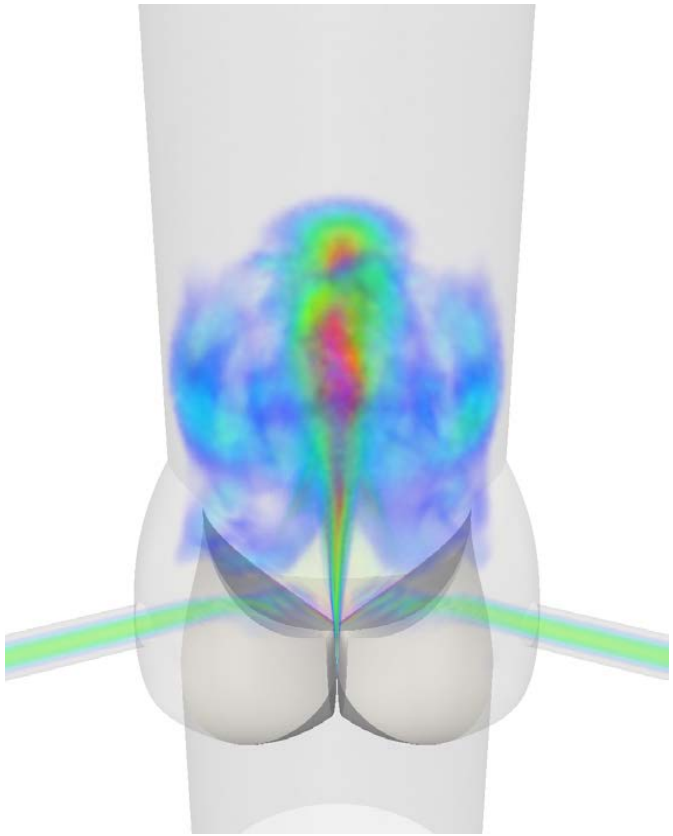
T★AFSM

WIAS RICE



Space–Time Interface-Tracking with Topology Change (ST-TC)

K. Takizawa and S. Asada

Waseda University

T. Tezduyar and A. Buscher

Rice University

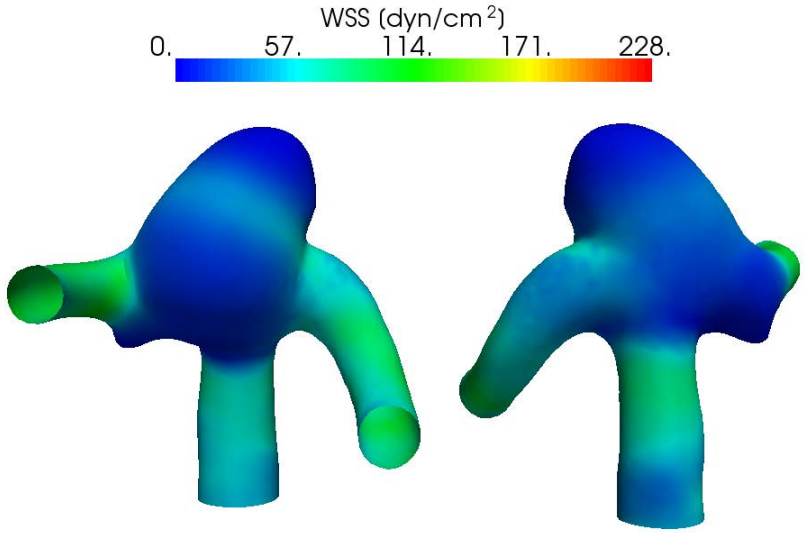
T★AFSM

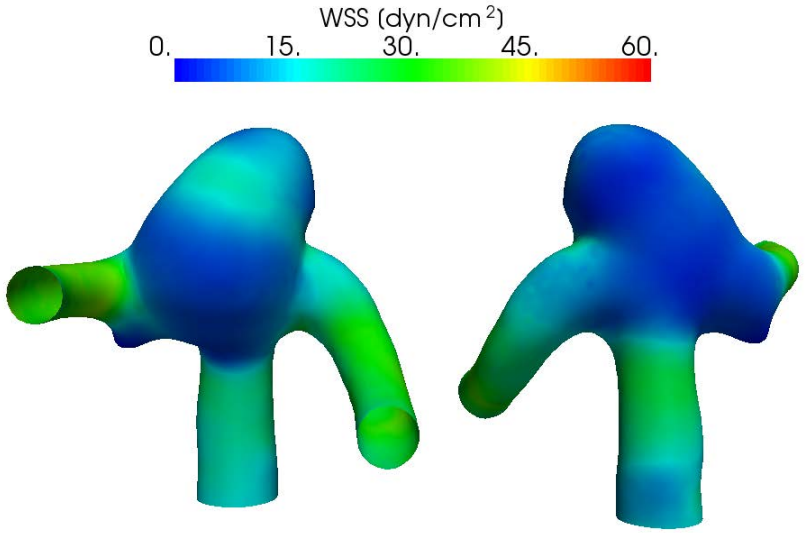
WiAS RICE

Role of Mesh Resolution in WSS Calculations

A Bifurcating Middle Cerebral Artery Segment with Aneurysm

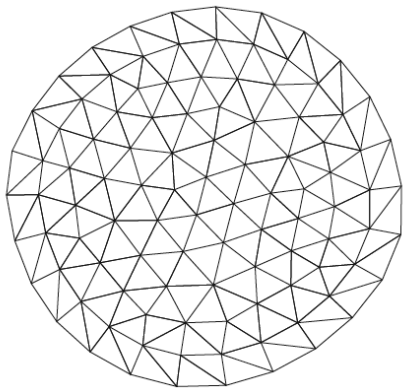
Coarse Mesh





At Maximum Flow Rate

Time-Averaged



K. Takizawa, C. Moorman, S. Wright, J. Christopher, and T.E. Tezduyar, "Wall shear stress calculations in space–time finite element computation of arterial fluid–structure interactions", Computational Mechanics, 46 (2010) 31–41, doi: 10.1007/s00466-009-0425-0.

