Exploring uses and limitations of Gridap.jl

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Gridap.jl

"Gridap provides a set of tools for the grid-based approximation of partial differential equations (PDEs) written in the Julia programming language. The library currently supports linear and **nonlinear** PDE systems for scalar and vector fields, single and multi-field problems, conforming and nonconforming **finite element** (FE) discretizations, on structured and unstructured meshes of simplices and n-cubes. It also provides methods for **time integration**. Gridap is extensible and modular. One can implement new FE spaces, and new reference elements, use external mesh generators, linear solvers, post-processing tools, etc. See, e.g., the list of available Gridap plugins."[BV20][VB22]

Features

- Entering the weak form in the mathematical syntax. Need to specify: LHS $a(u, v)$ and RHS $b(v)$.
- Can tackle different geometries and fields.
- Existence of subpackages such as on multivariate polynomials, algebra, mesh adaptivity etc.

Gridap github

Example of a domain

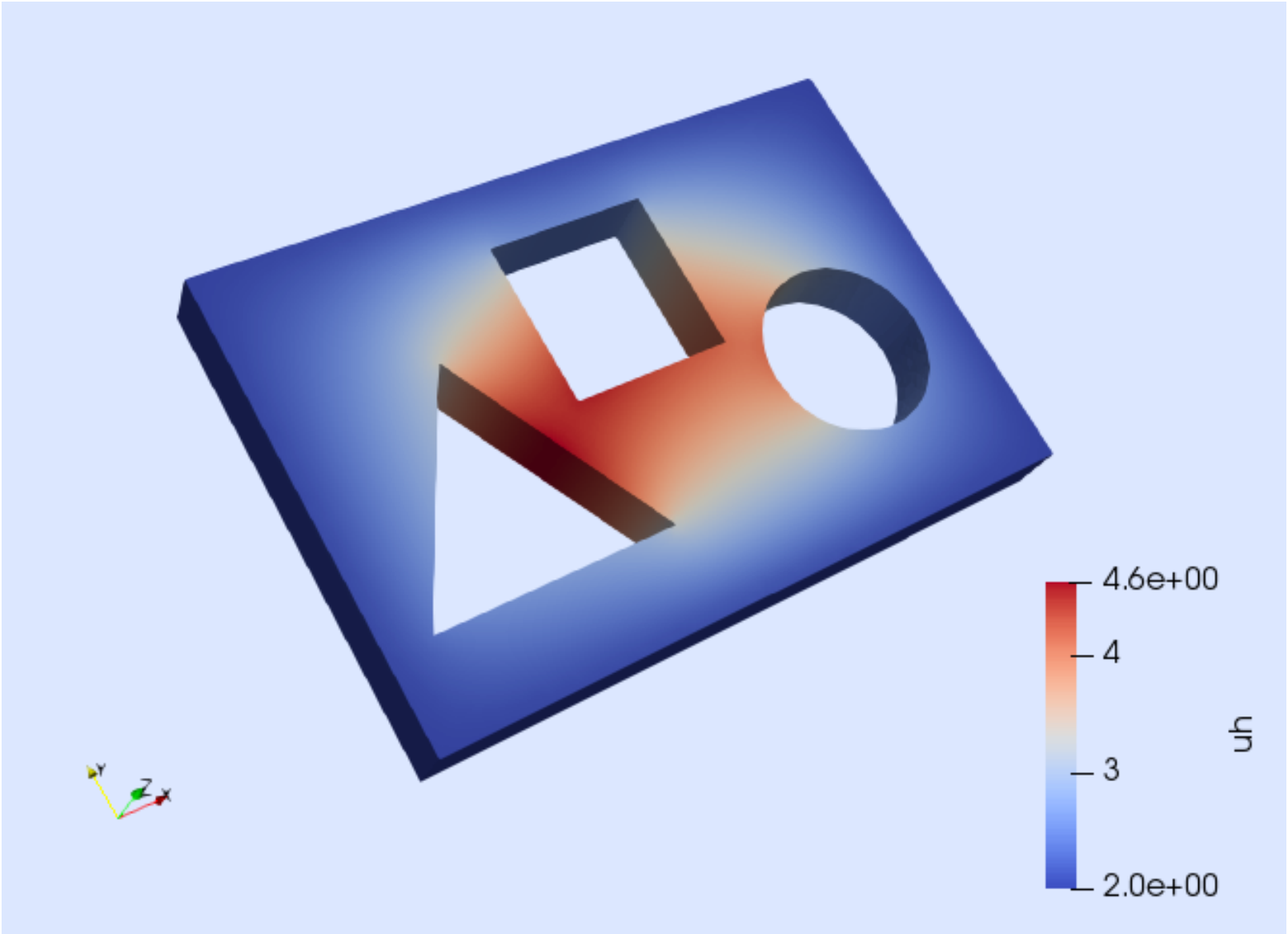

Figure: Poission equation

Example of a code

```
a(u,v) =
  ∫( ∇(v)⋅∇(u) )*dΩ +
  ∫( (γ/h)*v*u - v*(n_Γ⋅∇(u)) - (n_Γ⋅∇(v))*u )*dΓ +
  ∫(
    (γ/h)*jump(v*n_Λ)⋅jump(u*n_Λ) -
    jump(v*n_Λ)⋅mean(∇(u)) -
    mean(∇(v))⋅jump(u*n_Λ)
    )*dΛ

l(v) =
  ∫( v*f )*dΩ +
  ∫( (γ/h)*v*u - (n_Γ⋅∇(v))*u )*dΓ
```

Figure: Poission equation

How can one contribute?

? Create a tutorial on unexplored PDEs (Poisson-like).

? Do a comparison of performances (native DiffEq or Fenics).

? Look at the compatibility with time integrators (heat-like).

? Resolve existing issues...

How can one achieve

- Install the package.
- Find the write equation candidate.
- Contact the creators.
- Do some tests.
- Draw conclusions (probably disappointing).

References I


Santiago Badia and Francesc Verdugo, *Gridap: An extensible finite element toolbox in julia*, Journal of Open Source Software **5** (2020), no. 52, 2520.


Francesc Verdugo and Santiago Badia, *The software design of gridap: A finite element package based on the julia JIT compiler*, Computer Physics Communications **276** (2022), 108341.