Developmente of Shock-Fitting technique on unstructured grids

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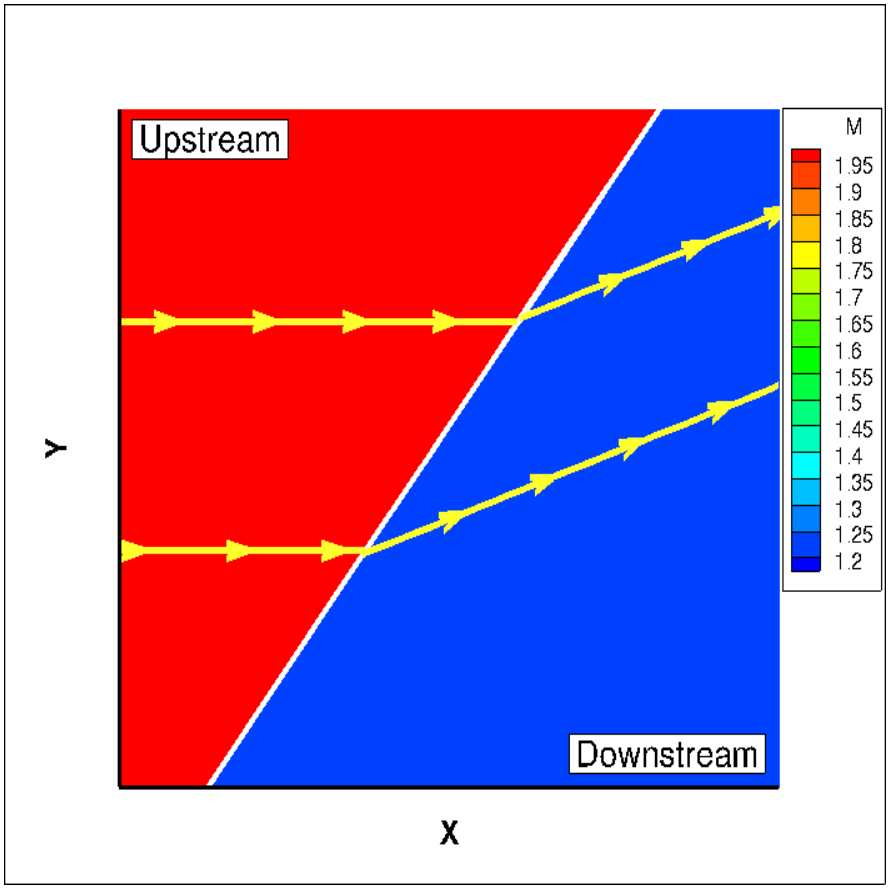
Rome, 13/2/2017

SAPIENZA
UNIVERSITÀ DI ROMA

Basic idea


Upstream
Downstream
M
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1.85
1.8
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1.7
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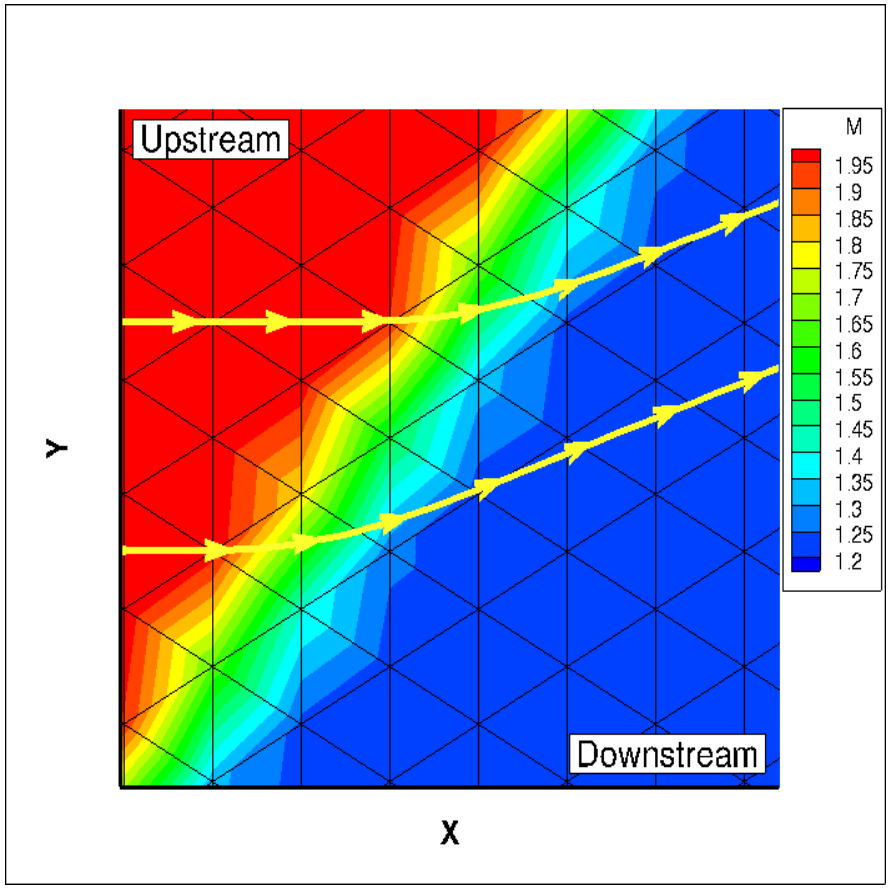
1.2
Y
X

