

Nektar++ Workshop 2015

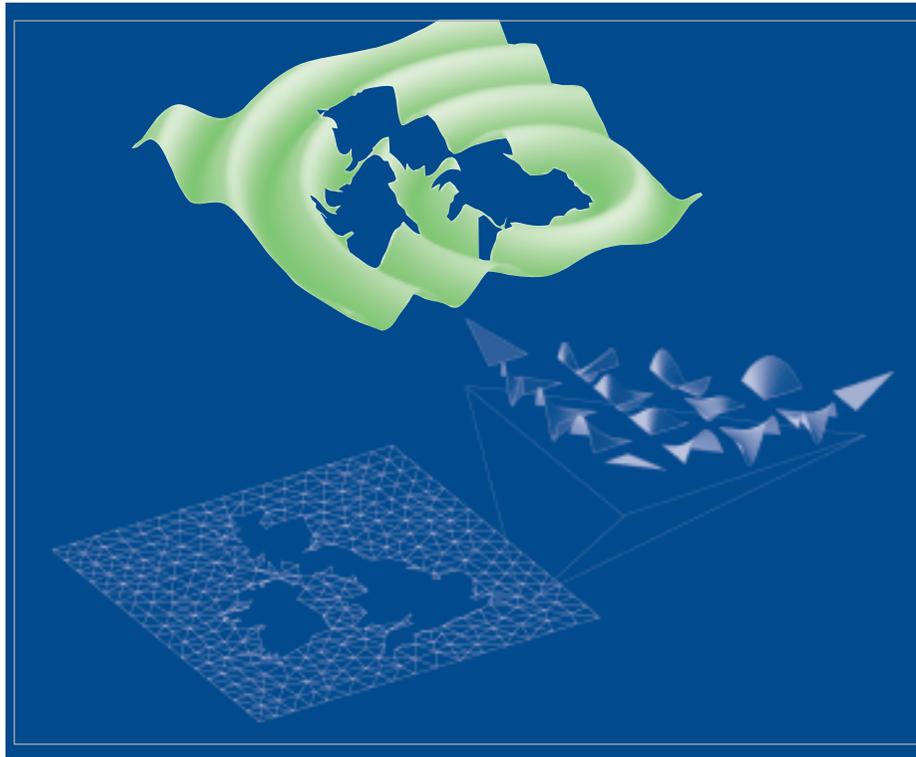
Imperial College London

Outline

- Initial Design & Ongoing developments
- Library design - *Chris Cantwell*
- Pre and Post processing - *Dave Moxey*
- Future topics - *Mike Kirby*
- User Applications: *This afternoon*
- *Tutorials tomorrow After dinner*

Nektar++: Spectral/hp element toolkit

Imperial College, University of Utah, Brown University



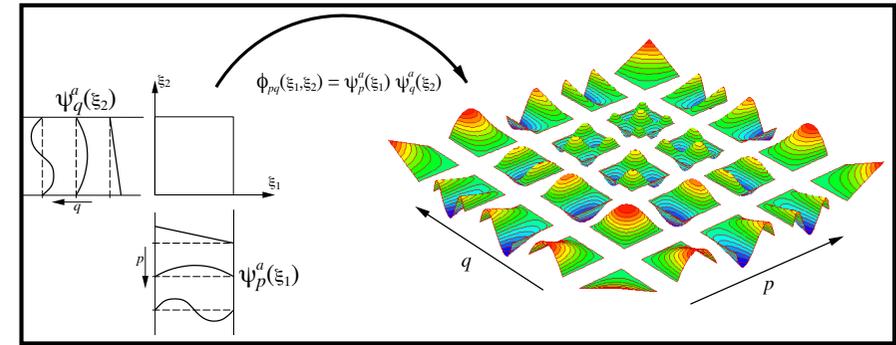
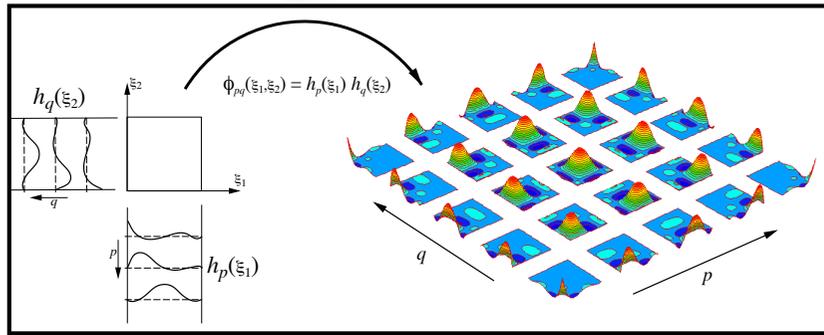
- 2003
- Restructure *Nektar*
- Expand applications
- Allow greater flexibility

www.nektar.info

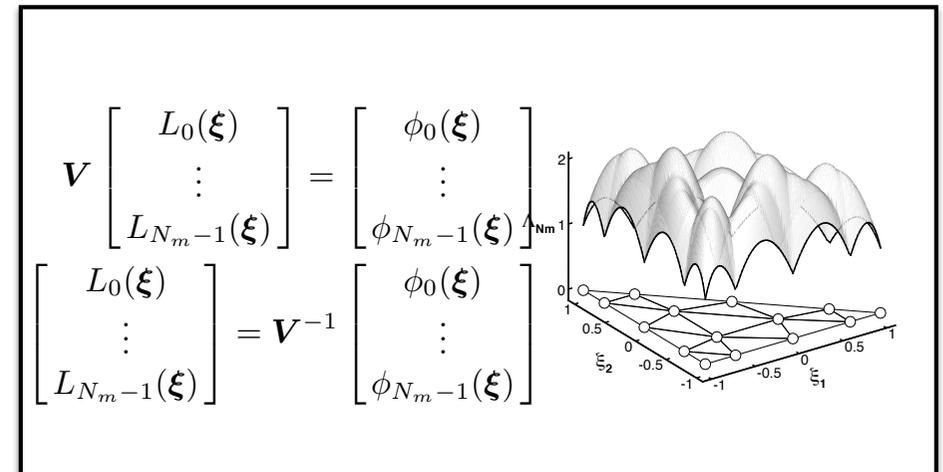
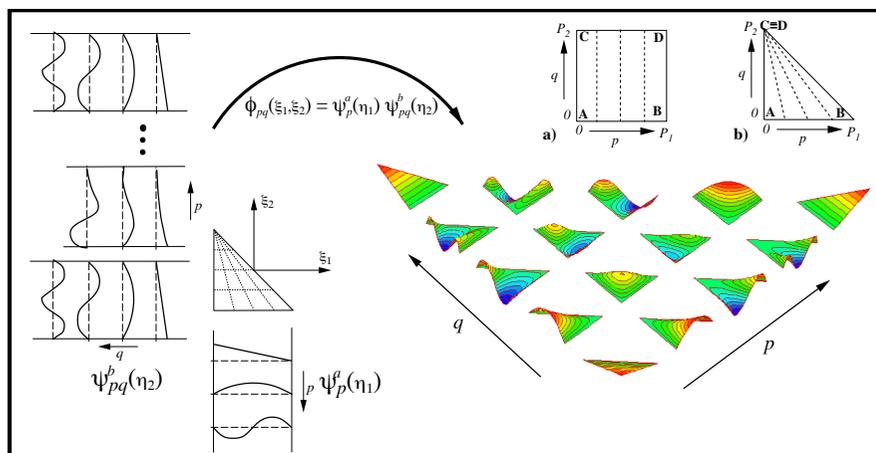
Original Scope

- Scalar basis fields (explicitly coupled)
 - Time dependent non-linear solvers
 - Implies scalar boundary conditions

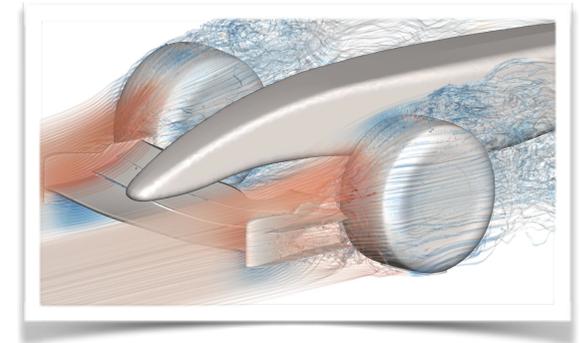
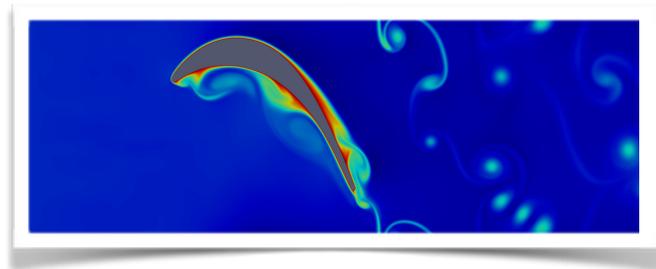
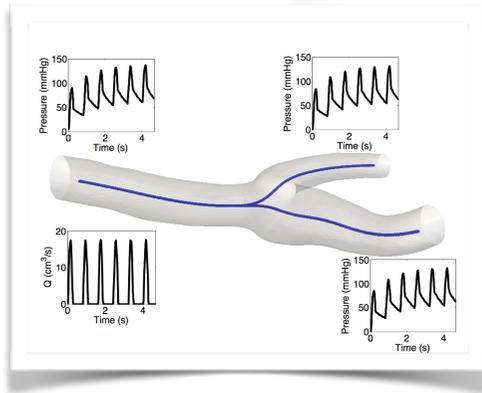
Original Scope



