
DTU

FVM bulk flow equation solution

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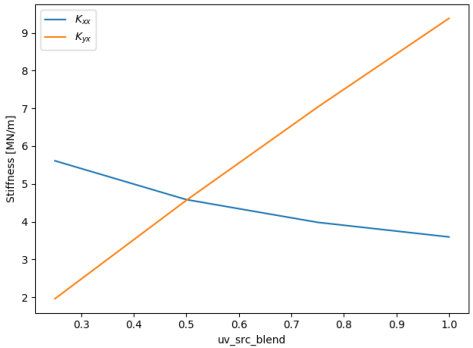
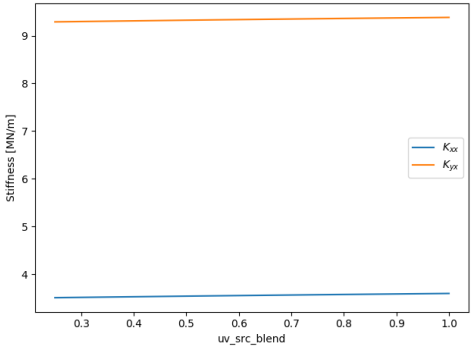
Stiffness coefficients

Original

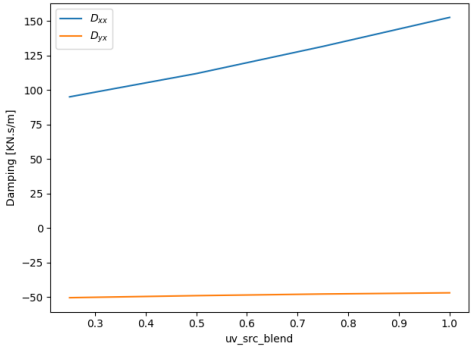


Corrected



Damping coefficients

Original



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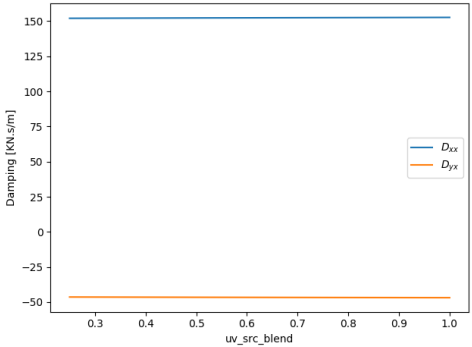

Required change...

Explicit terms properly accounted for in first-order problem

```
1 if self.uv_src_method == 0:
2   flux = - 0.5 * (self.R / self.C) * self.rho[i] * ( U_r[i] * f_r[i] + U_s[i] * f_s[i]) * self.
        cell[i, 2]
3
4   self.bu1[i] += (1. - self.uv_src_blend) * flux * self.u1[i]  # explicit portion
5   self.bv1[i] += (1. - self.uv_src_blend) * flux * self.v1[i]
```

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Stiffness coefficients

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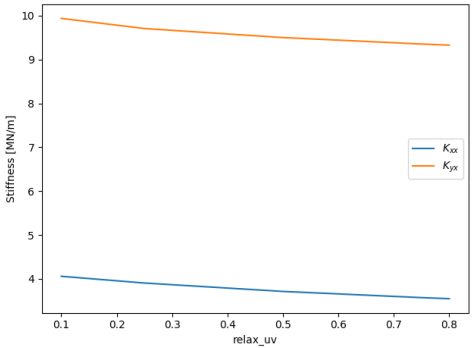
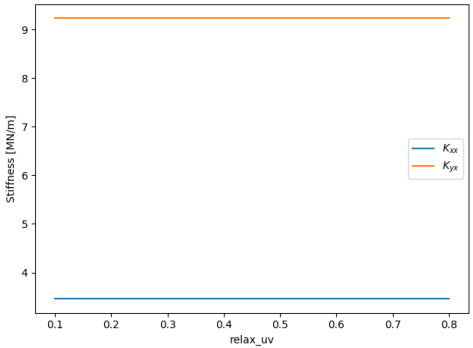
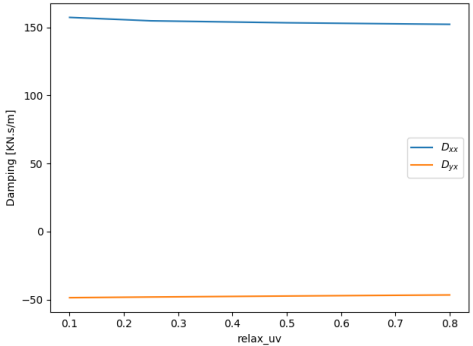


Corrected

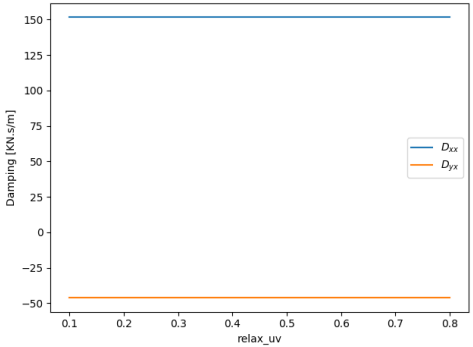


Damping coefficients

Original



Corrected



Required change...

Implicit relaxation of momentum (zeroth and first-order) yields dynamic coefficients sensitive to relaxation

$$\phi_C = \phi_C^* + \lambda^\phi \left(\frac{- \sum_{F \sim NB(C)} a_F \phi_F + b_C}{a_C} - \phi_C^* \right)$$

$$\frac{a_C}{\lambda^\phi} \phi_C + \sum_{F \sim NB(C)} a_F \phi_F = b_C + \frac{(1 - \lambda^\phi) a_C}{\lambda^\phi} \phi_C^*$$

$$a_C \leftarrow \frac{a_C}{\lambda^\phi}$$

added to produce a new term as

$$b_C \leftarrow b_C + \frac{(1 - \lambda^\phi) a_C}{\lambda^\phi} \phi_C^*$$

Implicit relaxation implementation

When forming momentum equation

```
  if self.relax_mode == 'implicit':
    self.A[i, i] = self.A[i, i] / self.relax_uv  # relax main diagonal
    self.A2[i, i] = self.A2[i, i] / self.relax_uv

self.apu = self.A.diagonal(0) #ap / param['relax_uv']
self.apv = self.A2.diagonal(0) #ap / param['relax_uv']

if self.relax_mode == 'implicit':
  self.bu += (1. - self.relax_uv) * self.apu * self.u  # relaxation has been applied to ap, i.e
     . ap = ap / relax
  self.bv += (1. - self.relax_uv) * self.apv * self.v
```

and when applying velocity corrections

```
self.u = self.u_star - self.Dp * self.grad_p_corr[:,0]
self.v = self.v_star - self.Dp * self.grad_p_corr[:,1]
```

Explicit relaxation

No relaxation applied to coefficient matrix and source term.
When applying corrections to velocities...

```
1 self.u = ( 1. - self.relax_uv ) * self.u + self.relax_uv * ( self.u_star - self.Dp * self.
      grad_p_corr[:,0] )
2 self.v = ( 1. - self.relax_uv ) * self.v + self.relax_uv * ( self.v_star - self.Dp * self.
      grad_p_corr[:,1] )
```