Basic idea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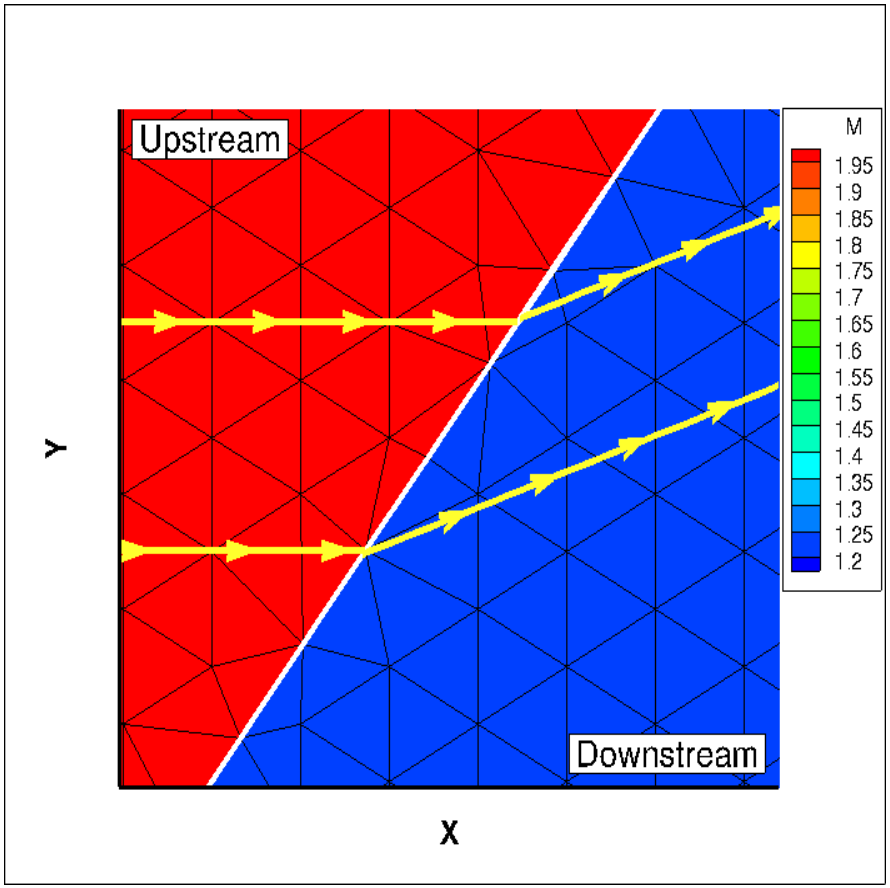
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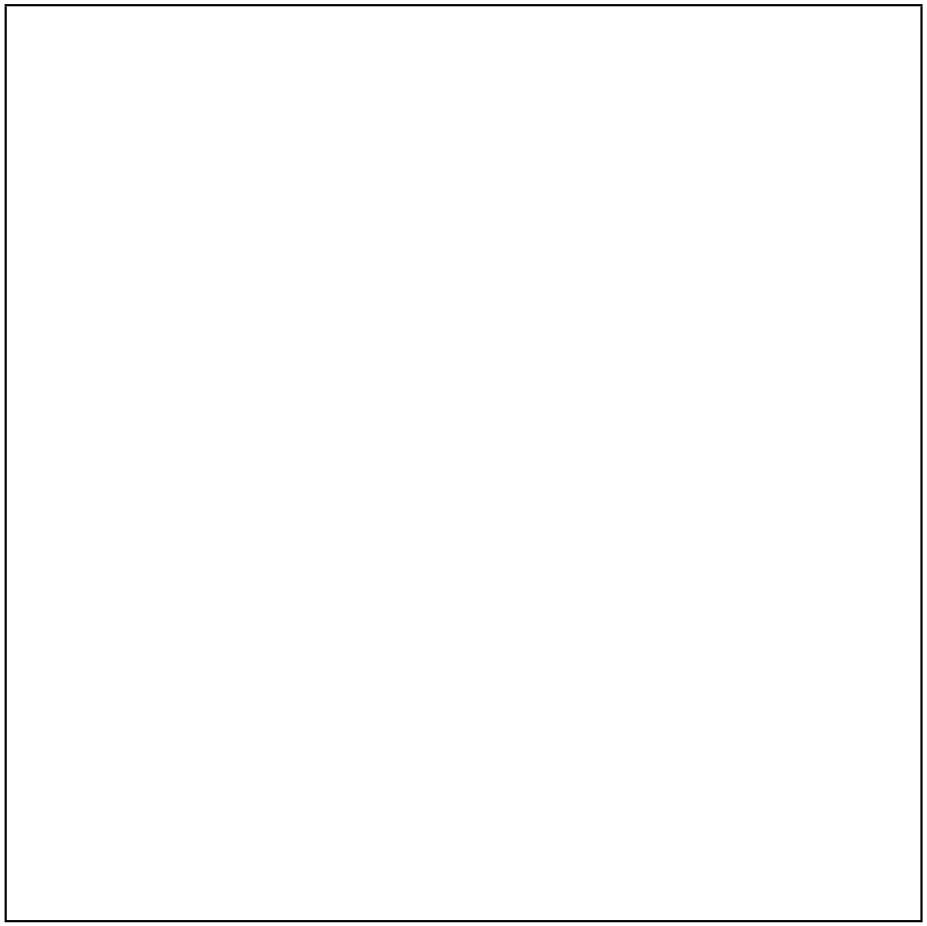
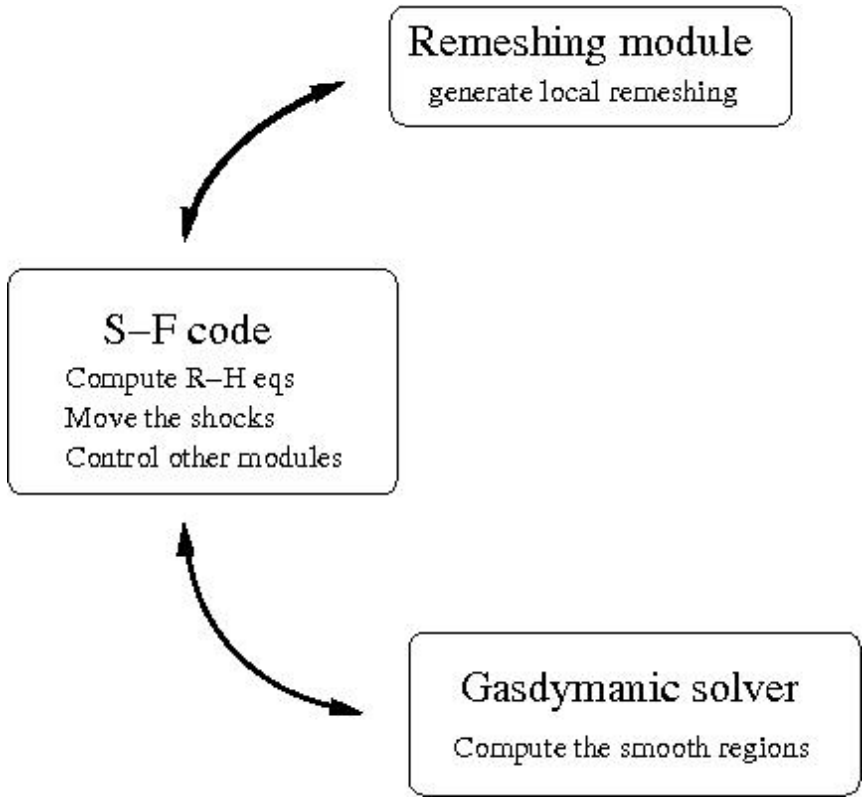