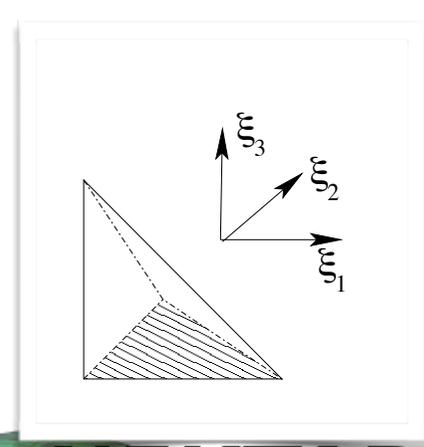
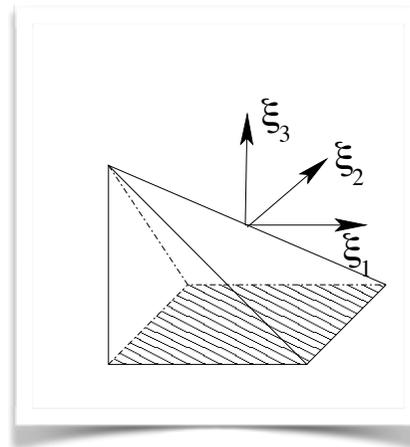
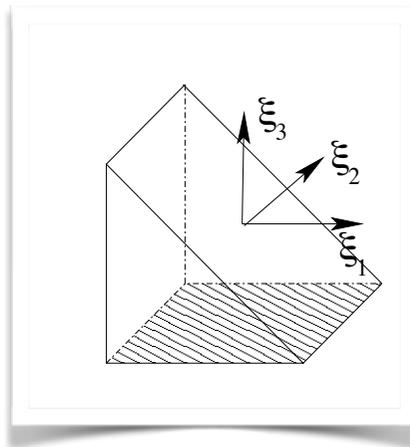
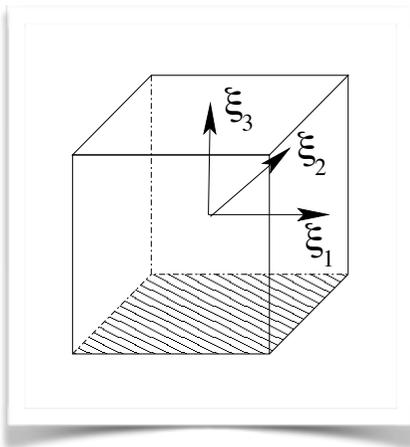
- Tensor nodal & modal product definition
- Nodal unstructured through mapping



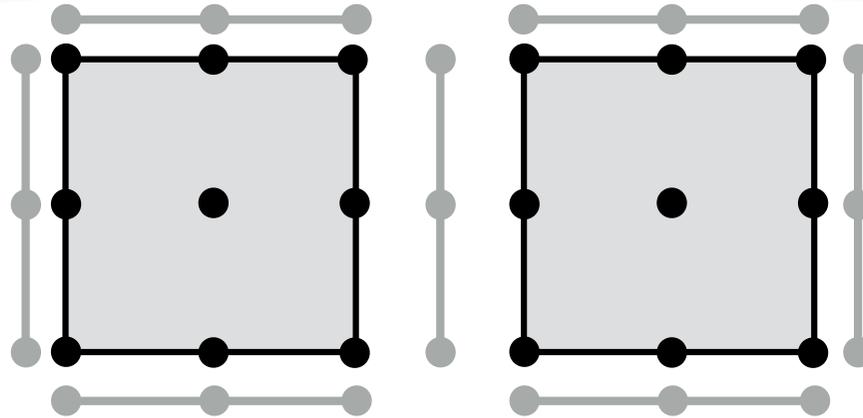
Original Scope



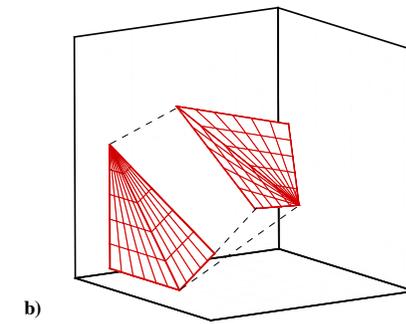
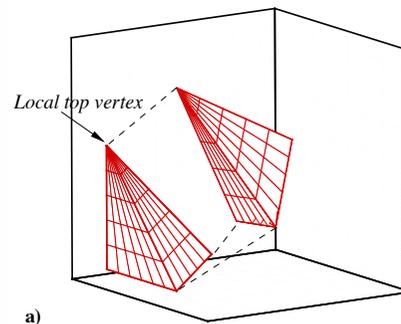
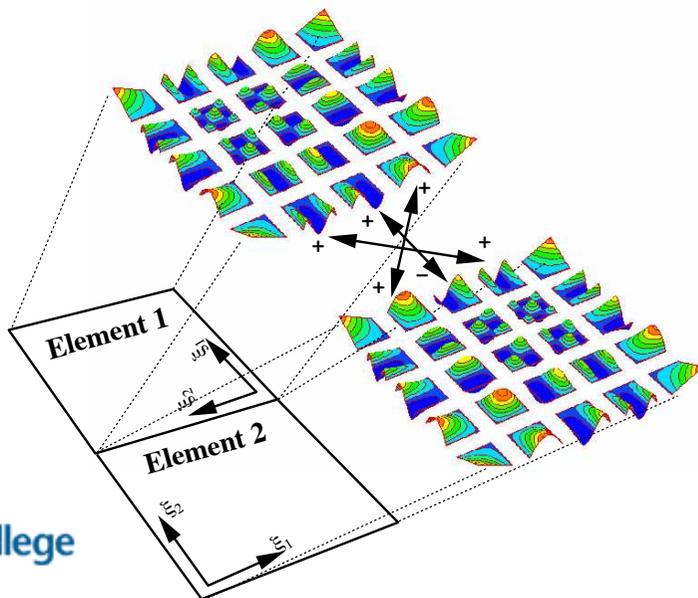
- Segment (1D), plane (2D) and volume domains (3D) & manifolds
- Hybrid Domains



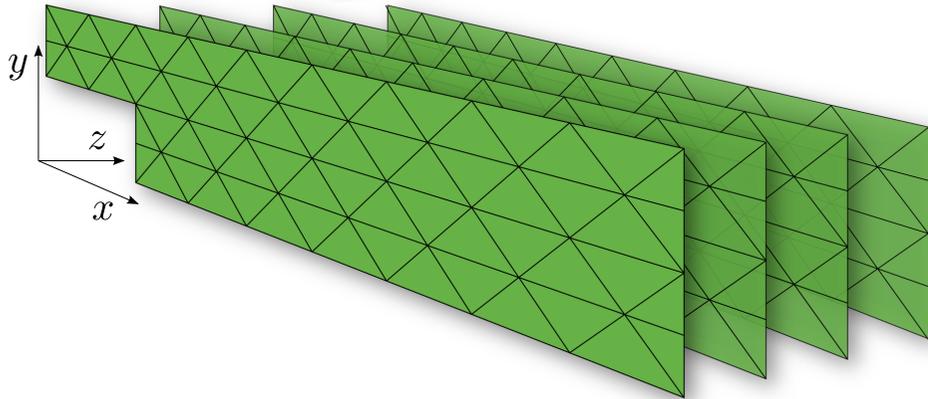
Original Scope



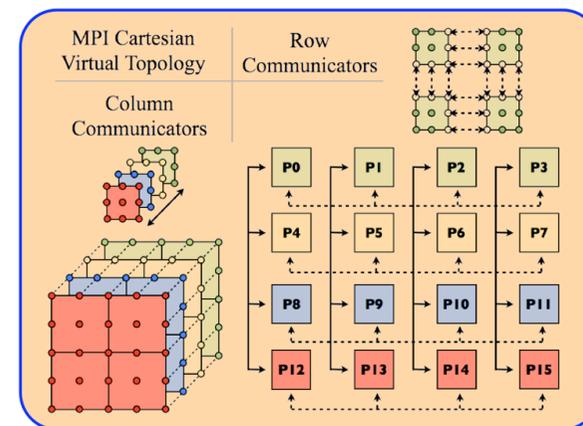
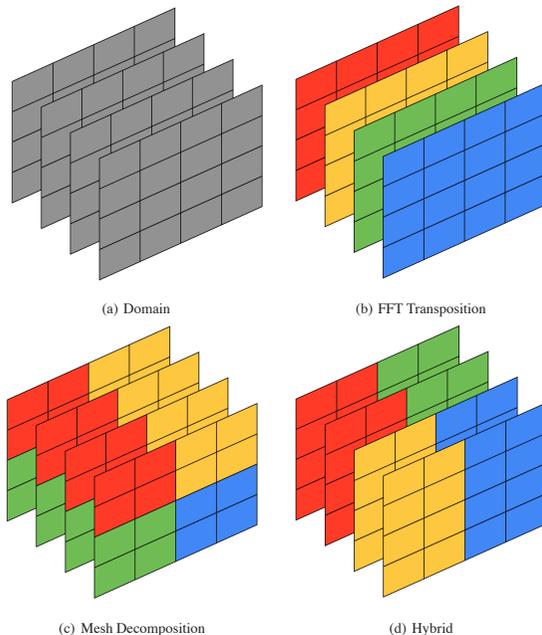
- Continuous and Discontinuous approx.
- DG & Flux Reconstruction



Original Scope



- Homogeneous expansions
- Parallel hybrid discretisation



Framework design

IncNavierStokes

CompressibleFlow

ADR

ImageWarping

...

SolverUtils

Core Nektar++ libraries

MultiRegions

LocalRegions

SpatialDomains

Collections

StdRegions

LibUtilities

Quadrature, bases, partitioning, input/output, linear algebra, interpreter, FFT, ...