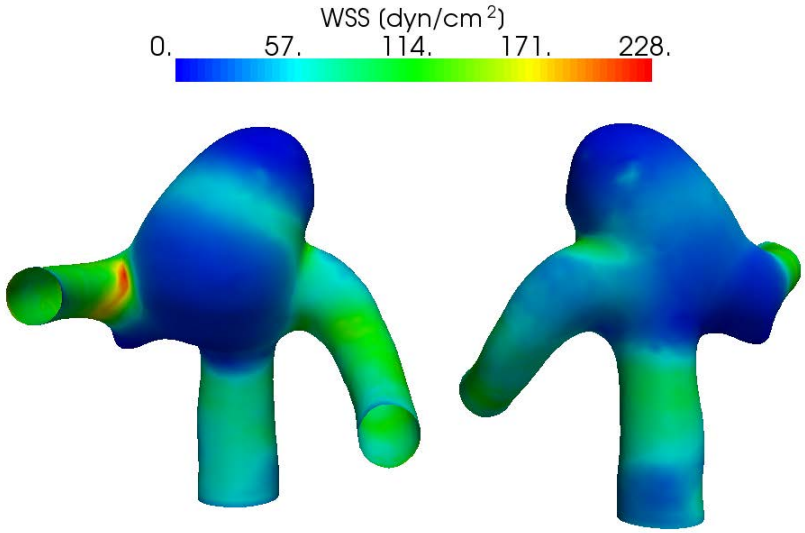
T★AFSM

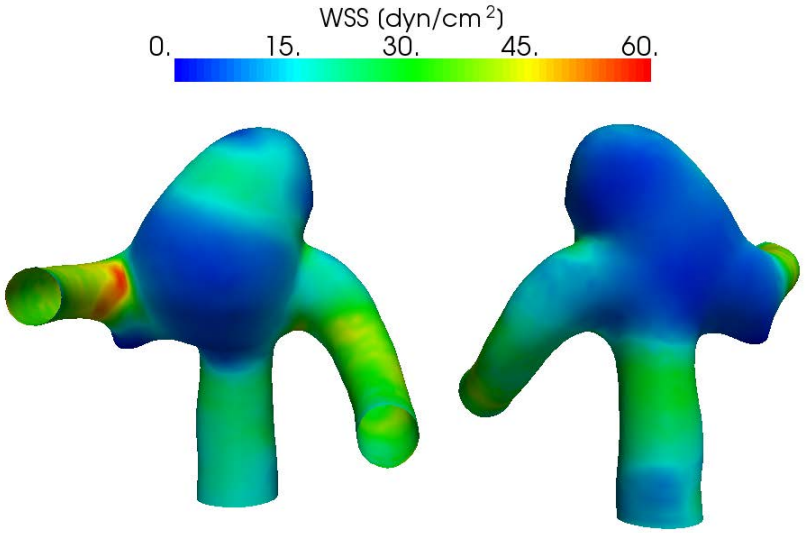
WiAS RICE

Role of Mesh Resolution in WSS Calculations

A Bifurcating Middle Cerebral Artery Segment with Aneurysm

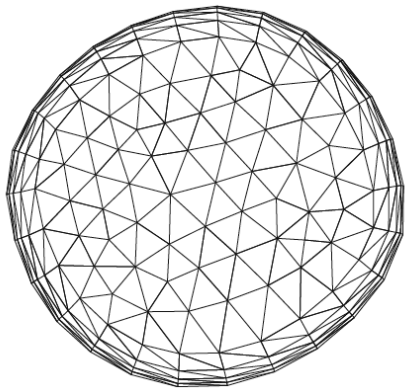
Fine Mesh





At Maximum Flow Rate

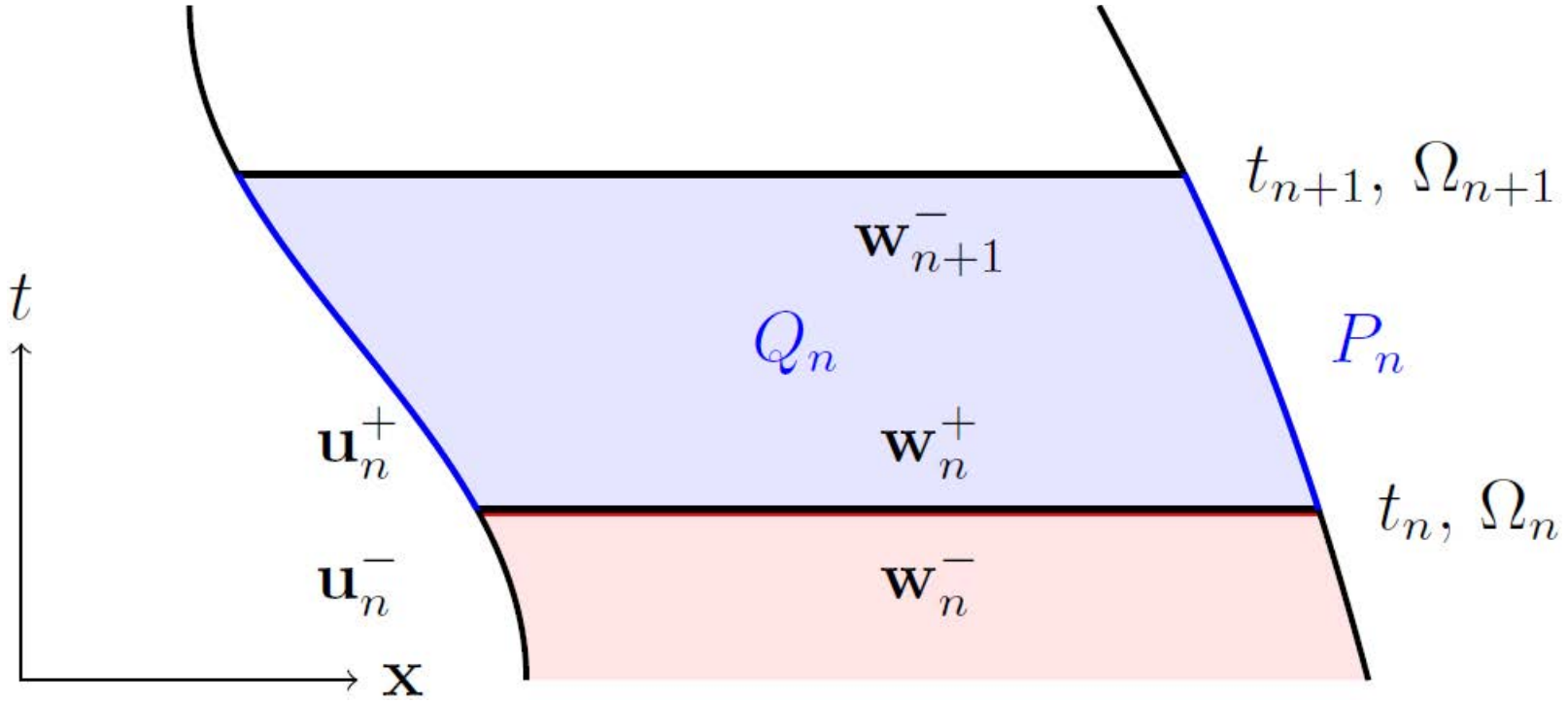
Time-Averaged



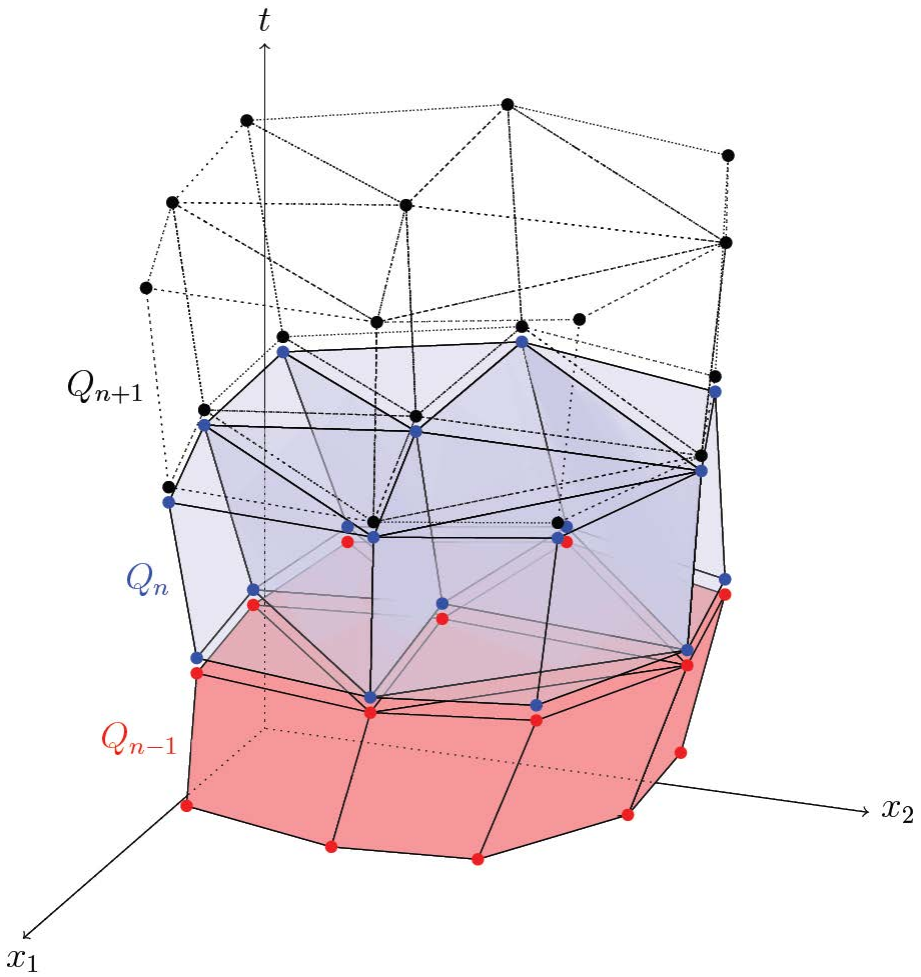
K. Takizawa, C. Moorman, S. Wright, J. Christopher, and T.E. Tezduyar, "Wall shear stress calculations in space–time finite element computation of arterial fluid–structure interactions", Computational Mechanics, 46 (2010) 31–41, doi: 10.1007/s00466-009-0425-0.