- Shock points move using R-H eqs.
- Mesh is locally remeshed to ensure that shock points and edges are part of computational mesh. No extra points are added, computational mesh is very similar to the original one
- Fitted shocks are internal boundaries for the gasdynamic solver.

Implementation of Unstructured SF

The implementation of the SF technique is modular

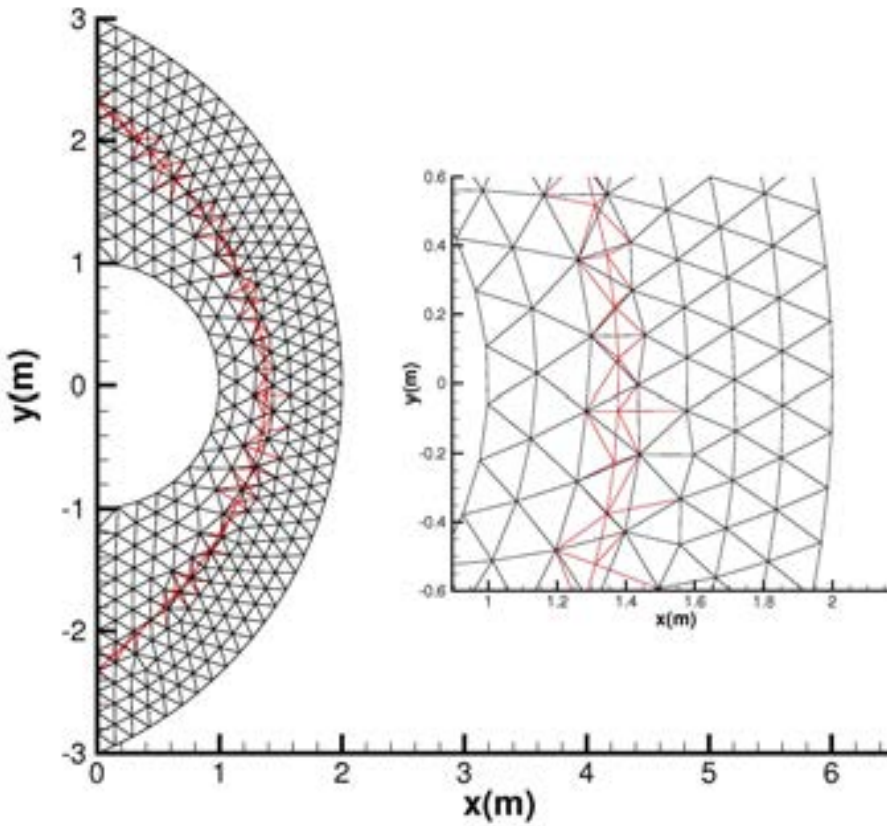


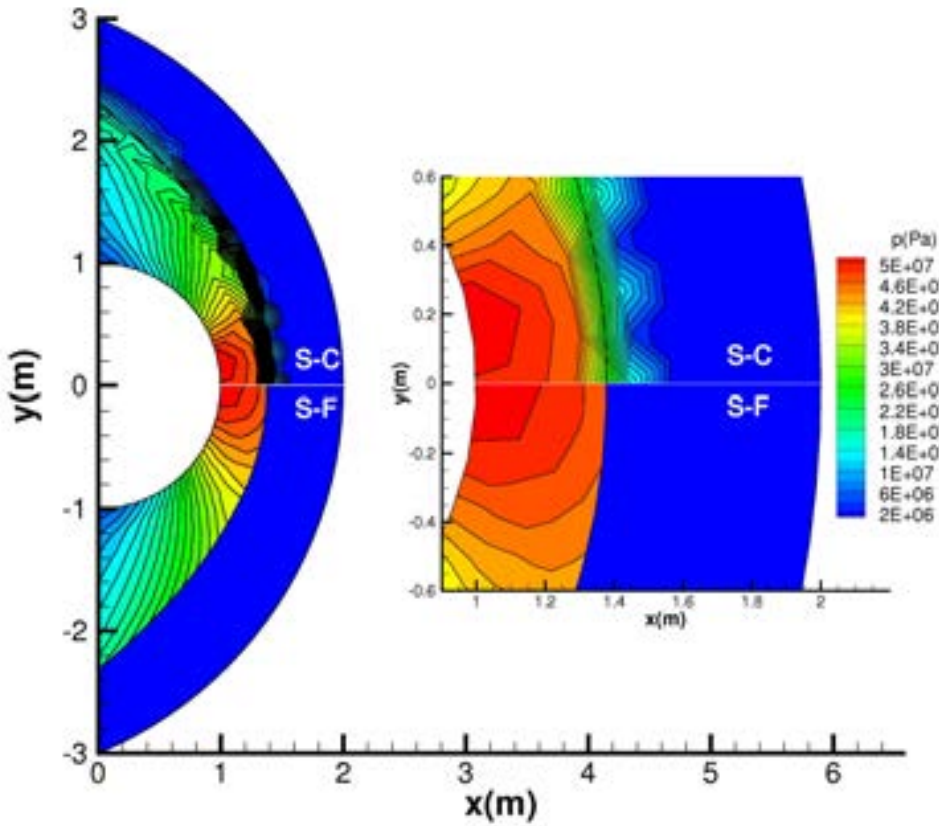
Key ingredients

- SF code
- Local remeshing module
- Gasdynamic solver

The local remeshing module and gasdynamic solver are in general codes "on the shelf" that are integrated in the computing procedure without modifications, since they operate as black box.

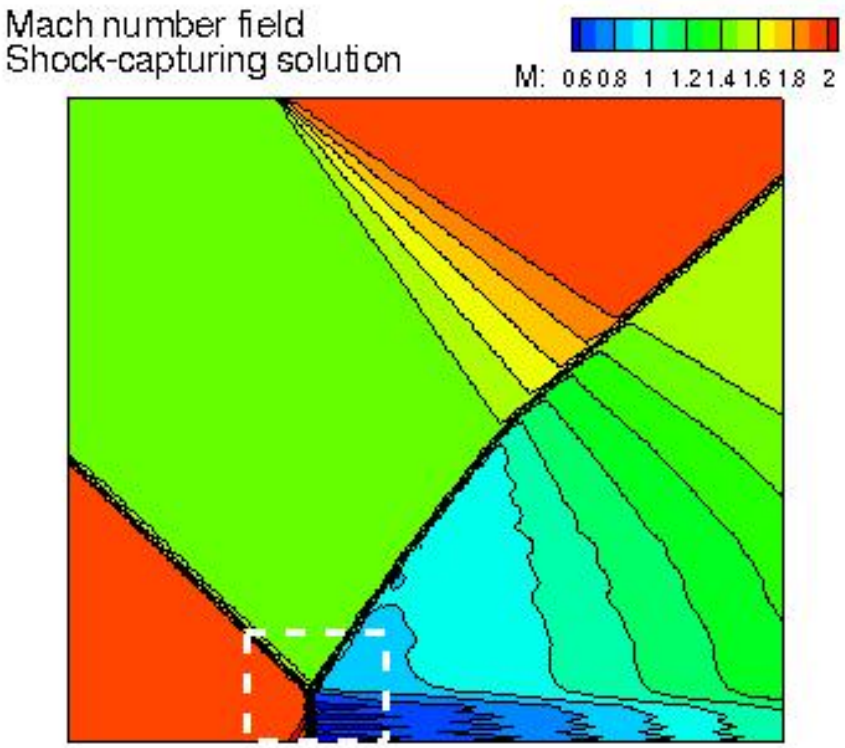
Ideal inviscid flow past a circular cylinder at $M_\infty = 20$