Boost

Metis

TinyXML

Gslib

VTK

PETSc

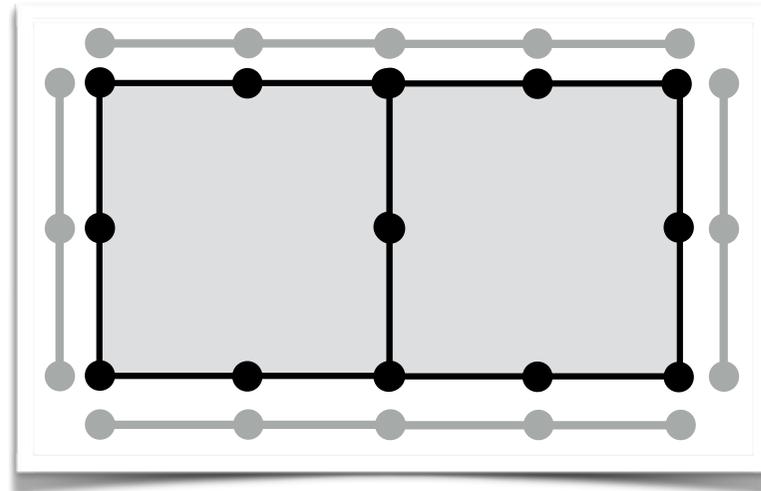
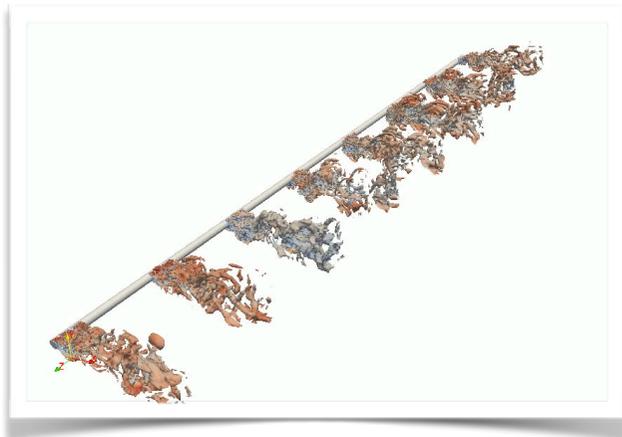
ARPACK

FFTW

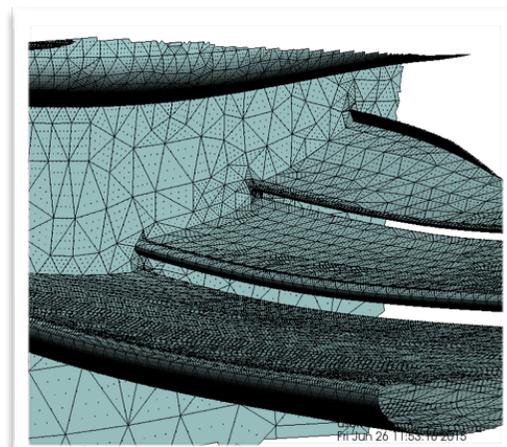
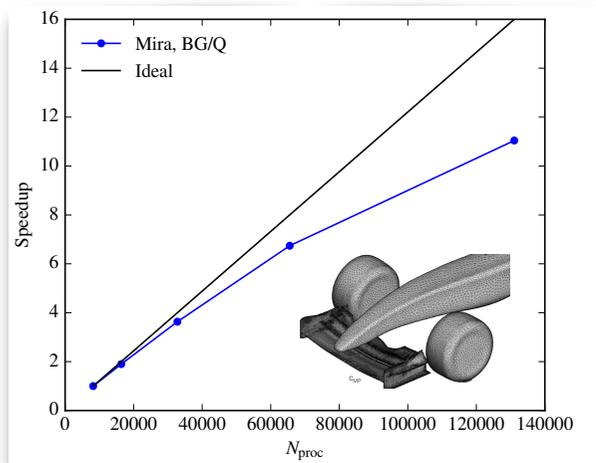
Scotch

Zlib

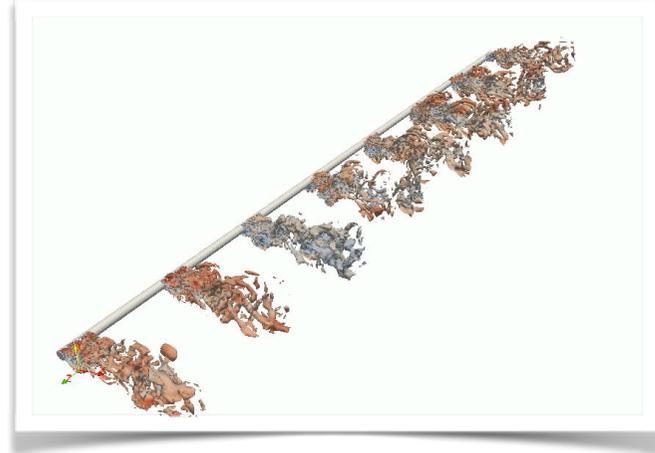
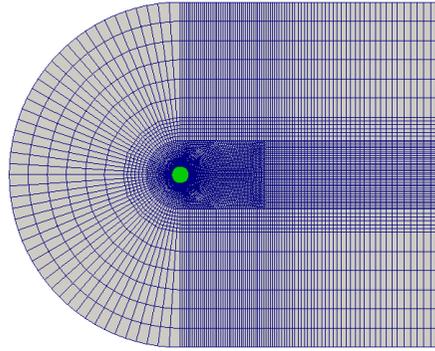
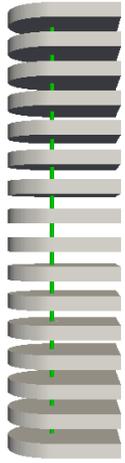
QT



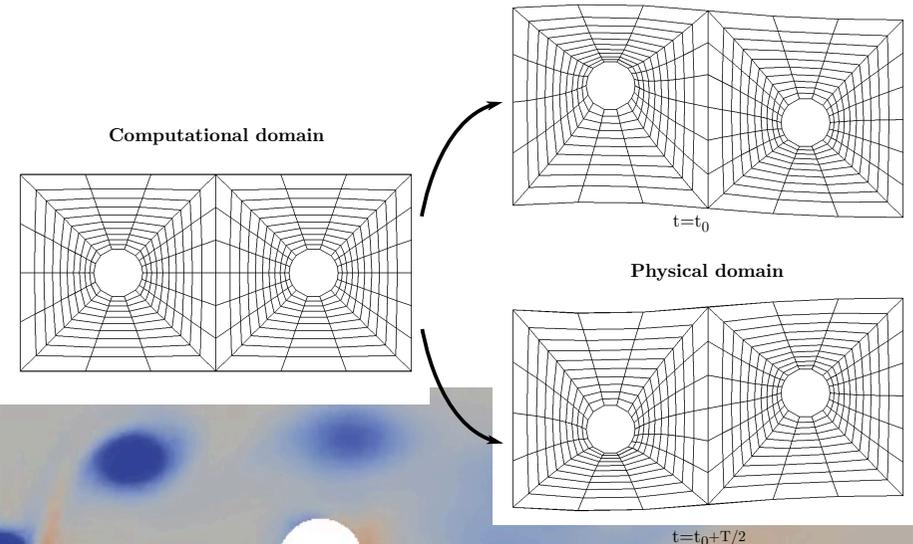
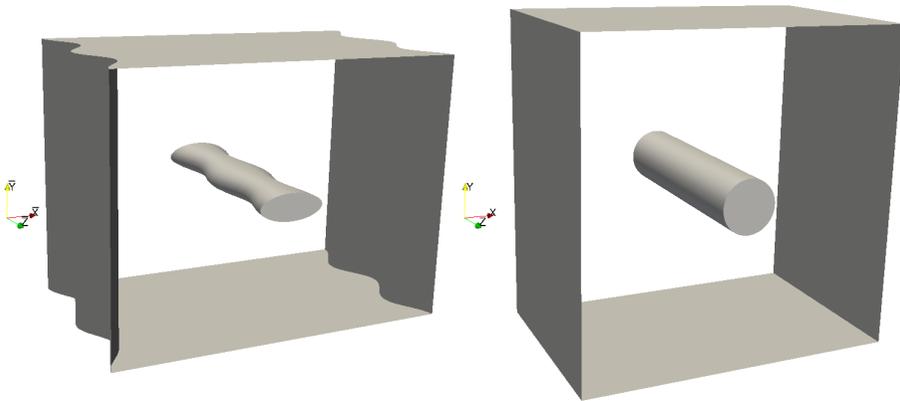
Ongoing developments



Ongoing developments



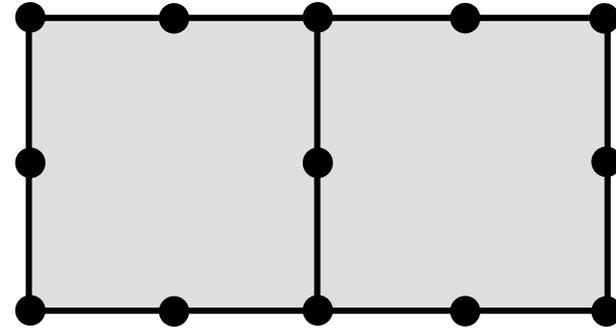
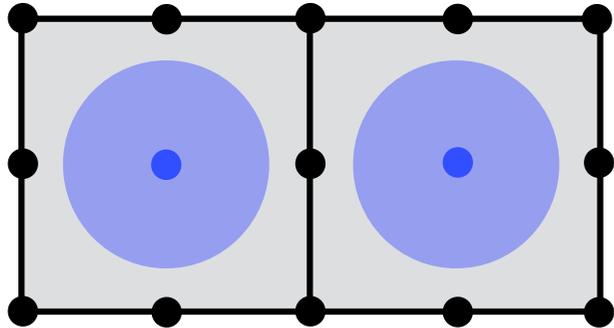
- Thick strip & moving mesh modelling