Deforming-Spatial Domain/Stabilized Space–Time (DSD/SST) Formulation

Space–Time Slab

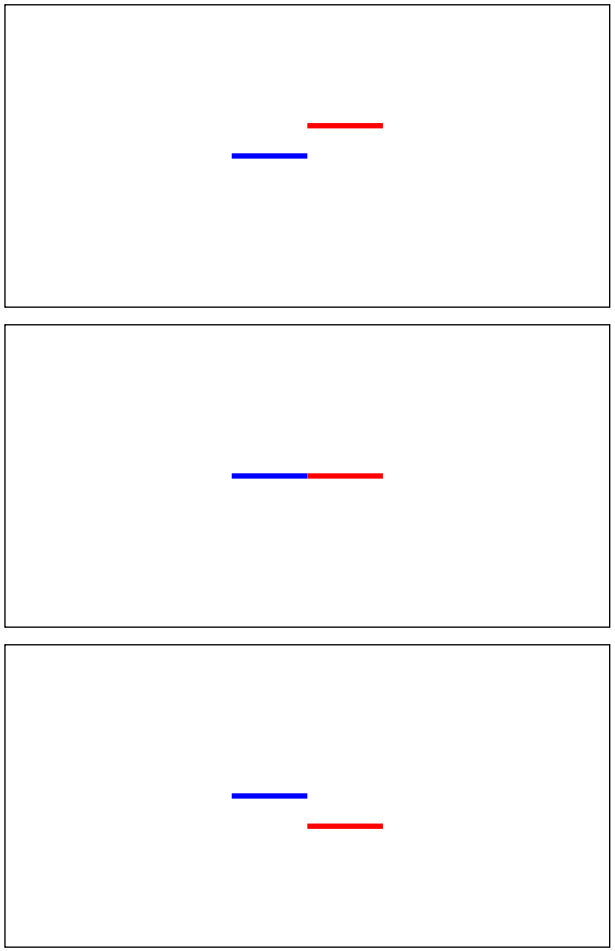


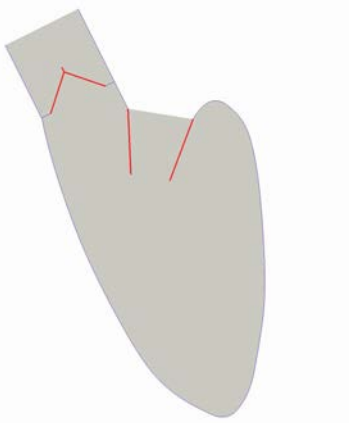
DSD/SST



- High spatial and temporal accuracy
- Advantages in space–time framework

ST-TC

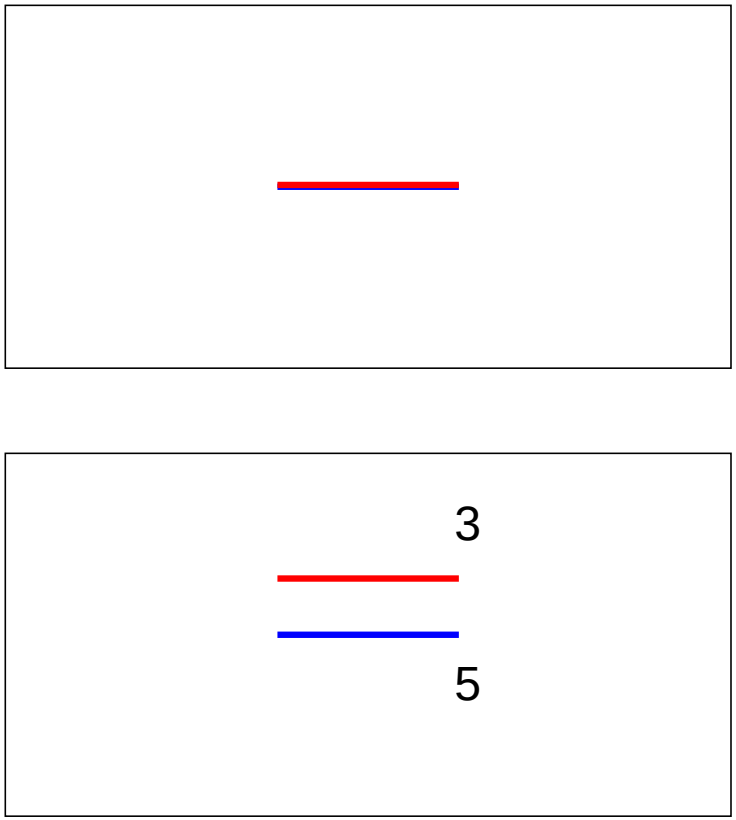


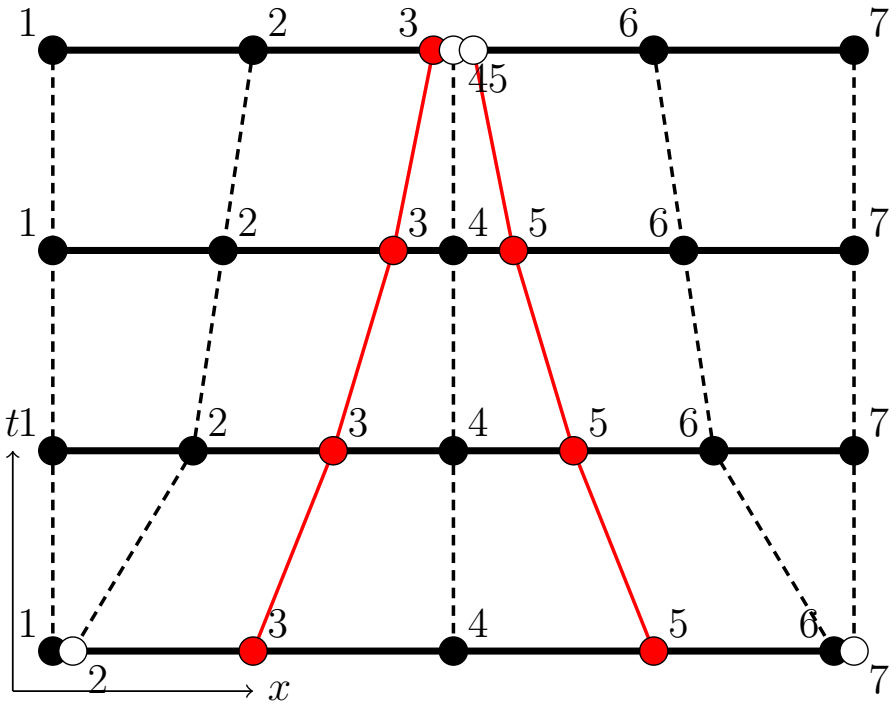


K. Takizawa, T.E. Tezduyar, A. Buscher, and S. Asada, “Space–time interface-tracking with topology change (ST-TC)”, Computational Mechanics, 2013, doi: 10.1007/s00466-013-0935-7.

ST-TC

Master–Slave System

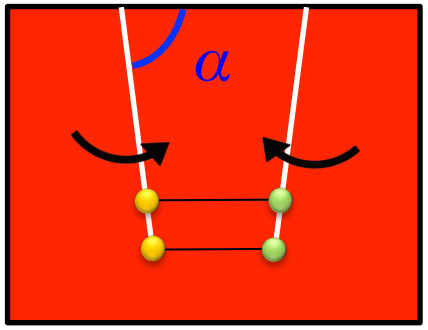


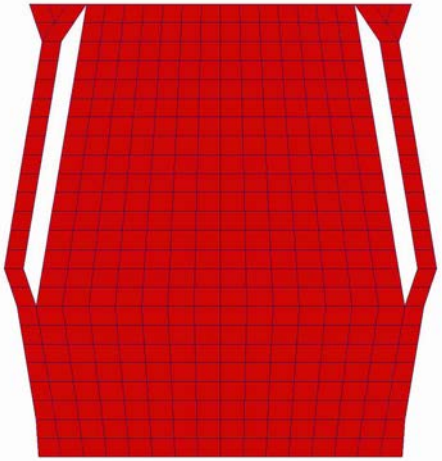


K. Takizawa, T.E. Tezduyar, A. Buscher, and S. Asada, “Space–time interface-tracking with topology change (ST-TC)”, Computational Mechanics, 2013, doi: 10.1007/s00466-013-0935-7.