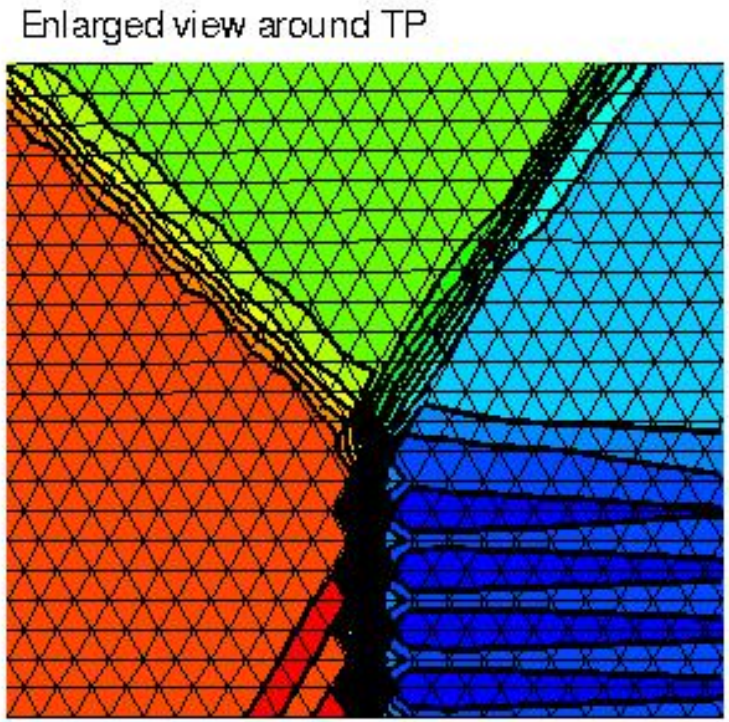




Examples of application of the unstructured SF technique

Mach reflection





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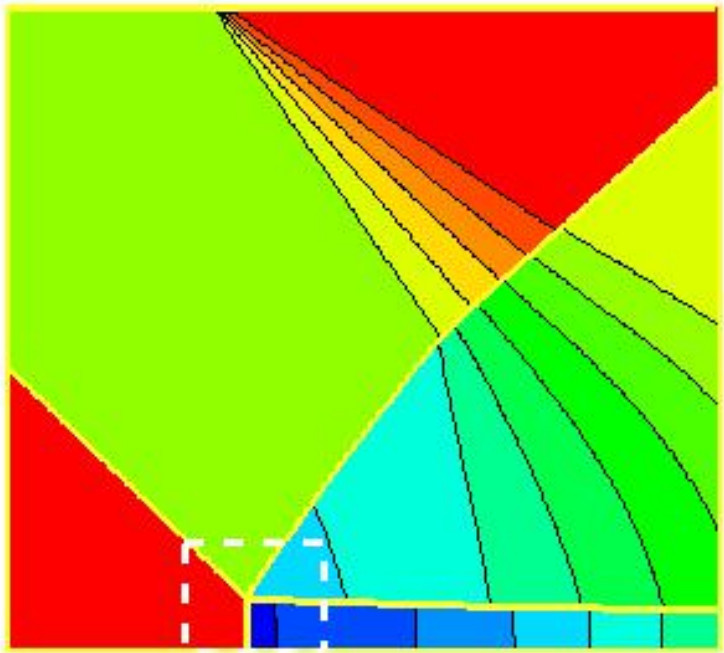
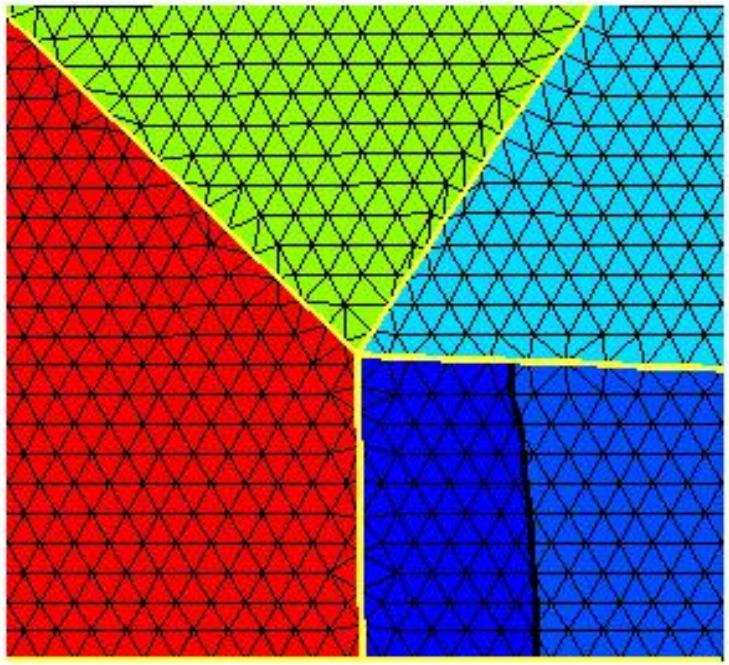
Mach reflection