Ongoing developments

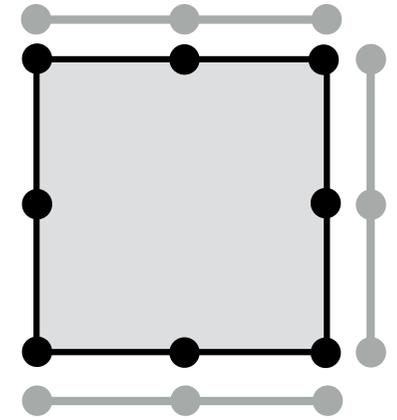
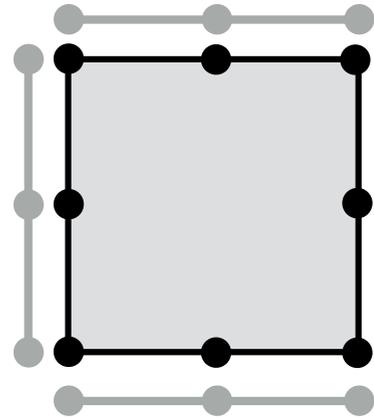
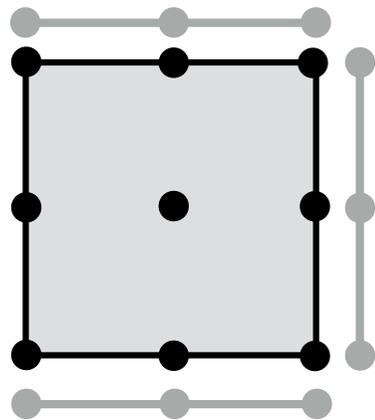
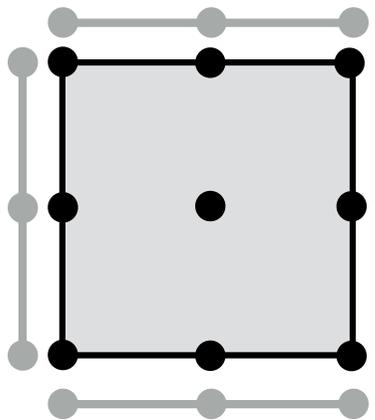
CG

static condensation



- CG-HDG interfacing

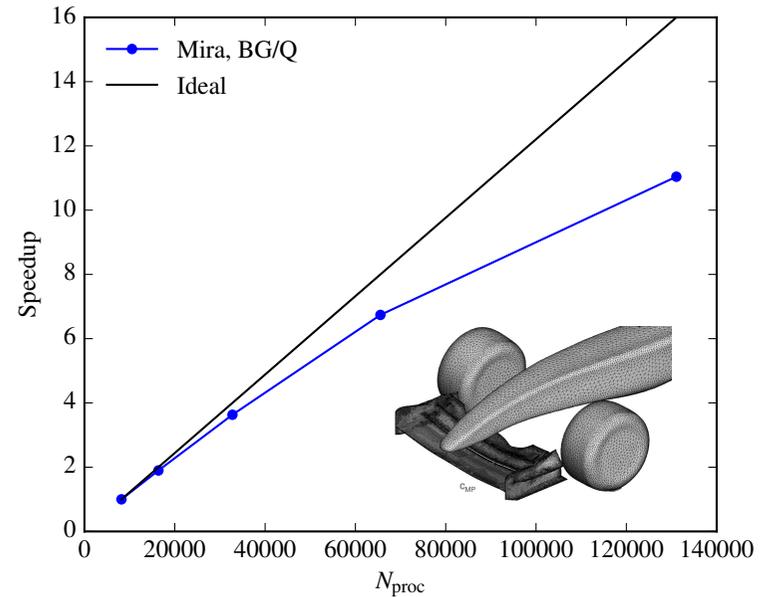
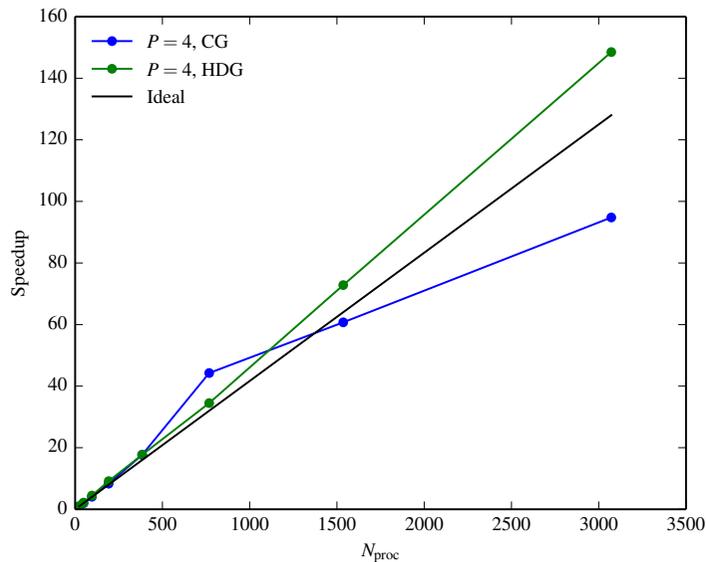
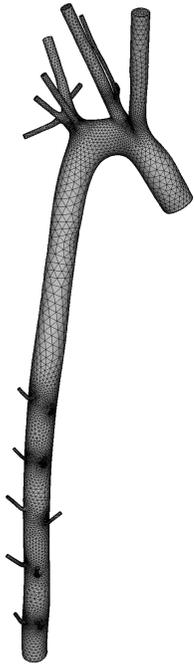
DG



static condensation

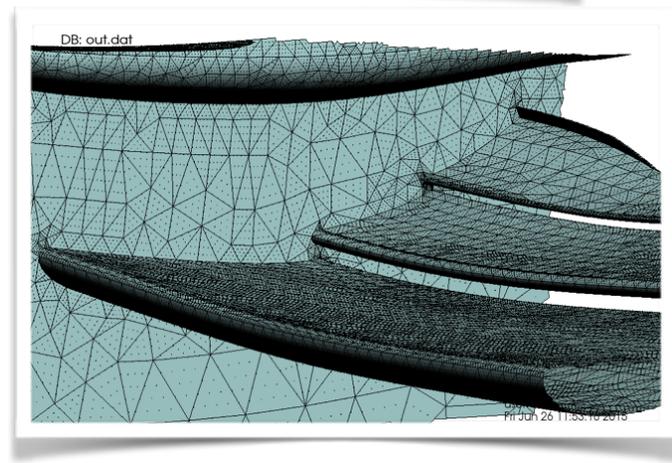
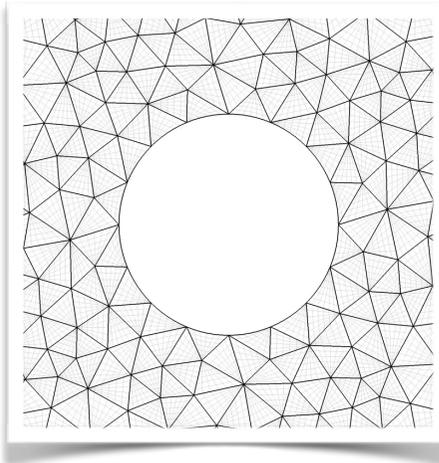
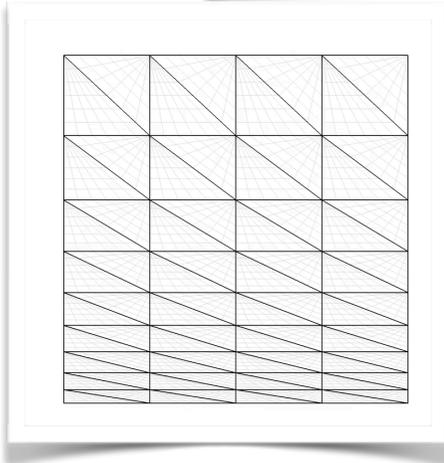
HDG

Ongoing developments

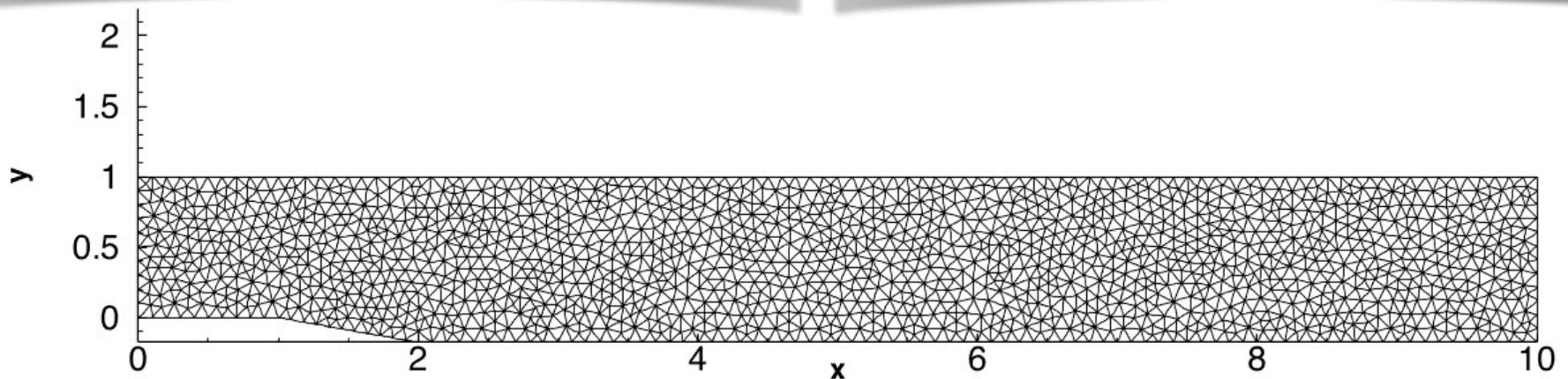
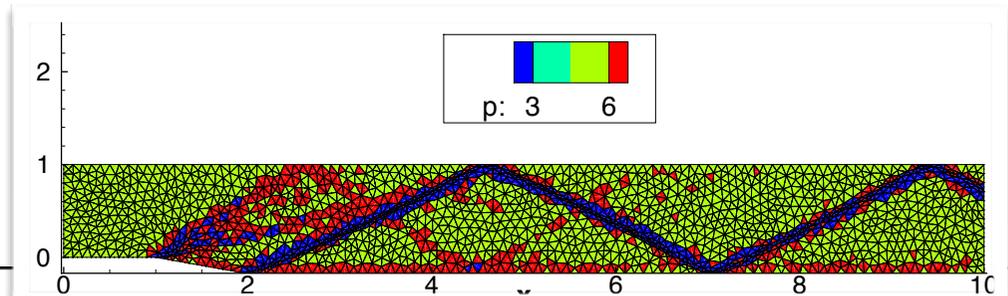
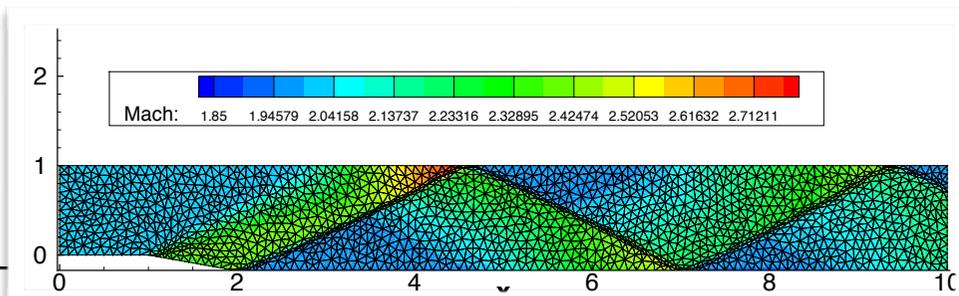


