Benchmark

Sebastian Gjertsen

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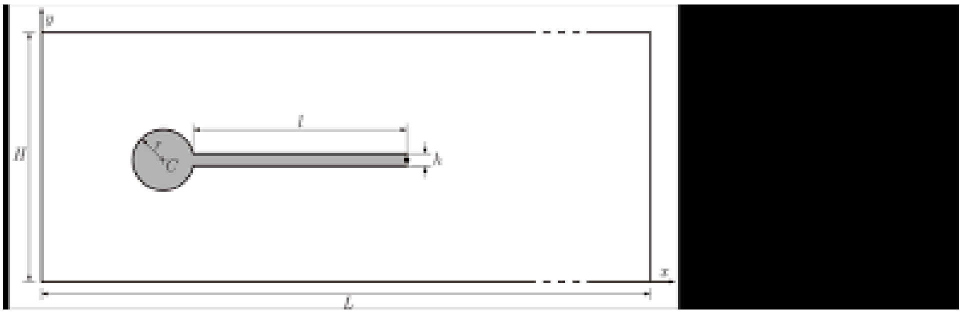
Problem Defintion

Domain



The computational domain resembles the classic cfd benchmark with an added bar, with dimensions:
The box: L = 2.5, H = 0.41
The bar: l = 0.35, h = 0.02
The circle is positioned at (0.2, 0.2) making it 0.05 of center from bottom to top, this is done to induce oscillations to an otherwise laminar flow.
Boundary conditions:
The fluid velocity has a parabolic profile on the inlet that changes over time:

$$u(0,y) = 1.5u_0\frac{y(H-y)}{(\frac{H}{2})^2}$$

$$u(0,y,t) = u(0,y)\frac{1-cos(\frac{\pi}{2}t)}{2} \text{ for } t < 2.0$$

$$u(0,y,t) = u(0,y) \text{ for } t \leq 2.0$$

We set no slip on the floor"and "ceilingso to speak.
On the fluid solid interface the boundary conditions are set to:

$$\sigma_f n_f = \sigma_s n_s \quad on \ \Gamma^0(interface)$$

In our variational form we leave this out and so implying that they are equal.

CSM test

Parameters

Tabell 1: My caption

Parameters	CSM1	CSM2	CSM3
$\rho_f[10^3 \frac{kg}{m^3}]$	1	1	1
$\nu_f[10^{-3} \frac{m^2}{s}]$	1	1	1
u_0	0	0	0
$\rho_s[10^3 \frac{kg}{m^3}]$	1	1	1
ν_s	0.4	0.4	0.4
$\mu_s[10^6 \frac{m^2}{s}]$	0.5	2.0	0.5
g	2	2	2

FSI test

Tabell 2: Parameters

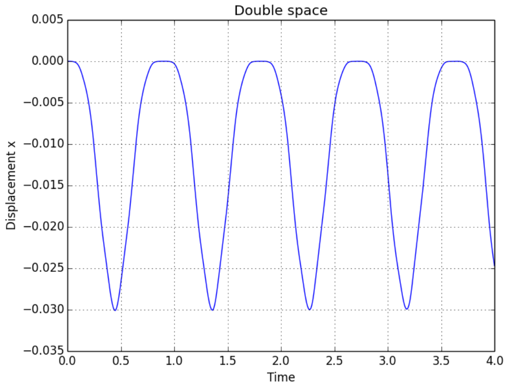
Parameters	FSI1	FSI2	FSI3
$\rho_f[10^3 \frac{kg}{m^3}]$	1	1	1
$\nu_f[10^{-3} \frac{m^2}{s}]$	1	1	1
u_0	0.2	1	2
$\mathrm{Re} = \frac{Ud}{\nu_f}$	20	100	200
$\rho_s[10^3 \frac{kg}{m^3}]$	1	10	1
ν_s	0.4	0.4	0.4
$\mu_s[10^6 \frac{m^2}{s}]$	0.5	0.5	2

Results:

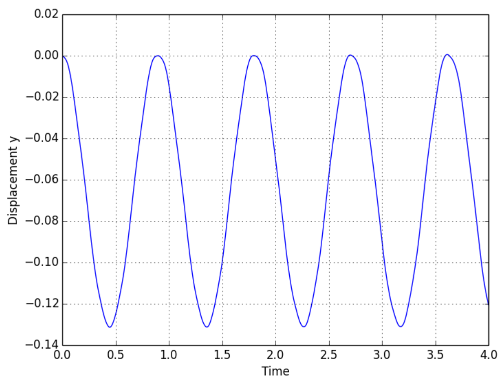
Tabell 3: FSI 1

Cells	Dofs	ux of A $[\times 10^{-3}]$	uy of A $[\times 10^{-3}]$	Drag	Lift	Spaces
2698	7095	0.0234594	0.797218	14.4963	0.915801	P1-P1-P1 stab= 0.01
2698	23563	0.02271	0.80288	14.1736	0.787891	P2-P2-P1
10792	92992	0.0227341	0.808792	14.1855	0.801044	P2-P2-P1
43168	369448	0.227352	0.812595	14.227	0.797242	P2-P2-P1
ref	**ref**	**0.0227**	**0.8209**	**14.295**	**0.7638**	**ref**

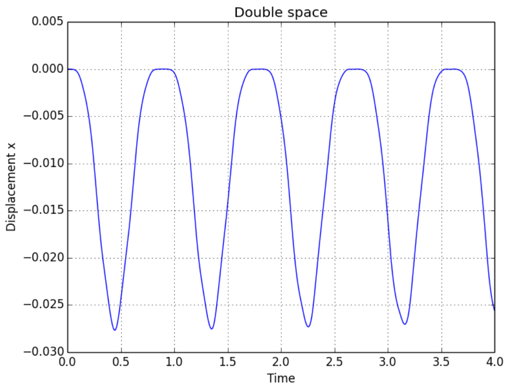
@articlequaini2014extended, title=An extended ALE method for fluid-structure interaction problems with large structural displacements, author=Quaini S ?Canic, S Basting A and Glowinski, R, year=2014



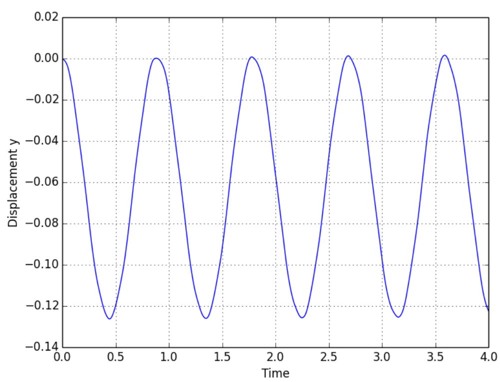
Figur 1: diff x with diffusion term



Figur 2: diff y with diffusion term



Figur 3: diff x without diffusion term



Figur 4: diff y without diffusion term