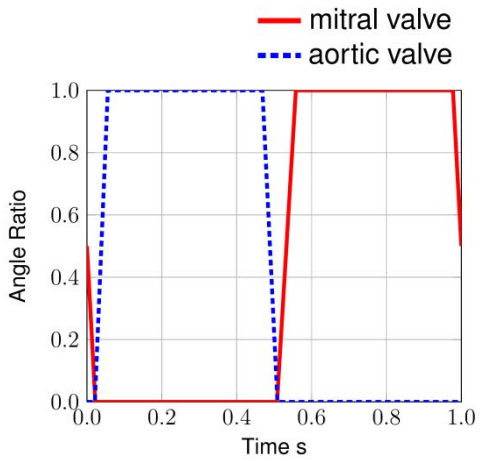
Left Ventricle with Aorta and Mitral Valves

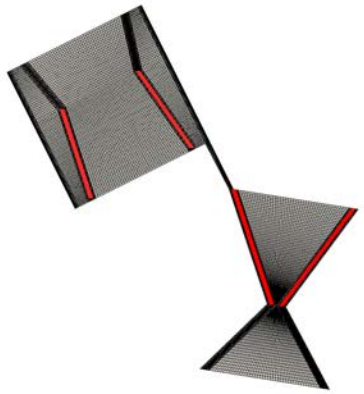
- Generate mesh and master–slaves based on angle





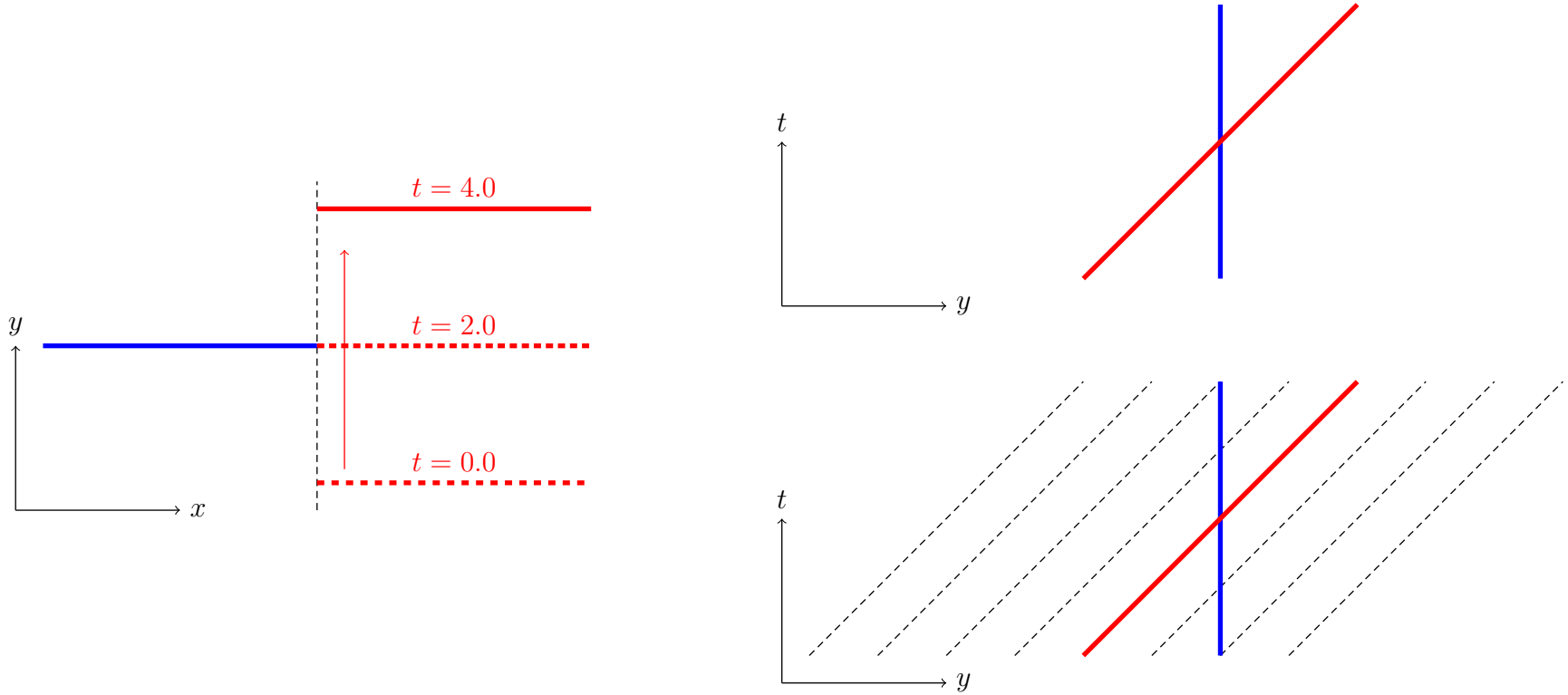
- Mapping angle and time and obtain mesh motions





ST-TC

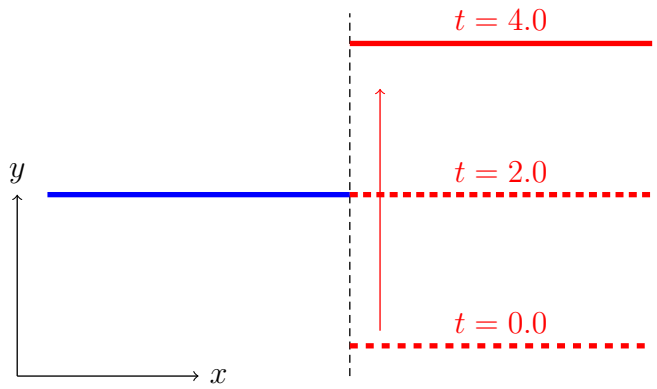
Lateral Element Boundary

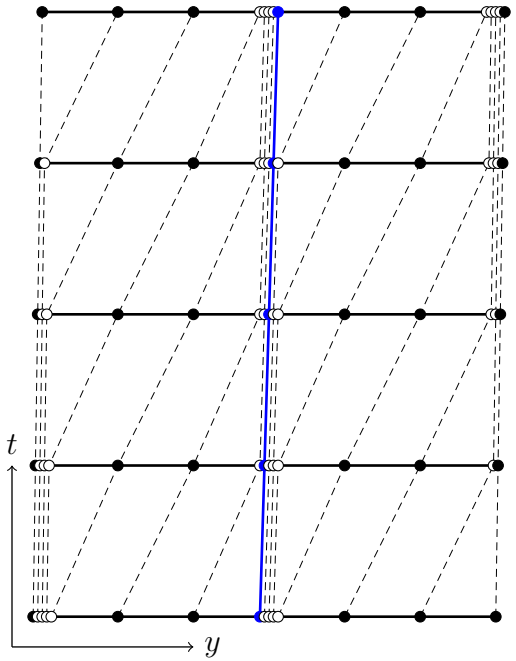


K. Takizawa, T.E. Tezduyar, A. Buscher, and S. Asada, “Space–time interface-tracking with topology change (ST-TC)”, Computational Mechanics, 2013, doi: 10.1007/s00466-013-0935-7.

ST-TC

Stationary-Bar Side

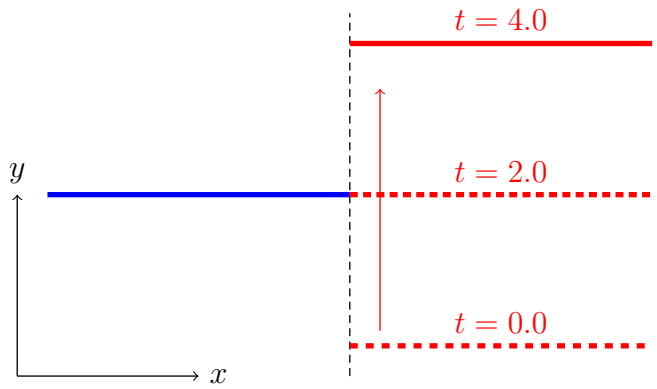


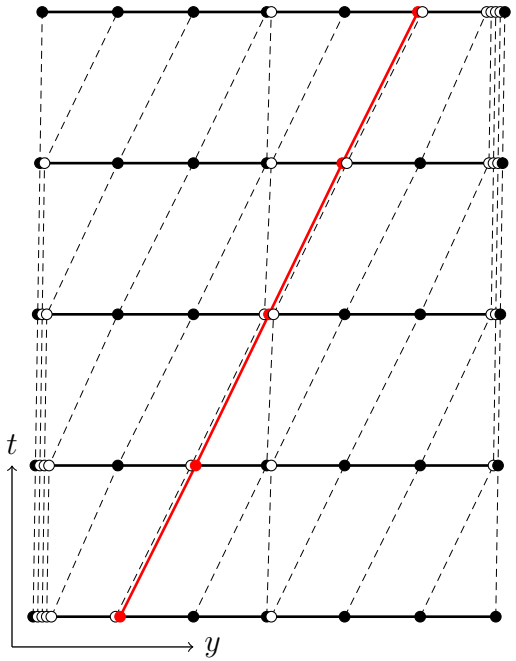


K. Takizawa, T.E. Tezduyar, A. Buscher, and S. Asada, “Space–time interface-tracking with topology change (ST-TC)”, Computational Mechanics, 2013, doi: 10.1007/s00466-013-0935-7.