- Scaling, preconditioning, threading
 - Threading branch under development
 - Threading manager is in master
 - Parallel I/O - HDF5, DMPLex

Ongoing developments

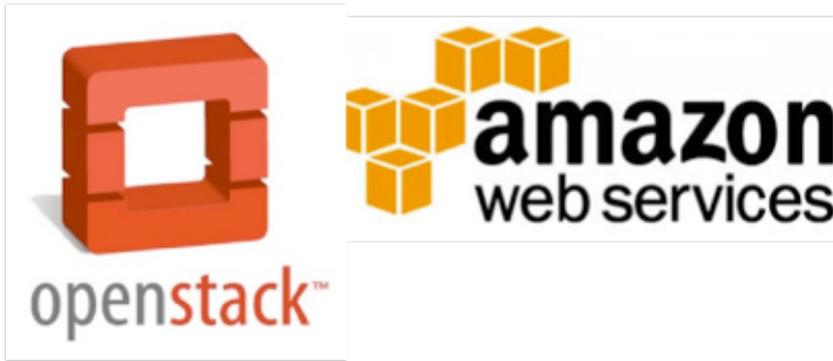


- Meshing, p, r-adaption



Deploying to the cloud

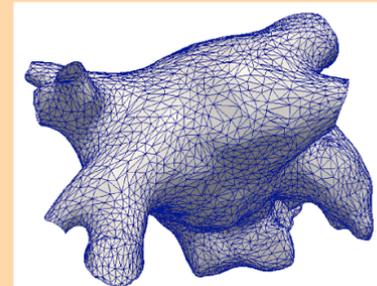
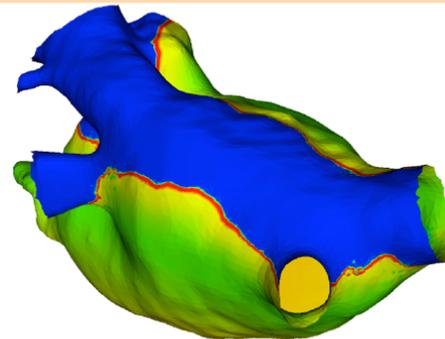
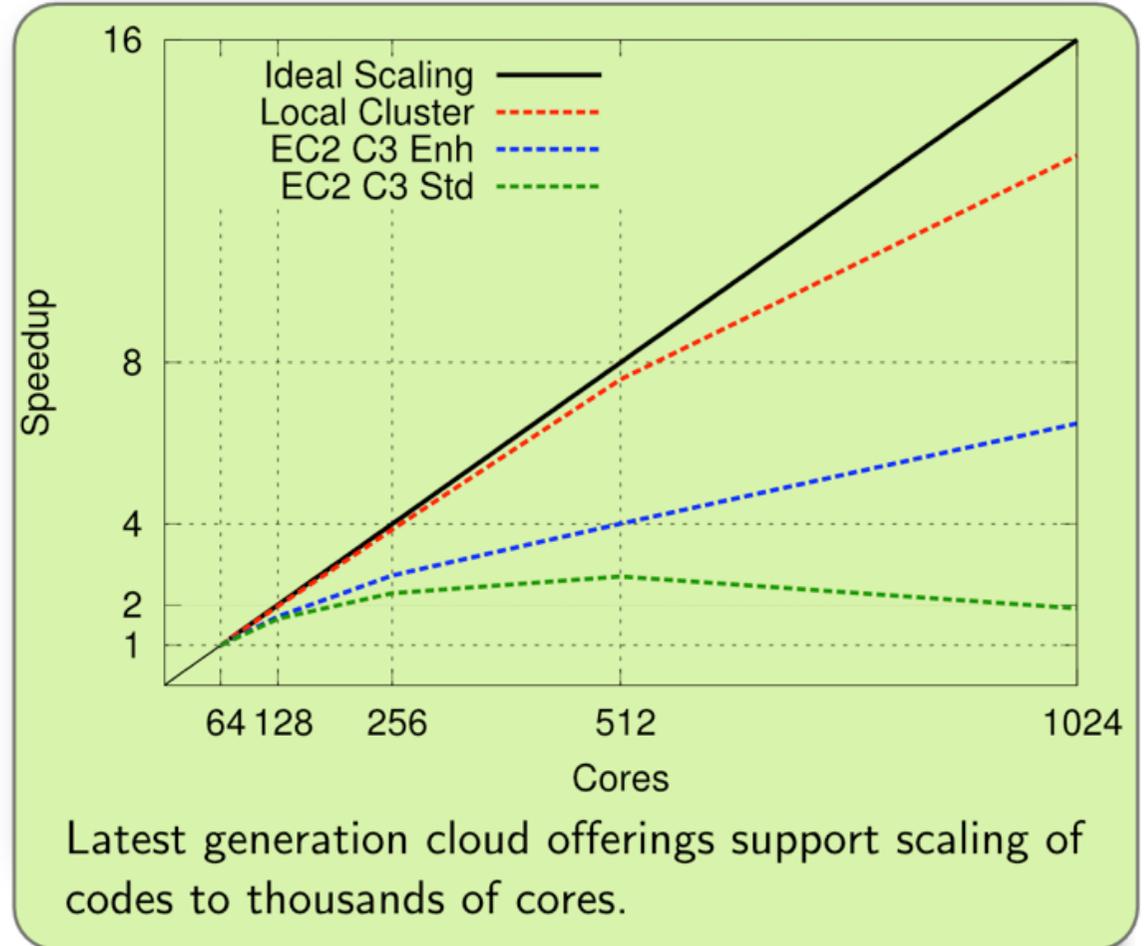
Cloud computing provides on-demand pay-per-use computing resources.



Challenging to configure and use.