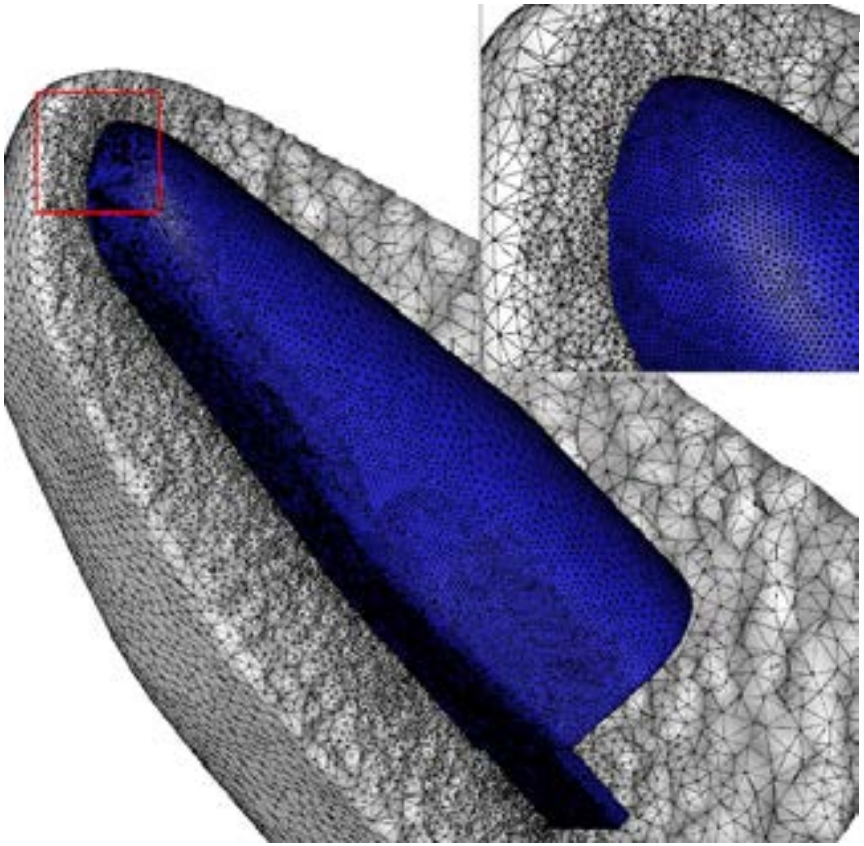
Fully fitted solution

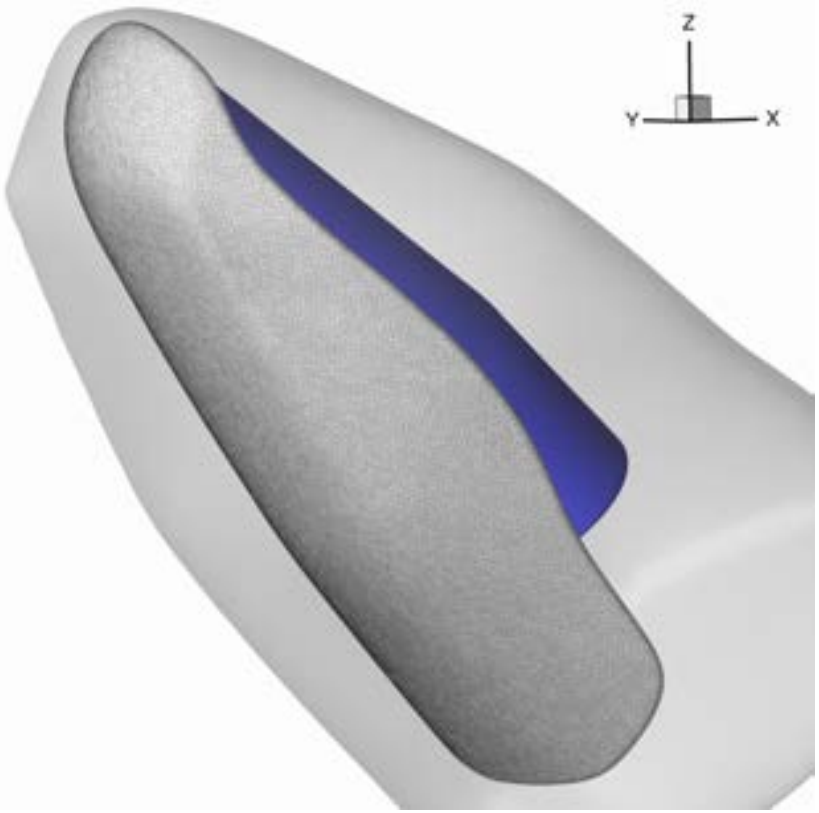




Examples of application of the unstructured SF technique

Hypersonic flow past IXV capsule





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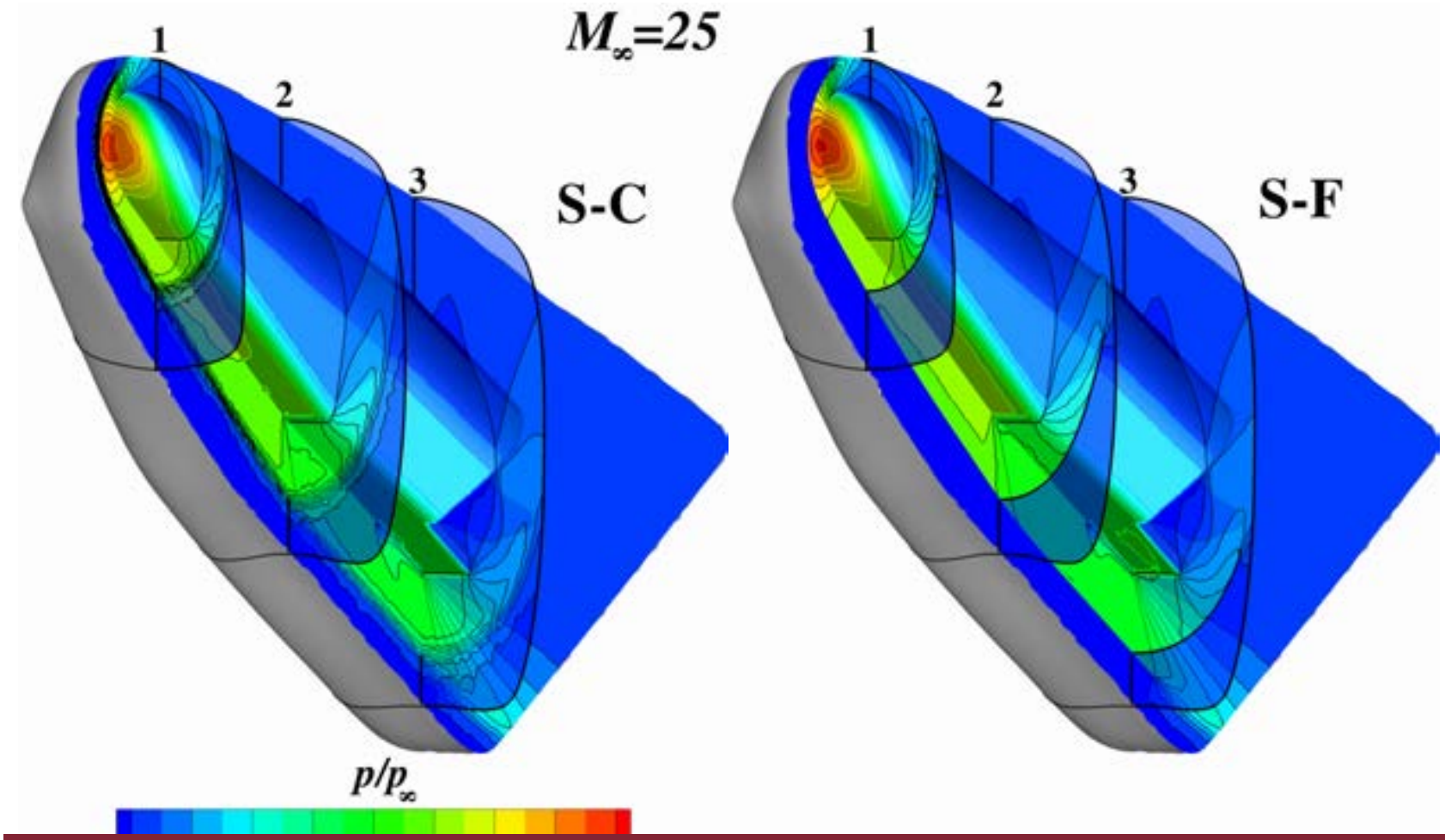


Interaction of a vortical structure with a normal shock

video1

video2

Collaborations

VKI

- three our students spent several months at VKI
- A 2D version of S-F for hypersonic flows was developed and implemented in CoolFluid code
- A 3D version of S-F is under development

INRIA

- my PhD student spents three months at INRIA
- A 2D version of S-F for unsteady flows was developed an implemented in NEO code

