Ideia

Dividir a malha em DG e CG, interagindo em boundaries. Dg próximo das fraturas, e vai entrando para dentro da CG na medida em que a solução vai avançando

Adaptar a malha e fazer DG no tempo. Métodos de CFD para estudar

* Deforming-SpatialDomain/Stabilized Space-Time (DSD/SST)

[1] T.E. Tezduyar, “Stabilized finite element formulations for incompressible flow computations”, Advances in Applied Mechanics, 28 (1992) 1–44.

# Strong Form

and:

where:

Equilibrium:

Isotropic homogeneous material:

Considering the symmetries:

The fluid flow continuity:

Or, equivalently:

Strong form :

BCs:

and at

and at

Function spaces:

*How to include and constraints in the spaces?*

Apply finite differences:

where

Where is the length of the timestep, is the intrinsic permeability and is the fluid viscosity.

# Weak form.

Eqn (1).

For each }:

or, equivalently:

In norm notation:

Where

In index-free notation:

For incompressibility, and . Normalize by :

,

Eqn (2)

Integration by parts

Or, equivalently:

where

# Galerkin

Eqn 1:

where

Eqn 2:

where

**INVESTIGATE COERCIVITY**

Eqn1 + Eqn2:

Let:

Hence:

In the incompressiblity limit,

That will be zero for any divergence-free function in the incompressibility limit. A very small coercivity makes the PDE unstable. The method is sensitive to perturbations (boundary condition).

Blue term – is it our bad guy? The velocity of the solid phase…

Integral by parts

Green and blue interact:

Assuming constant, C-S on the blue:

Problem arises in the incompressible, undrained limit:

In the incompressibility limit,

In the undrained limit

So the system becomes sensitive to the boundary conditions close to incompressible and undrained limits. How to enhance stability? We can provide more power to the term nulled out, as the blue equation is the one killing our good guys.

Following Hughes (1986) idea for pressure stabilization, we would add a residual term like:

We need to select such that we get the coercivity towards , but does not harms the other terms. Lets work to keep half of the original coercivity.

Peter-Paul:

Invert estimates:

Peter-Paul:

Everything back together:

Need to choose and so that

Lets choose:

And and

Now let’s choose so that :