ST-TC

Flapping-Bar Side

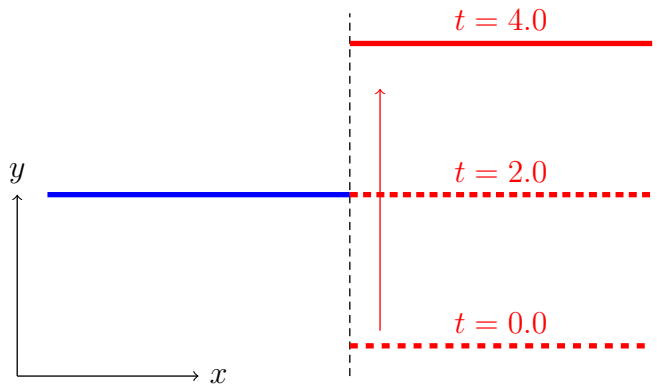


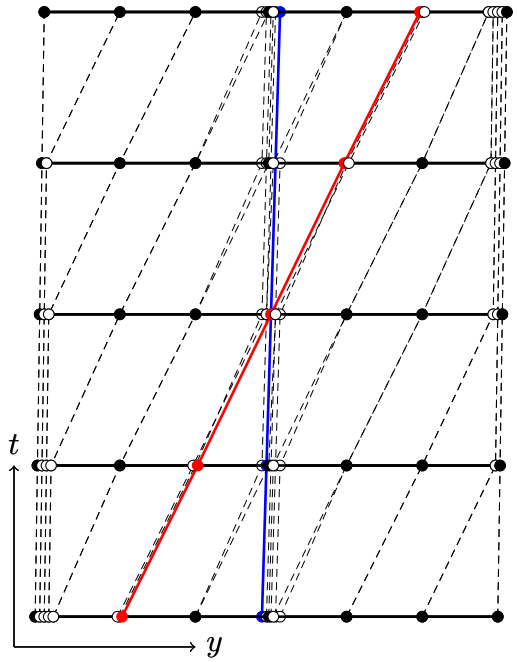


K. Takizawa, T.E. Tezduyar, A. Buscher, and S. Asada, “Space–time interface-tracking with topology change (ST-TC)”, Computational Mechanics, 2013, doi: 10.1007/s00466-013-0935-7.

ST-TC

Both Sides



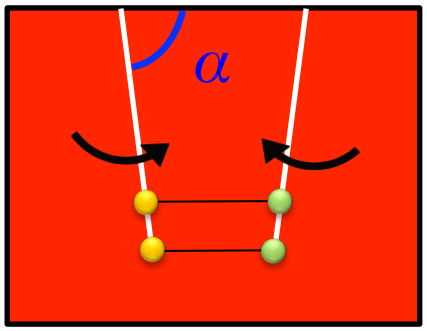


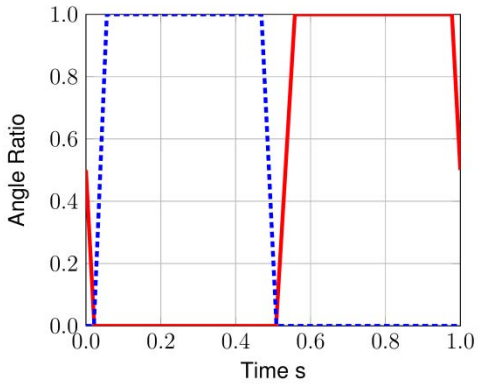
K. Takizawa, T.E. Tezduyar, A. Buscher, and S. Asada, “Space–time interface-tracking with topology change (ST-TC)”, Computational Mechanics, 2013, doi: 10.1007/s00466-013-0935-7.