Collaborations

Dalian university of technology

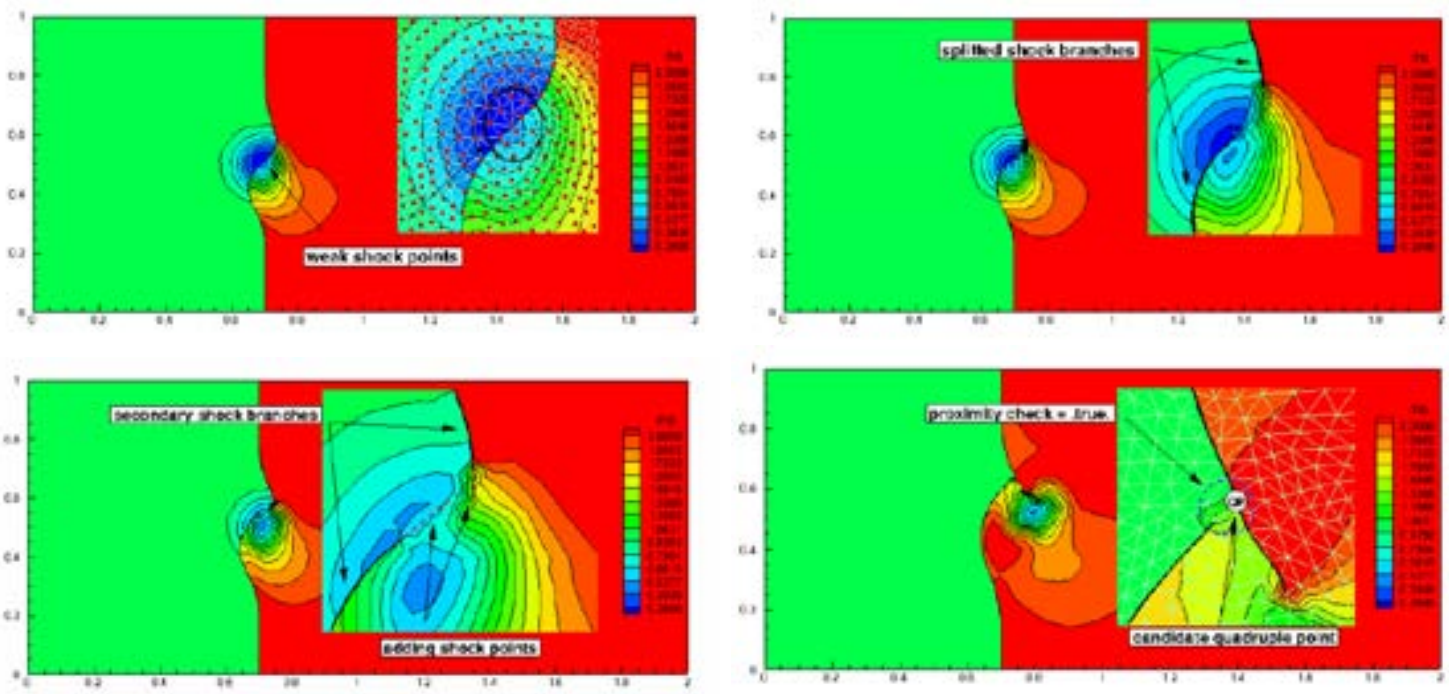
- This group developed an unstructured S-F for cell centered solvers.
- Two chinese Phd students spent three months here.

British columbia University

- This group developed a remeshing technique based on unstructured S-F that allows the insertion of a line or a surface in a existing mesh.
- Prof. Carl Ollivier-Gooch will spent one month here this year.