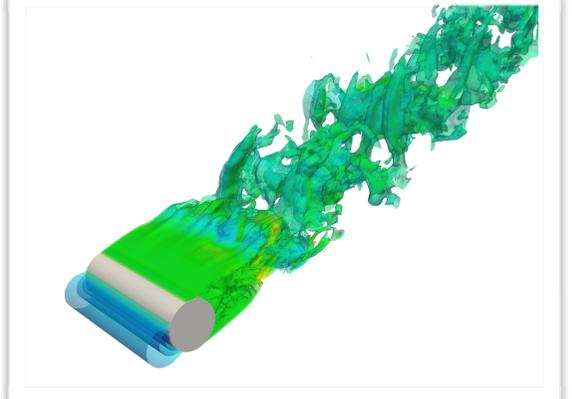
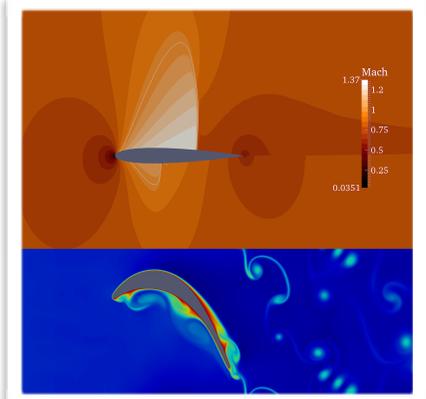
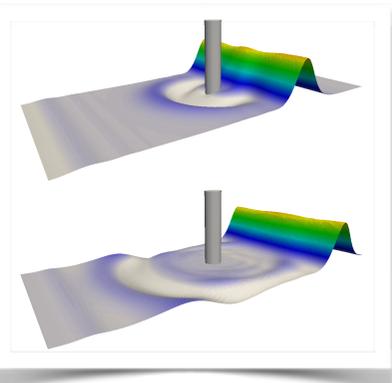
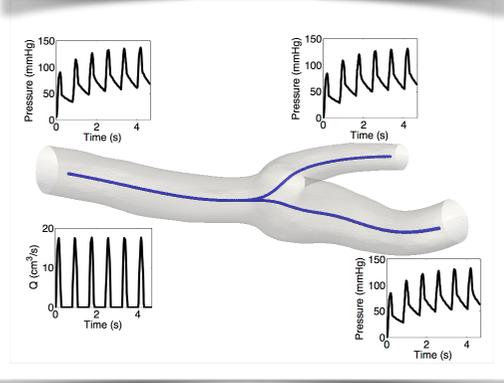
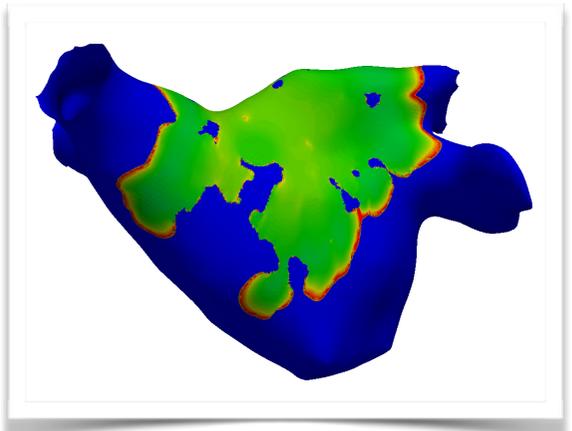
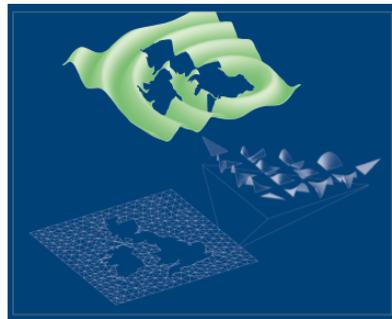
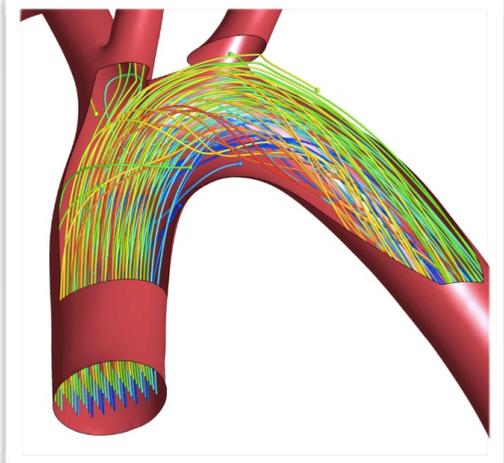
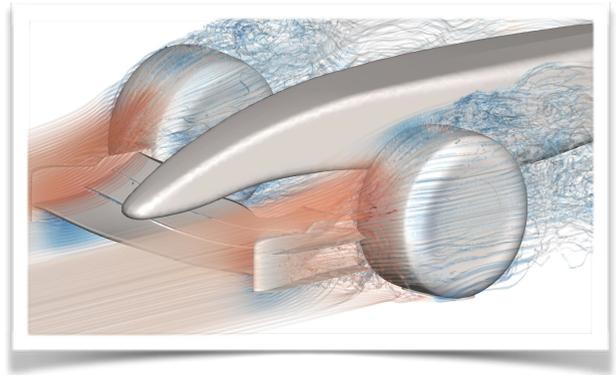
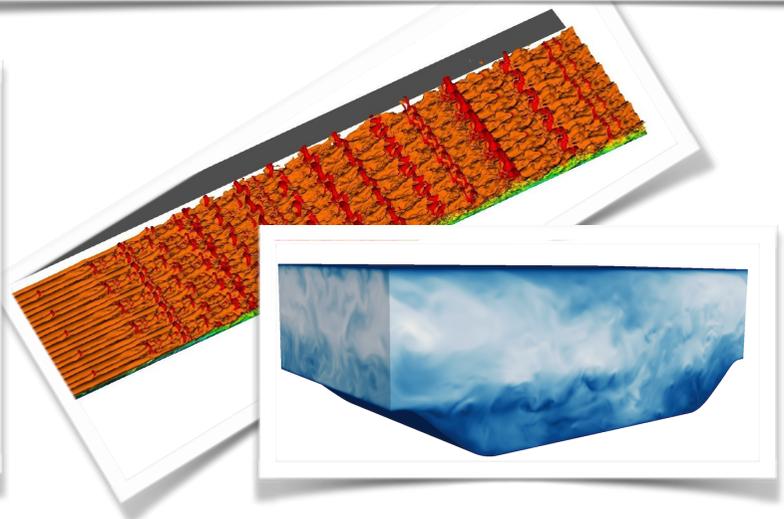
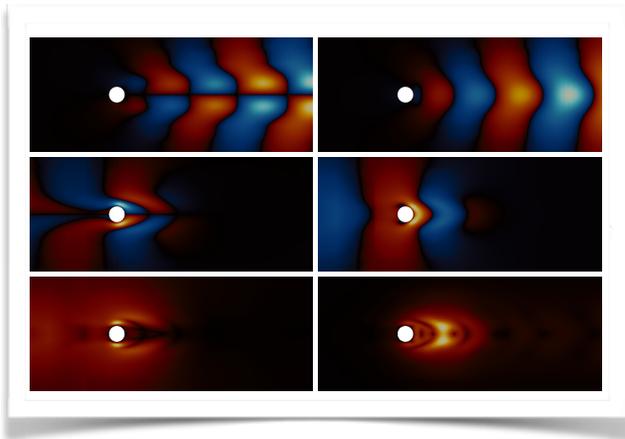
Nekkloud: web-interface for Nektar++

Libhpc: Unify access to resources and simplify deployment to clusters and clouds.



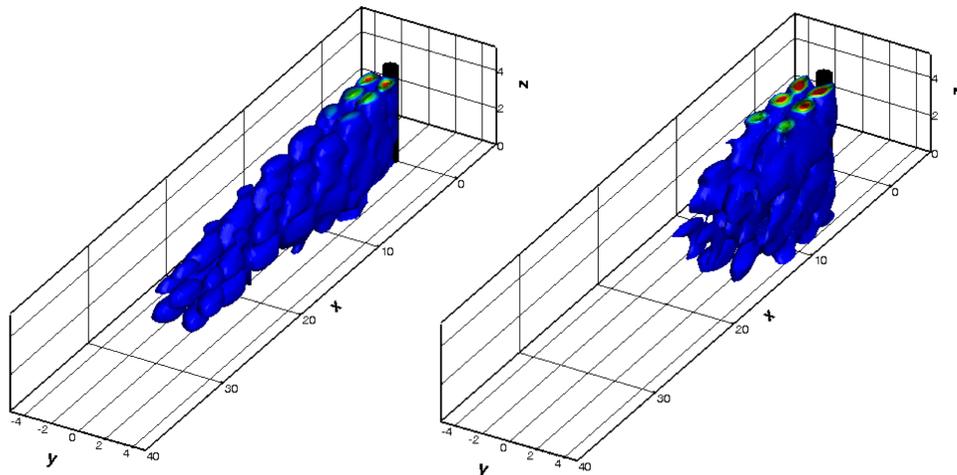
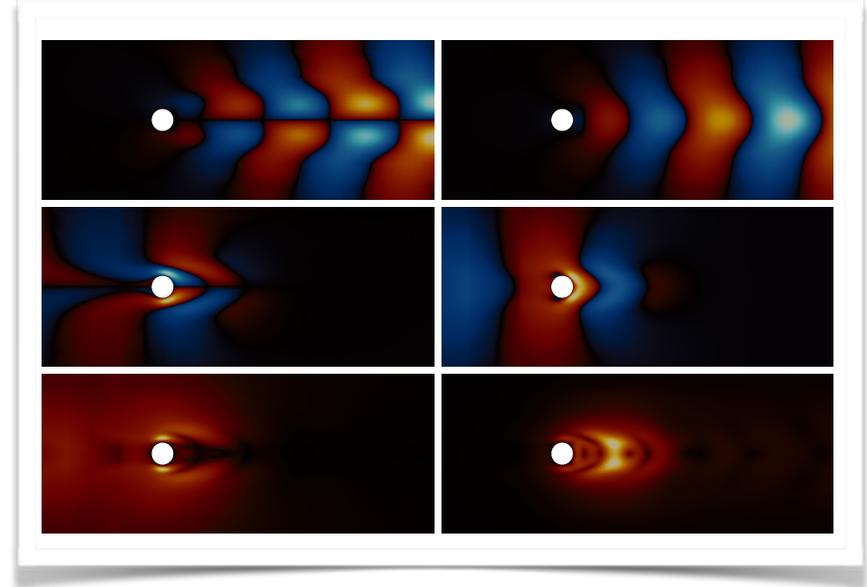
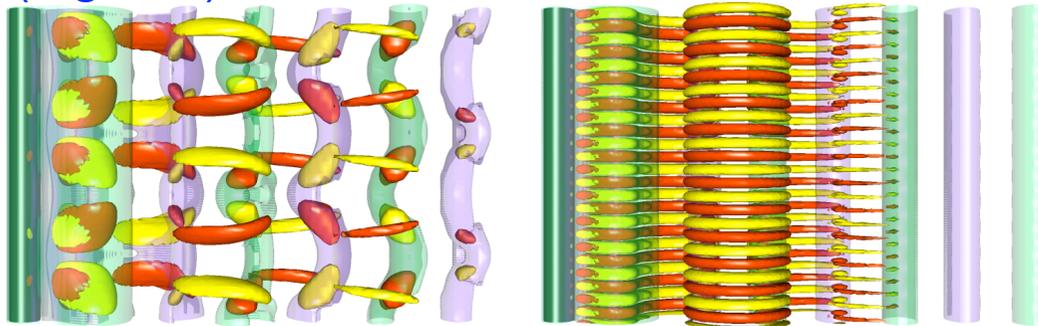
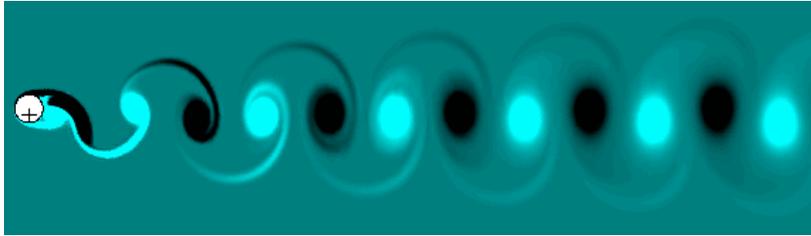
Cardiac Electrophysiology

Nektar++ Applications



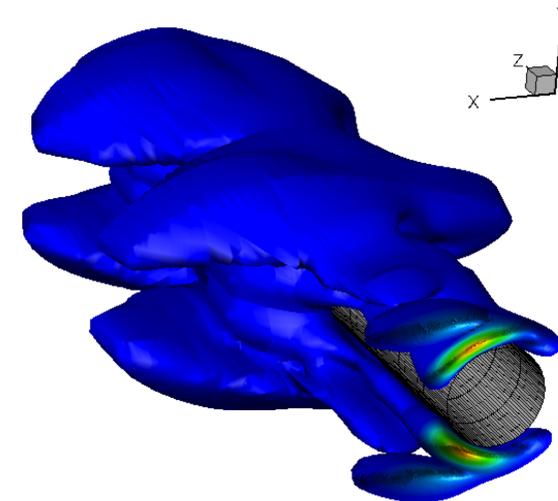
Direct Stability Analysis

Direct
stability
analysis
(Biglobal)