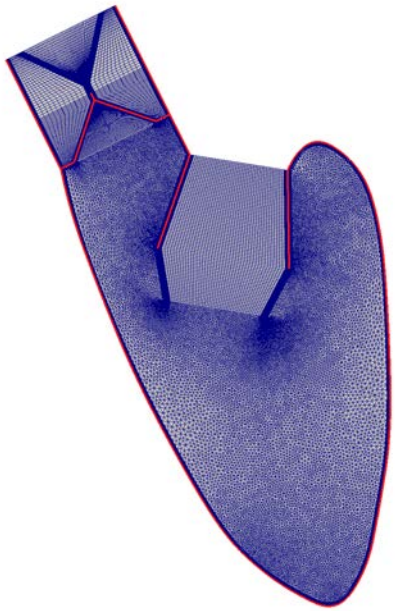
T★AFSM

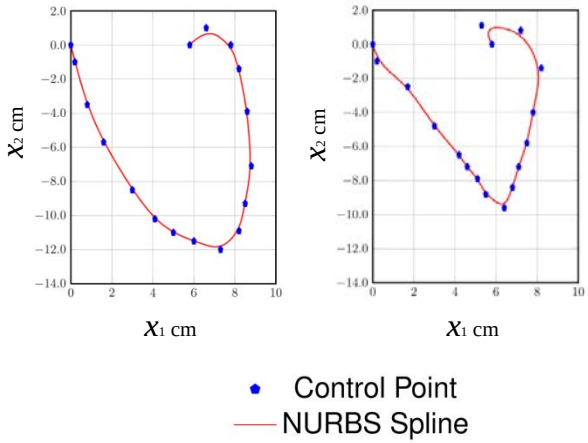
WIAS RICE

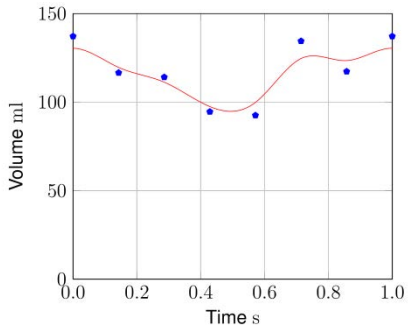
Ventricle Mesh Motion

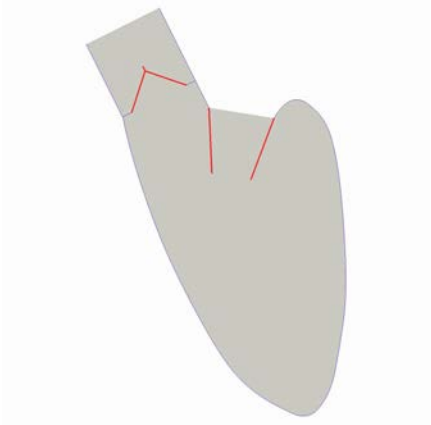






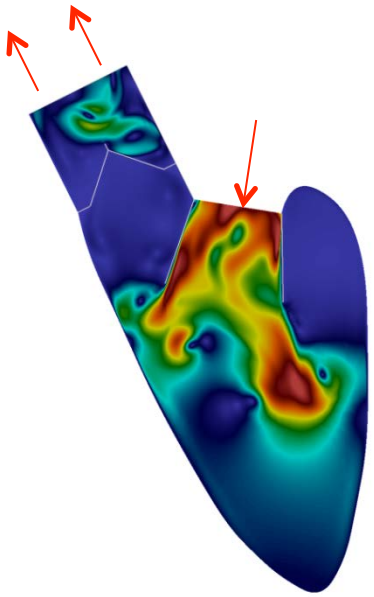


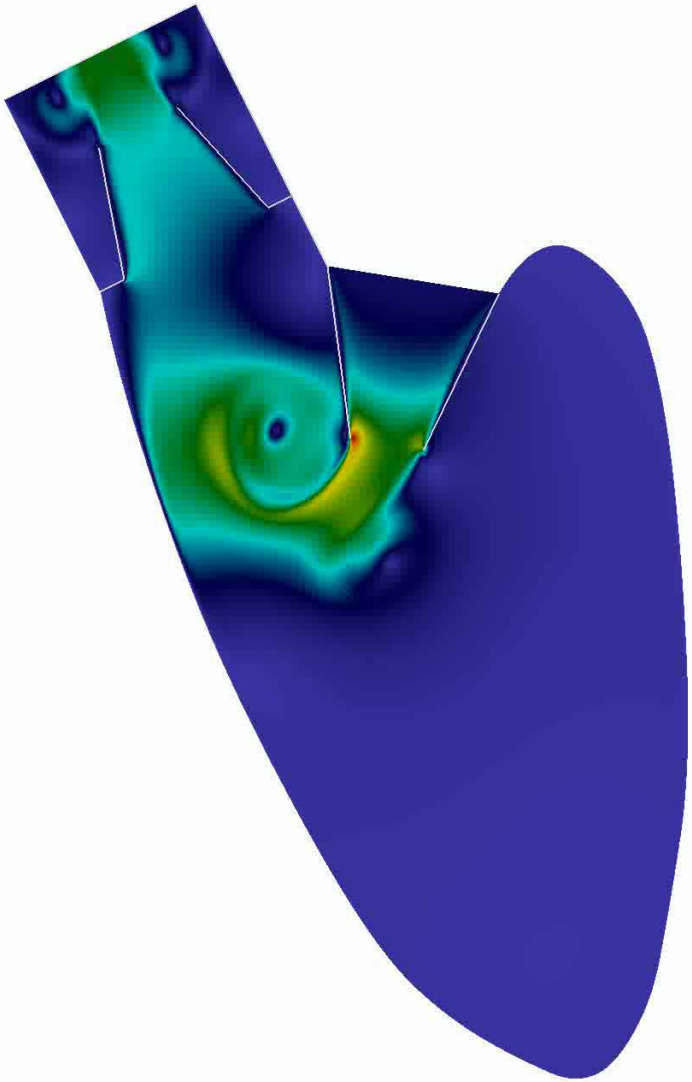


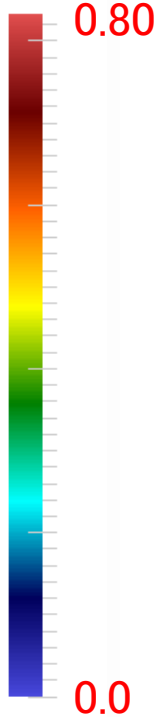


Computational Results

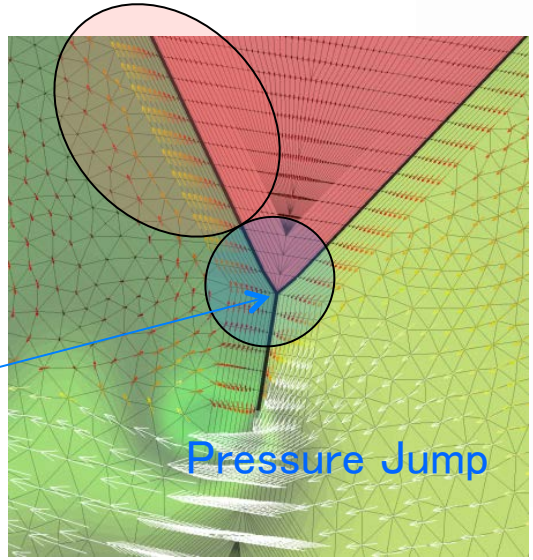
Aorta





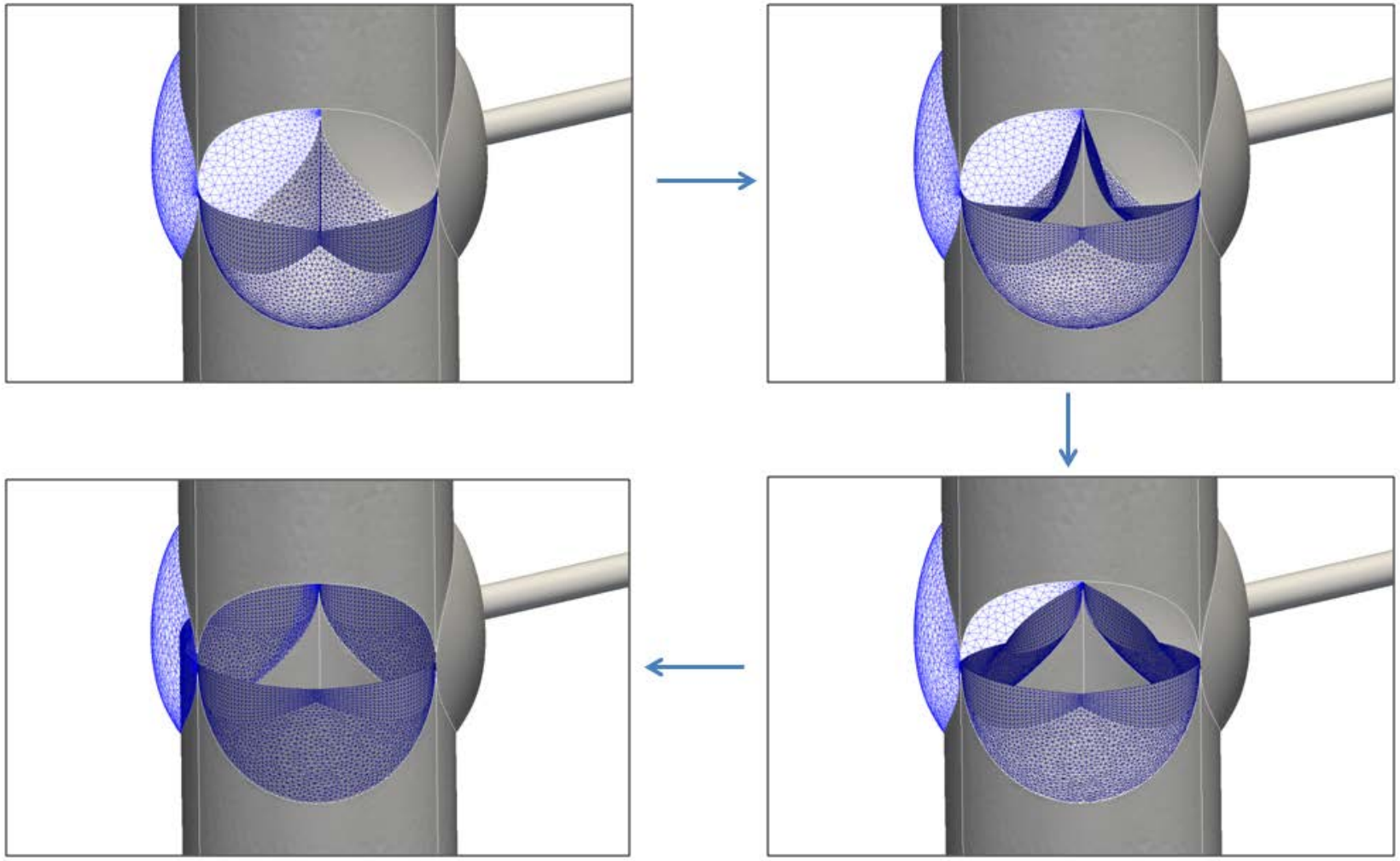


Boundary Layer



Aortic Valve with Coronary Arteries

Valve Motion