Future developments

Shock-Detection and Topological changes



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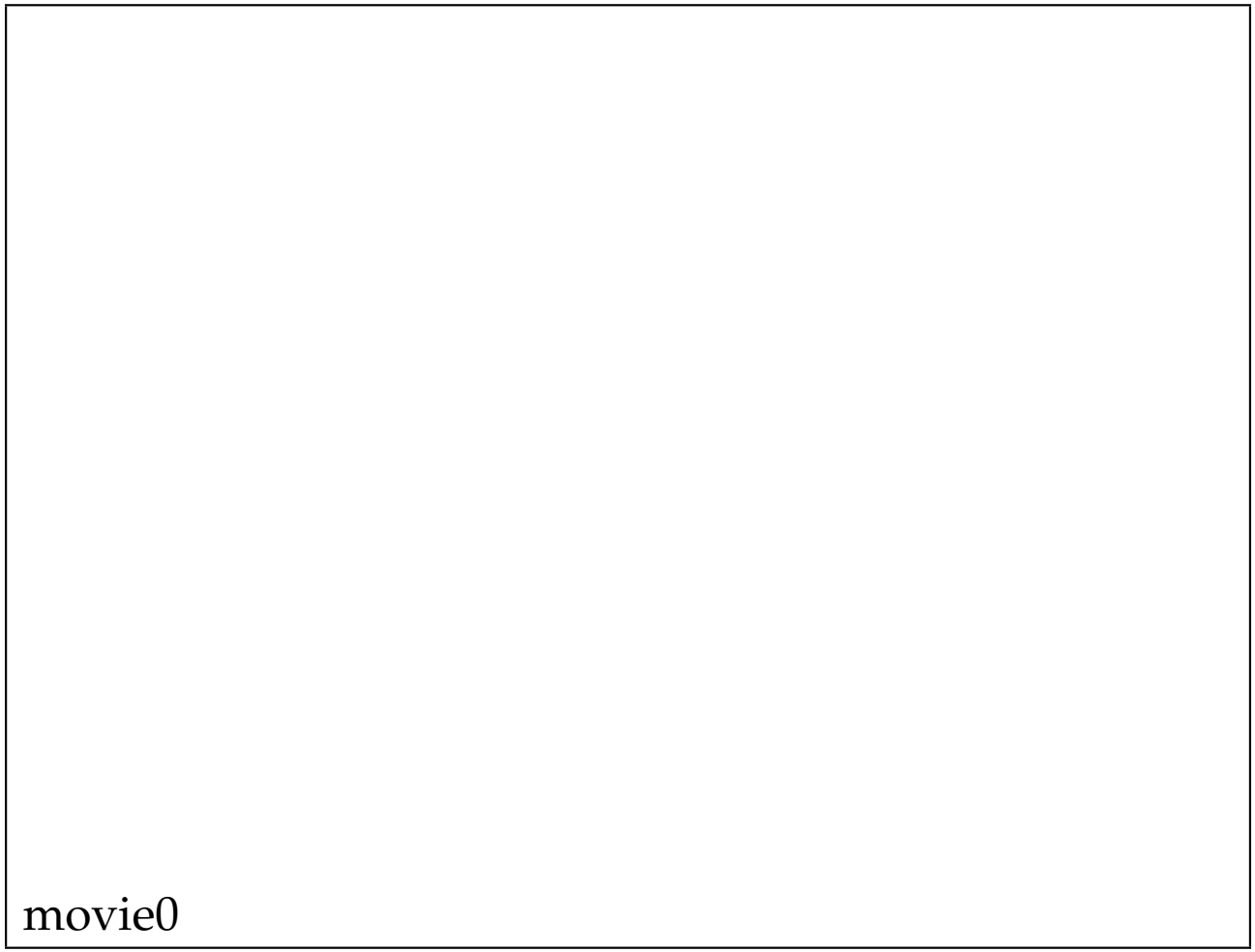
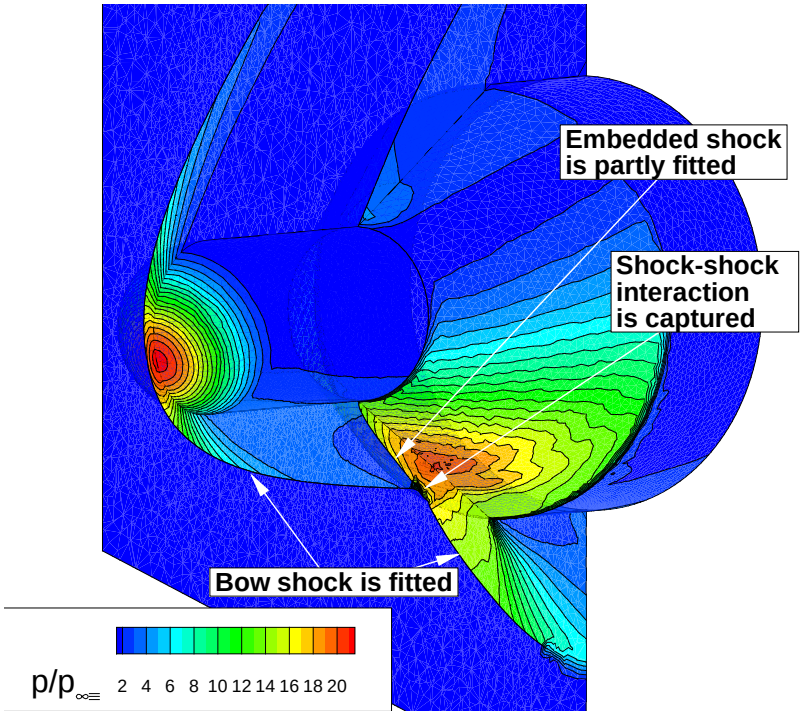
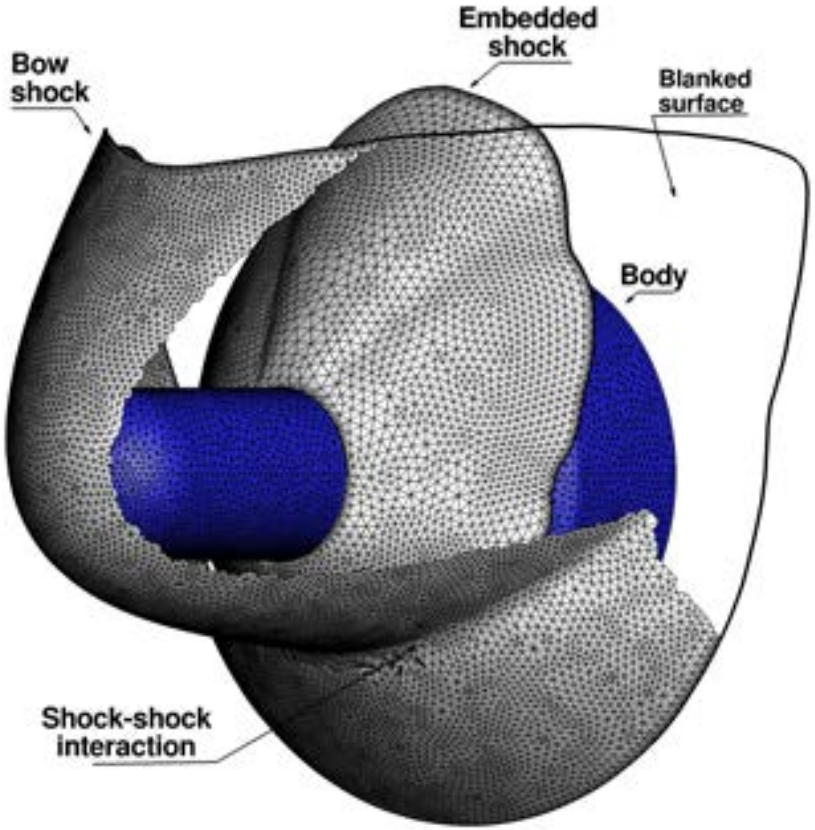


movie0

Future developments

Three dimensional interactions





Future developments

Development of techniques past moving bodies

video1

video2