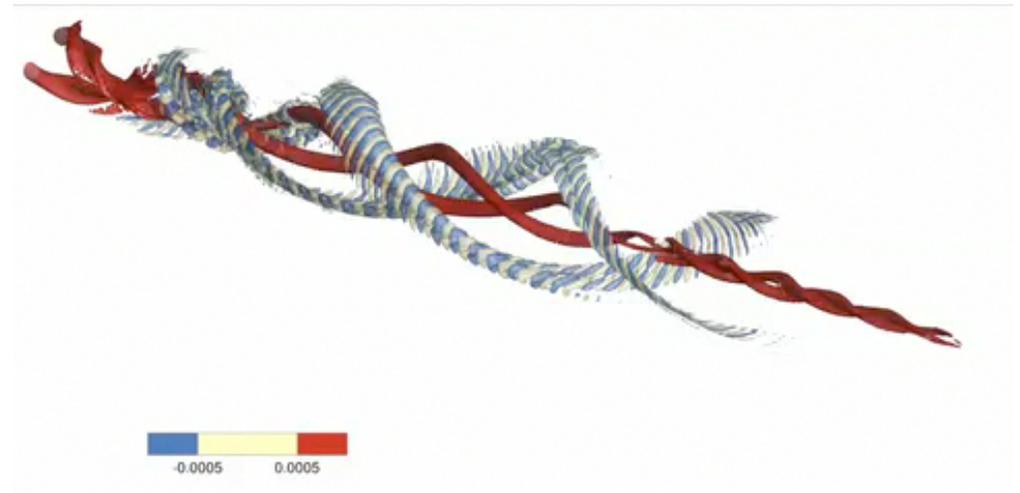
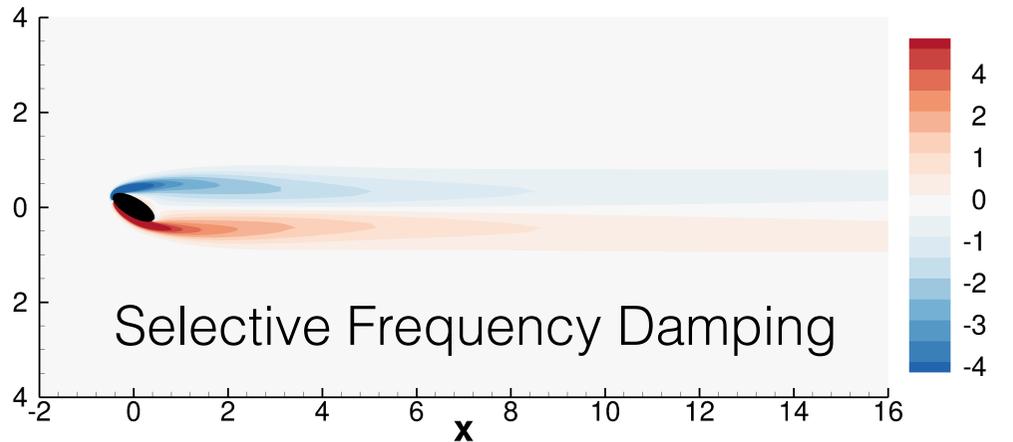
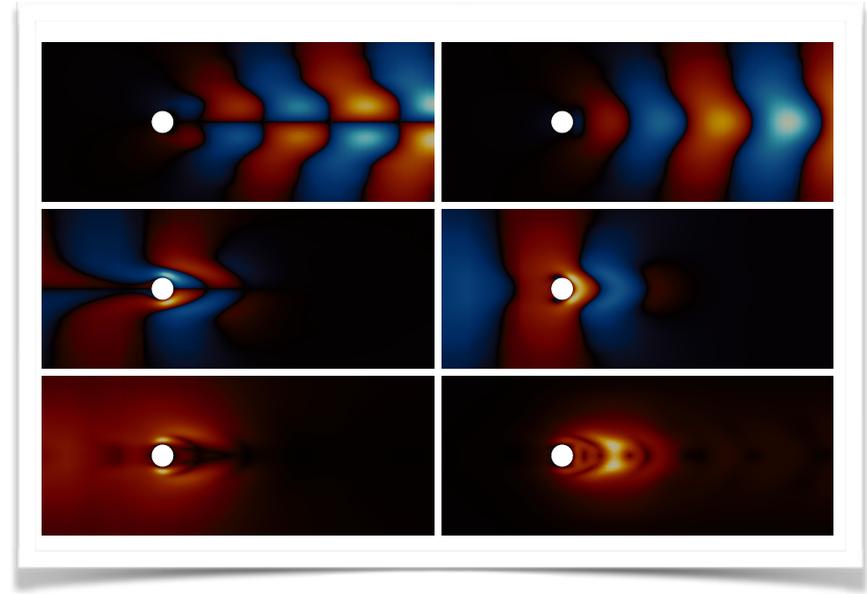
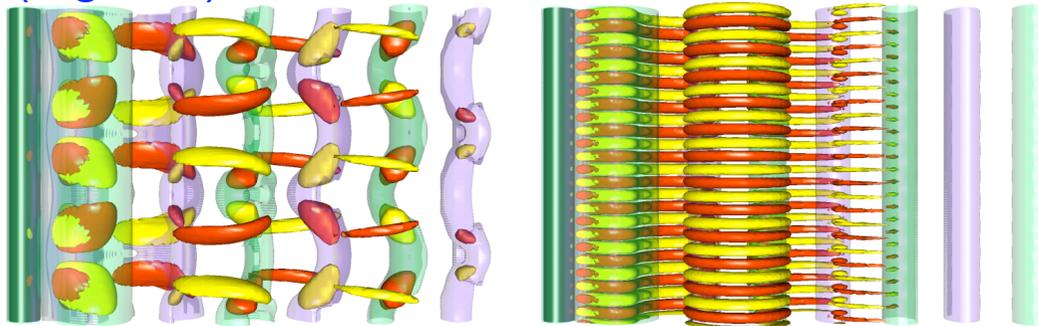
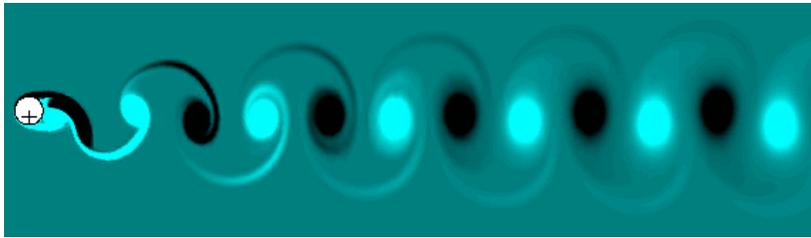
(c) $A = 0.008$

(d) $A = 0.15$.

