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PSYDAC: a parallel finite element library with automatic code generation YAMAN GÜÇLÜ, Max Planck Institute for Plasma Physics, Garching b. München, Germany, SAID HADJOUT, Max Planck Institute for Plasma Physics & Technical University of Munich, Garching b. München, Germany, AHMED RATNANI, Mohammed VI Polytechnic University, Benguerir, Morocco — PSYDAC is a Python 3 library for the solution of partial differential equations, with a focus on isogeometric analysis using B-spline finite elements. Support for multi-patch geometries and finite element exterior calculus is under development. In order to use PSYDAC [1], the user defines the geometry and the model equations in an abstract form using SymPDE [2], an extension of Sympy [3] that provides the mathematical expressions and checks their semantic validity. Once a finite element discretization has been chosen, PSYDAC maps the abstract concepts to concrete objects, the basic building blocks being MPI-distributed vectors and matrices. Python code is generated for the all the computationally intensive operations (matrix and vector assembly, matrix-vector products, etc.), and it is accelerated using either Numba [4] or Pyccel [5]. We illustrate the library's capabilities with some plasma physics examples.

References (open source software)

[1] PSYDAC: https://github.com/pyccel/psydac
[2] SymPDE: https://github.com/pyccel/sympde
[3] Sympy: https://www.sympy.org
[4] Numba: https://numba.pydata.org
[5] Pyccel: https://github.com/pyccel/pyccel

Yaman Güçlü
Max Planck Institute for Plasma Physics, Germany

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