



FOR 493 - P3: A monolithic multigrid FEM solver for fluid structure interaction

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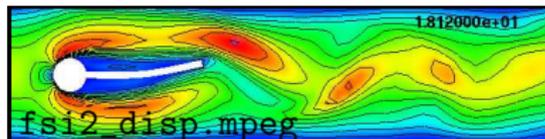




Current status of our FSI solver

☞ FEATFLOW Q_2/P_1^{dis}

- monolithic, fully coupled FEM, higher order
- fully implicit 2nd order discretization in time (Crank-Nicholson)
- Newton method for the coupled system (Jacobian matrix via divided differences)
- coupled geometric-MG solver with Vanka-like smoother
- adaptive time step control, a priori space-adapted mesh



☞ **NEW:** FEAST Q_1/Q_1 (→ H.Wobker)

- fully coupled, stabilized FEM
- HPC SCARC solver
- ...





Status of the numerical FSI benchmarks

☞ Subtests for validating CFD and CSM components are available:

- CSM1-3: "OK"
- CFD1: "easy" $\rightarrow Re = 20$
- CFD2: (also) "easy" $\rightarrow Re = 100$
- CFD3: "non-trivial" $\rightarrow Re = 200$

☞ FSI settings with desired properties:

- FSI1: "simple" \rightarrow for validation only
- FSI3: "hard" \rightarrow due to CFD3
- FSI2: fully oscillating while CFD2 (\approx same Re number!) is steady
 \Rightarrow **Excellent check for interaction mechanisms**

☞ Tasks:

- Collect available internal results
- Prepare for external results submission (web formular)
- Evaluation and comparison of mathematical and algorithmic components



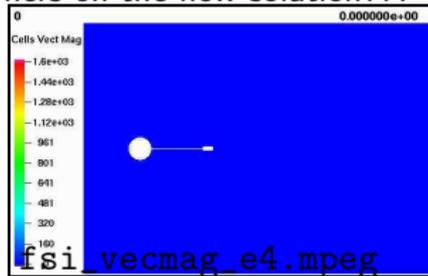
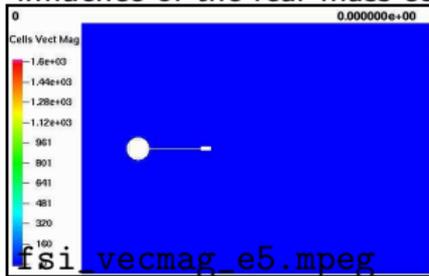


Benchmarking of the experimental data

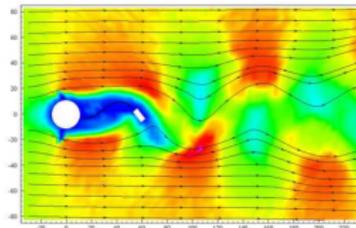


First computational results and tasks

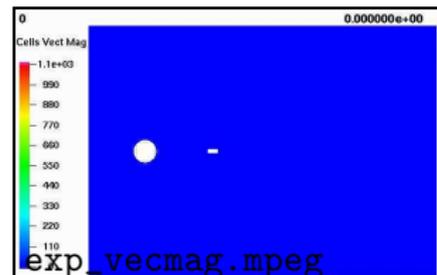
- rotational degree of freedom of the cylinder included
- beam thickness influences the solver performance
- influence of the rear mass corners on the flow solution???



Flustruc experiment, Erlangen



experiment



computation





Outlook (I)



Discretization



adaptive time step control coupled to the nonlinear solver performance



edge-oriented stabilization of convective terms for fluid and structure for Q_2



dynamic mesh alignment, updated ALE method, remeshing



Solvers



more robust smoothers with respect to anisotropy



decoupled solvers of "Discrete Projection" type: algebraic decoupling of "large" velocity & deformation part (=nonlinear, but well conditioned for small Δt) and "small" pressure part (=linear, but ill-conditioned) \rightarrow FEAST



Numerical benchmarks



collect internal results

