

Finite Elements in Fluids

Assignment 1

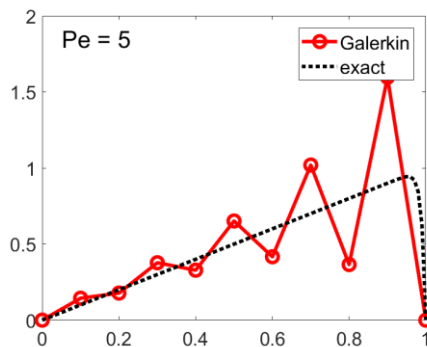
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We have seen in this first lesson, 4 different methods for approximating Convection-Diffusion equations. Galerkin Method, Upwind XXXX, XXXX, Galerkin Least Squares.

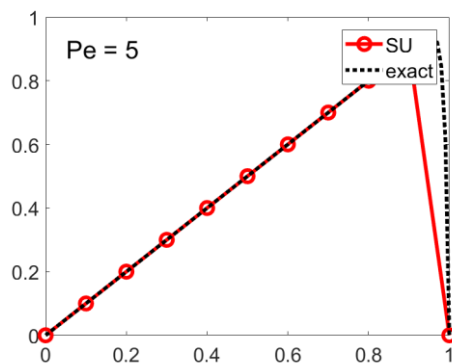
We have then implemented this method in Matlab Code and tried in different examples. The results we got show that in linear elements, the SUPG and GLS behave the same way, as they have the same code.

Next we can see the results applied to a couple of examples:

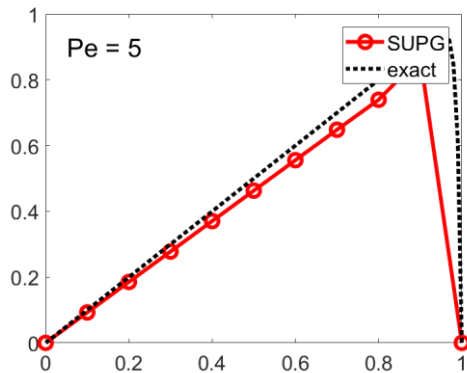
Galerkin method:



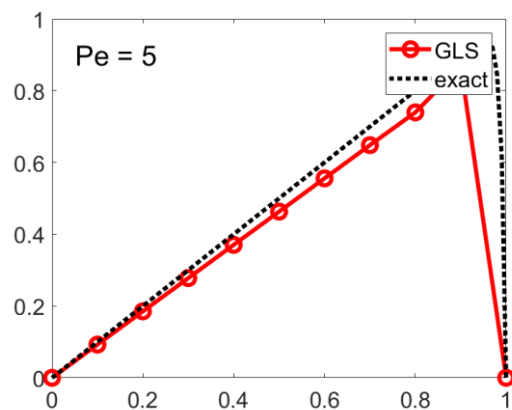
SU method:



SUPG method:



GLS method:



We can see that the Galerkin method starts oscillating in the very beginning and when we implement the Upwind we see that it stabilizes a lot the solution. For SUPG and GLS in linear elements we get the same exact result. The piece of code we added to approximate the solution is just adding the source term to the equation such as:

From:

```
Ke = Ke + w_ig*(N_ig'*a*Nx_ig + Nx_ig'*nu*Nx_ig) ...
    + w_ig*(tau*a*Nx_ig)'*(a*Nx_ig);
x = N_ig*Xe; % x-coordinate of the gauss point
s = SourceTerm(x,example);
fe = fe + w_ig*(N_ig)'*s;
```

To:

```
x = N_ig*Xe; % x-coordinate of the gauss point
s = SourceTerm(x,example);
Ke = Ke + w_ig*(N_ig'*a*Nx_ig + Nx_ig'*nu*Nx_ig) ...
    + w_ig*(tau*a*Nx_ig)'*(a*Nx_ig - s);
```