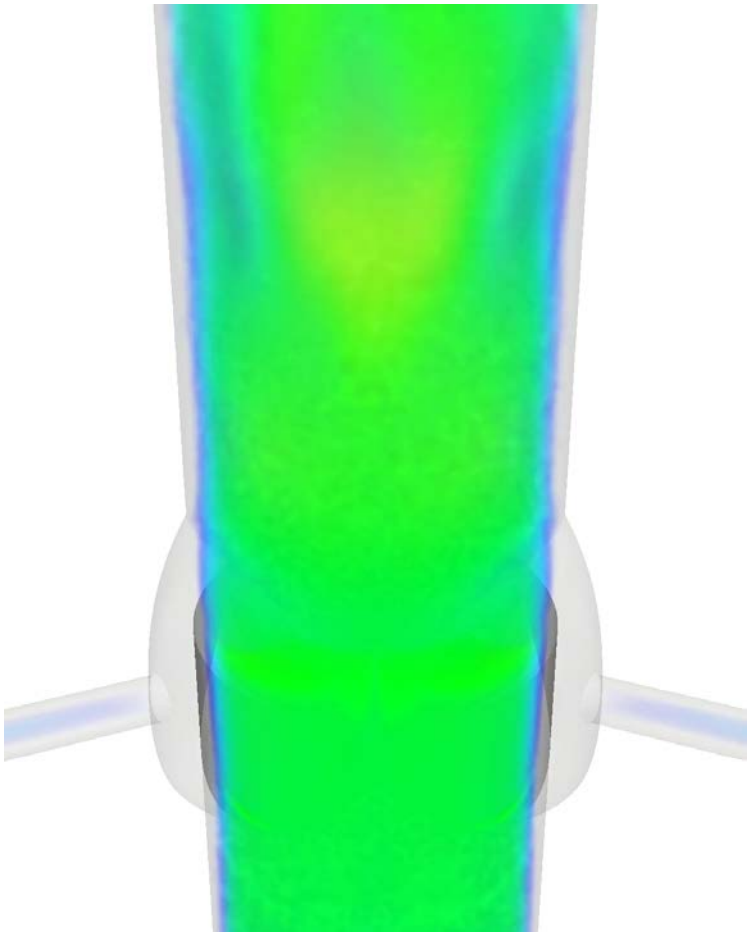


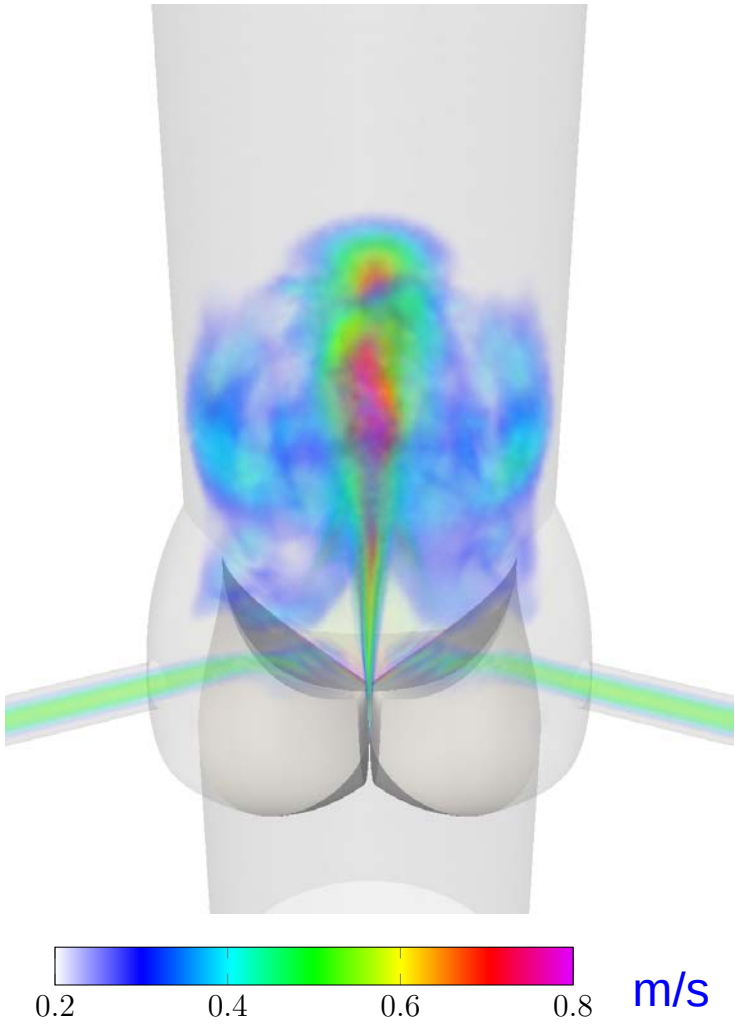
T★AFSM

WIAS RICE

Aortic Valve with Coronary Arteries

Velocity Magnitude



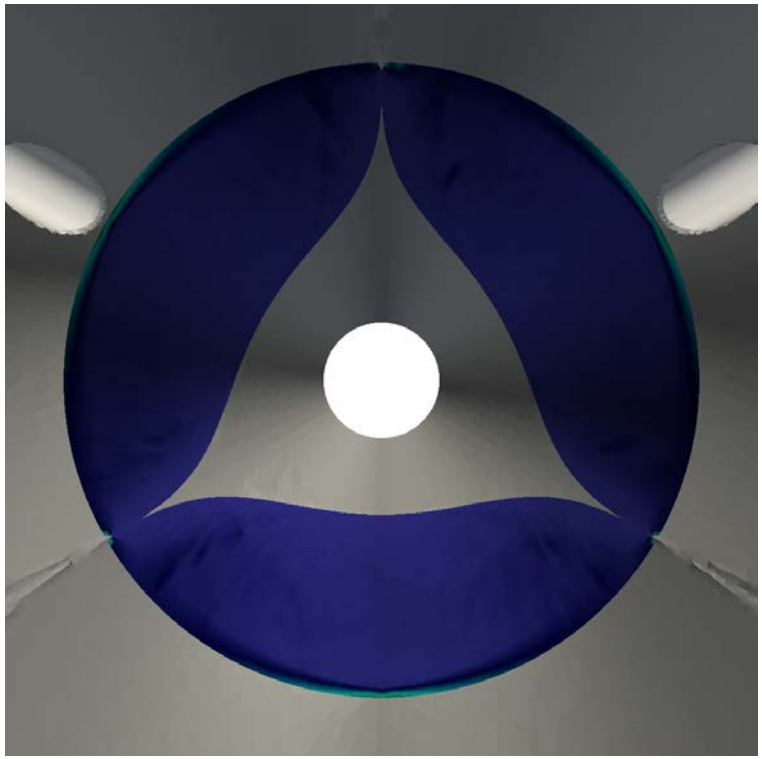


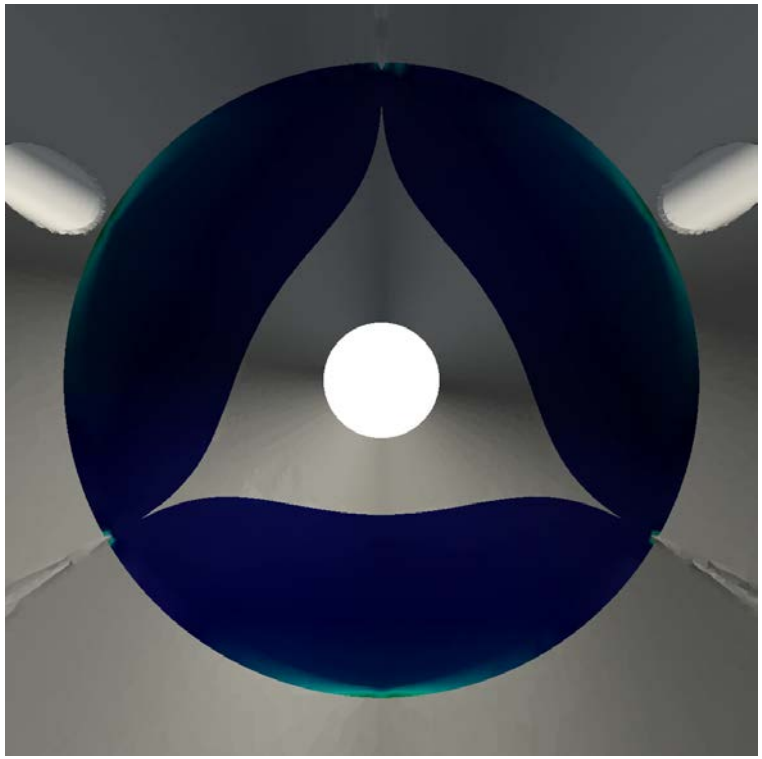
T★AFSM

WIAS RICE

Aortic Valve with Coronary Arteries

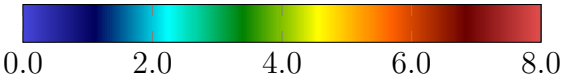
WSS





Upper Surface

Lower Surface



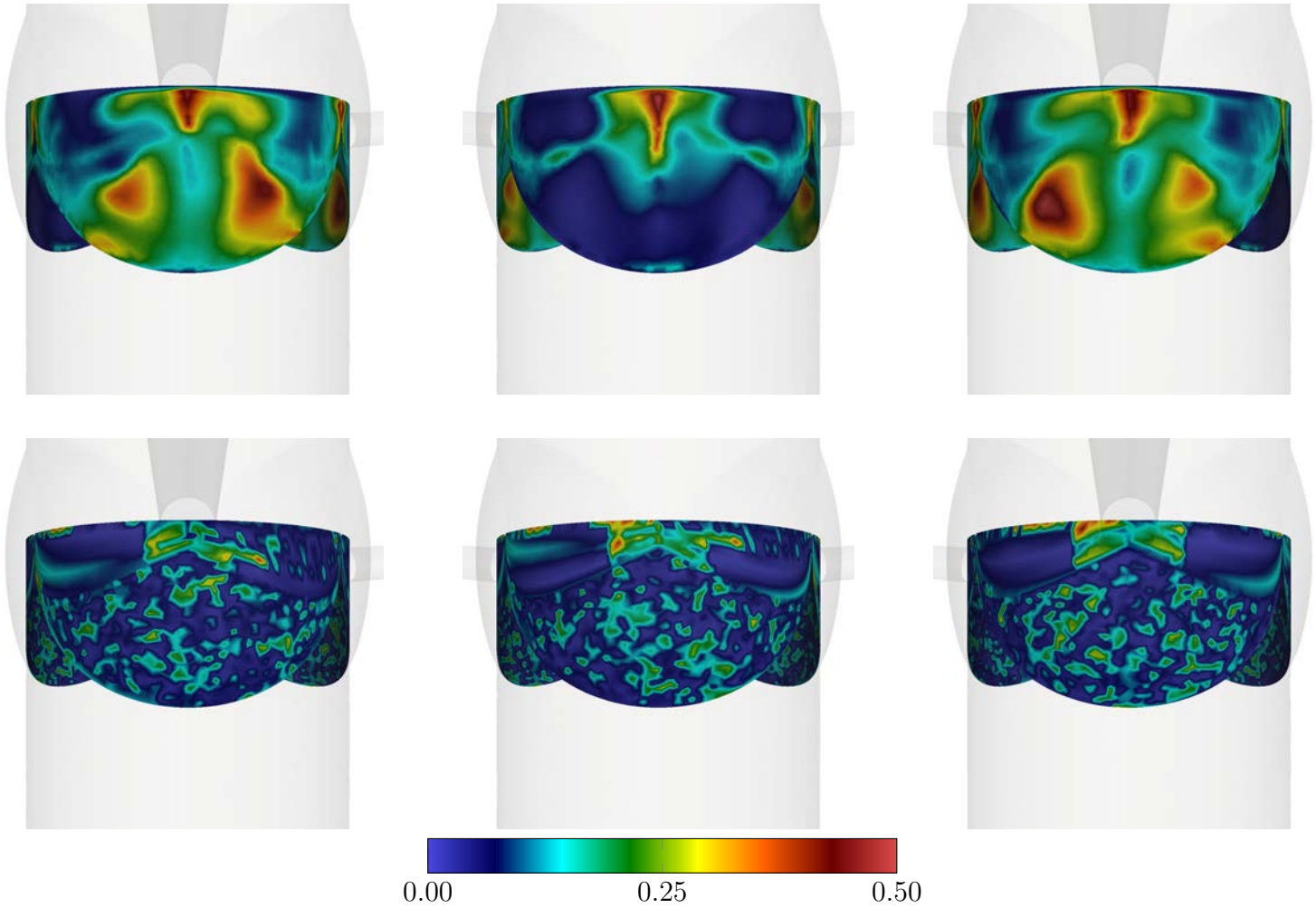
Pa

Aortic Valve with Coronary Arteries

OSI

Upper Surface

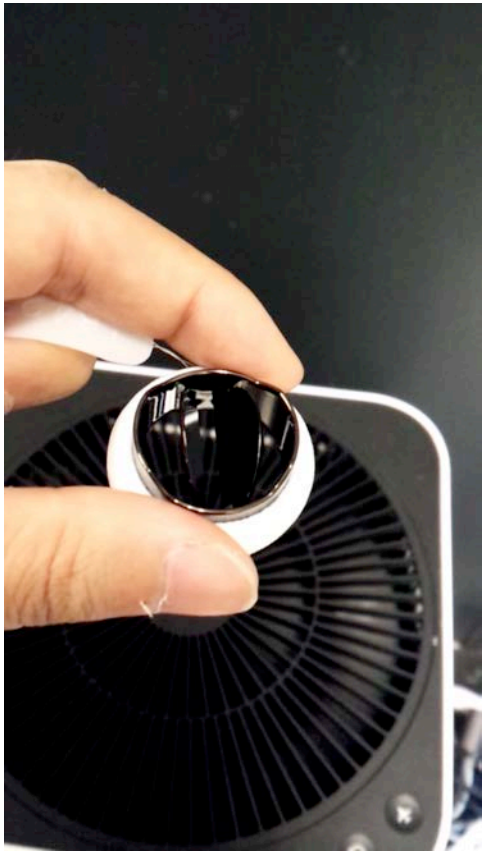
Lower Surface