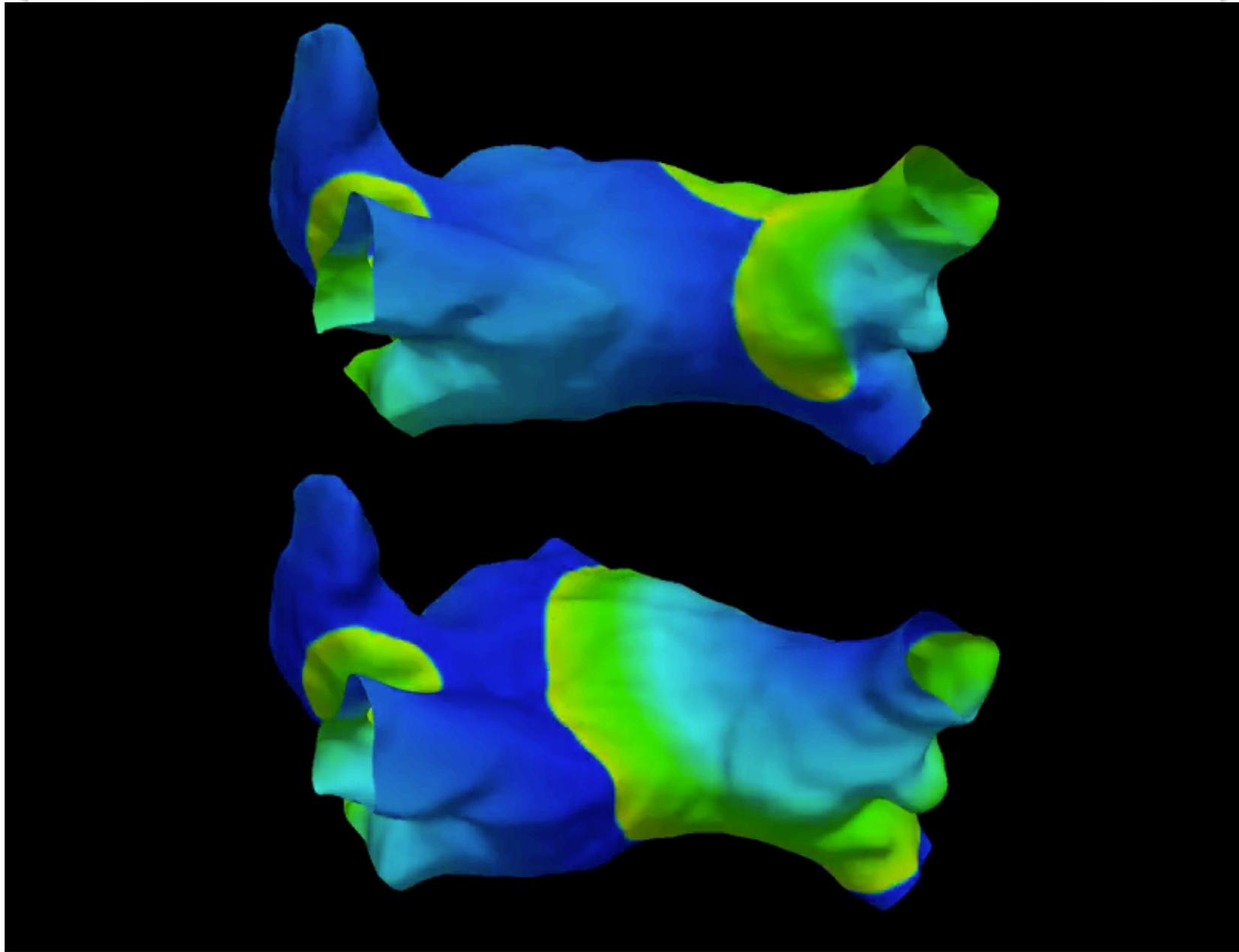


Direct Stability Analysis

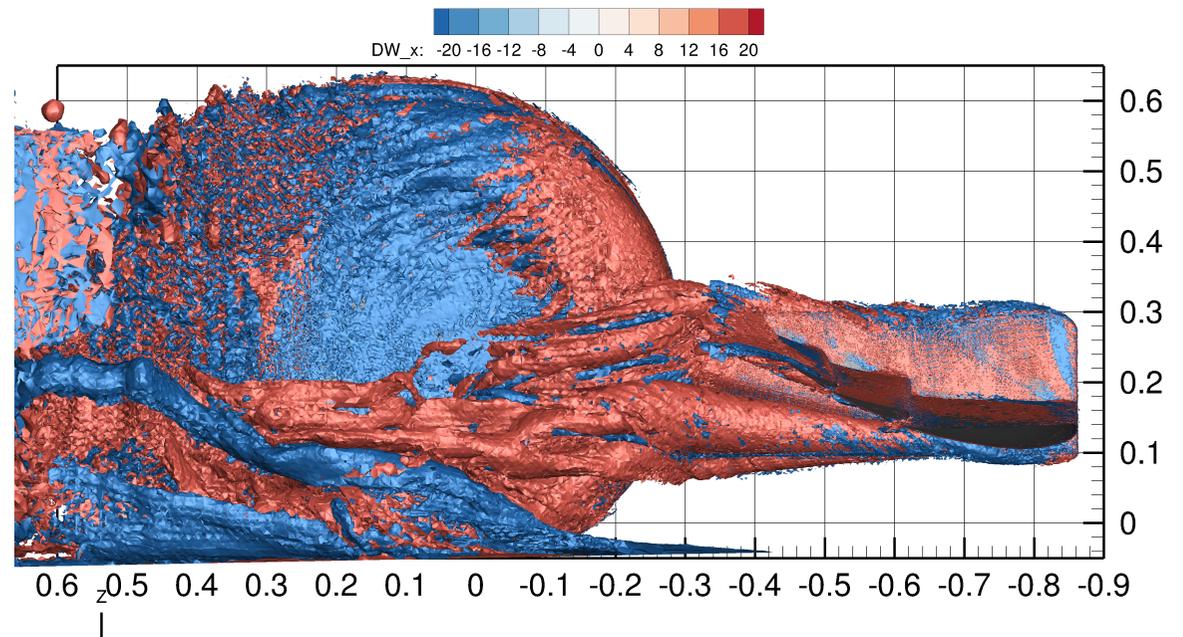
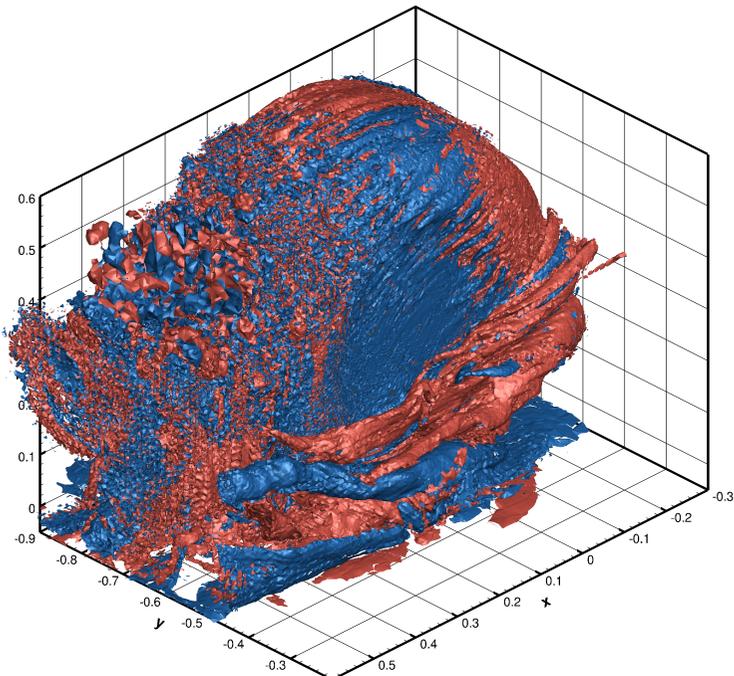
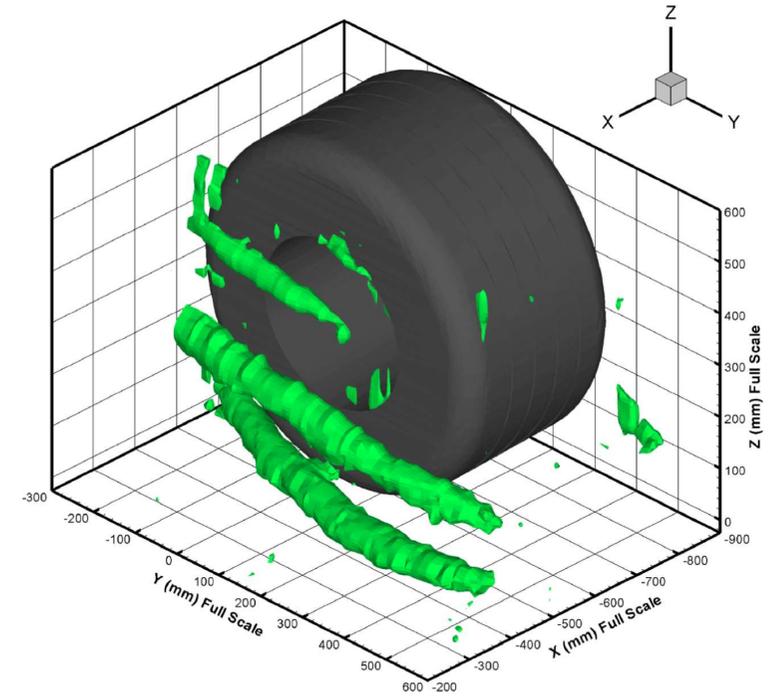
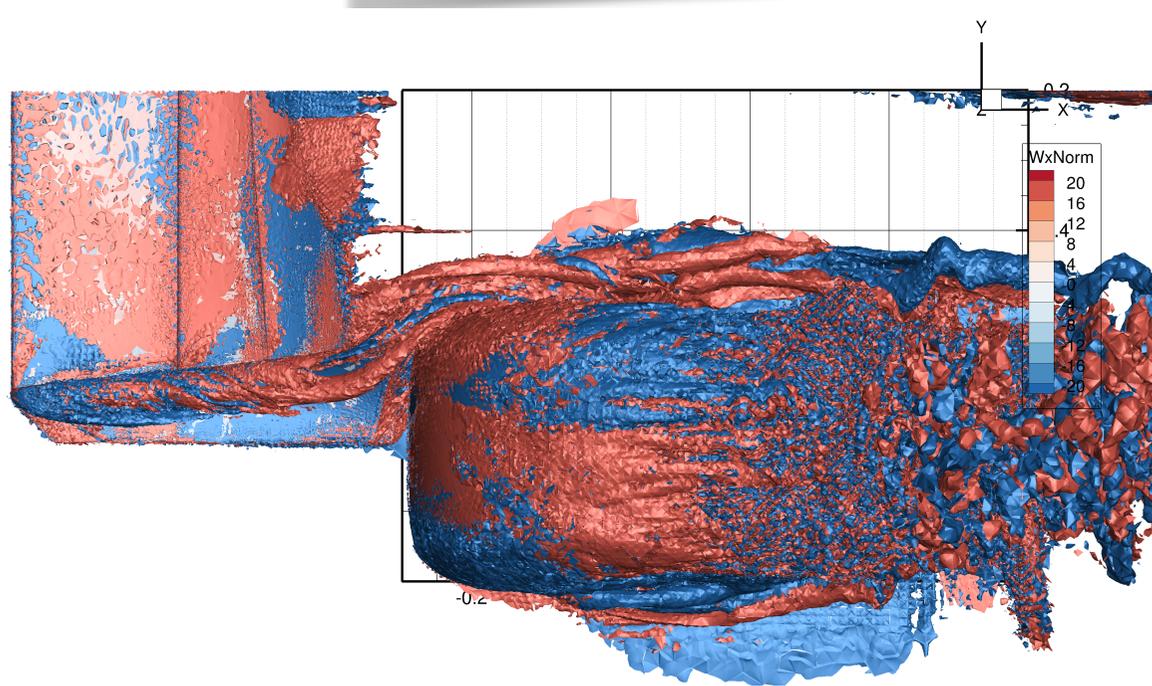
Direct
stability
analysis
(Biglobal)



Computational Electrophysiology



High Re modelling



Outline

- Ongoing developments & Applications
- Library design - *Chris Cantwell*
- Pre and Post processing - *Dave Moxey*
- Future topics - *Mike Kirby*
- User Applications: *This afternoon*
- *Tutorials tomorrow After dinner*

The Locals



Joaquim Peiró



Yan Bao



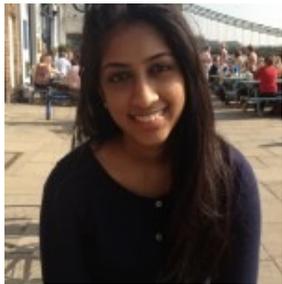
Chris Cantwell



David Moxey



Hui Xu



Rheeda Ali



Paola
Alpresa-Gutierrez



Dirk Ekelschot



Daniele de Grazia



Douglas Serson



Bastien Jordi



Jean-Eloi Lombard



Gianmarco
Mengaldo



Yumnah Mohamied



Rodrigo Moura



Michael Turner