git

- Quality of documentation, examples, tests, ...
Heterogeneity II:

- Dependencies & Interfaces & I/O formats
  - Geometry modeling
  - Mesh generation
  - Matrix solvers
  - Postprocessing
  - Visualization

- FEM technology
  - 2D / 3D / 2D & 3D
  - Simplicial elements (triangles, quadrilaterals)
  - Product elements (quads, bricks, prisms, pyramids)
  - Cartesian / distorted meshes
  - Structured / unstructured meshes
  - Low-order / higher-order
  - Nonadaptive / adaptive

- Problem types
  - First-order / second-order
  - Linear / nonlinear
  - Stationary / time-dependent
  - Scalar / vector-valued
  - Real / complex

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Heterogeneity III:

- Physics models
  - Heat transfer
  - Electrostatics
  - Electromagnetics
    - Time-domain
    - Frequency-domain
  - Solid mechanics
    - Elasticity
    - Visco-elasticity
    - Plasticity
  - Fluid mechanics
    - Inviscid / viscous
    - Compressible / incompressible
    - Laminar / turbulent
    - Newtonian / non-newtonian

- Single-physics / multiphysics
Benchmark = problem where exact solution is available

**Sample benchmarks for elliptic PDE:**

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Sample benchmarks for elliptic PDE:


Response to Mitchell’s paper:

Sample papers.
Benchmarks in Hermes

To become part of FEMhub.

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