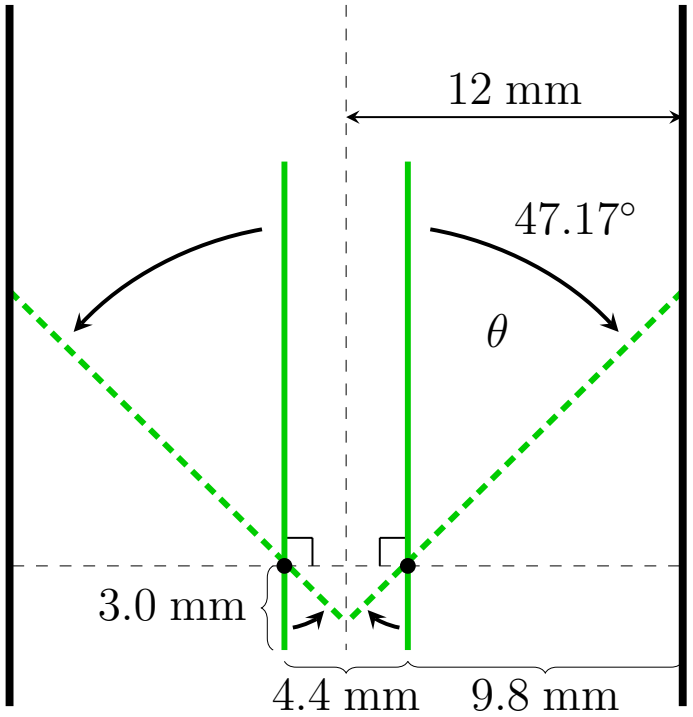


OSI on moving domain: Takizawa et al., “Wall Shear Stress Calculations in Space–Time Finite Element Computation of Arterial Fluid–Structure Interactions”, *Computational Mechanics*, **46** (2010) 31–41.

Mechanical Aortic Valve

Motion

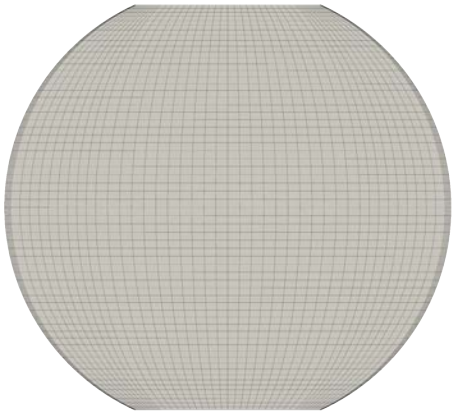


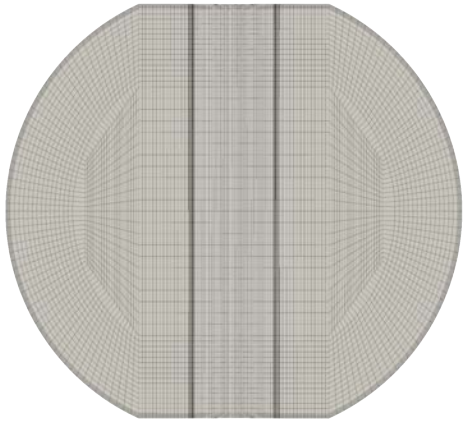


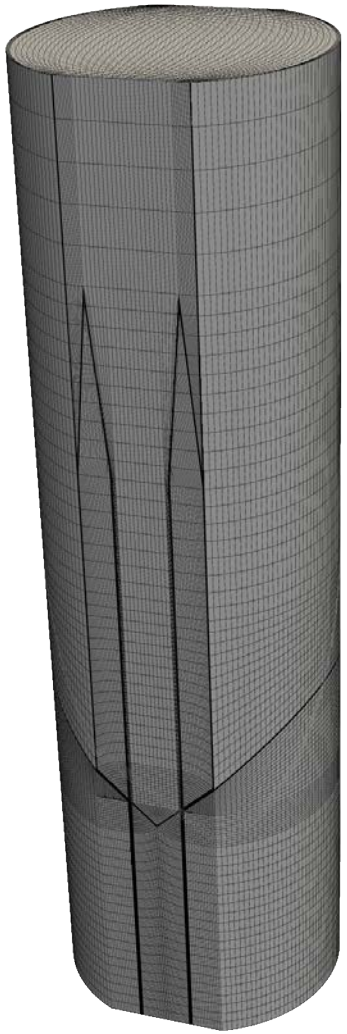
Provided by
Dr. Itatani, Kitazato University Hospital

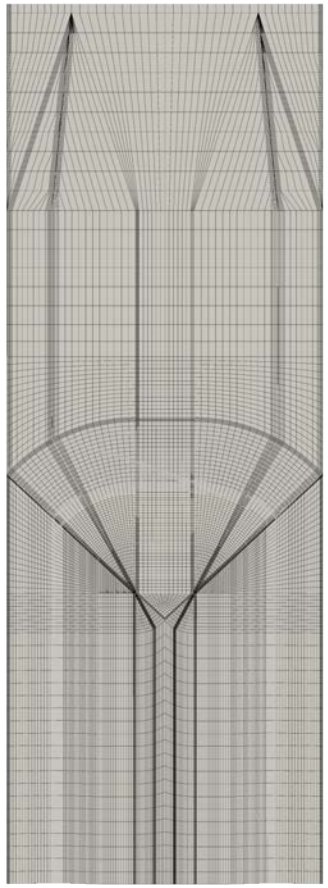
Mechanical Aortic Valve

Mesh







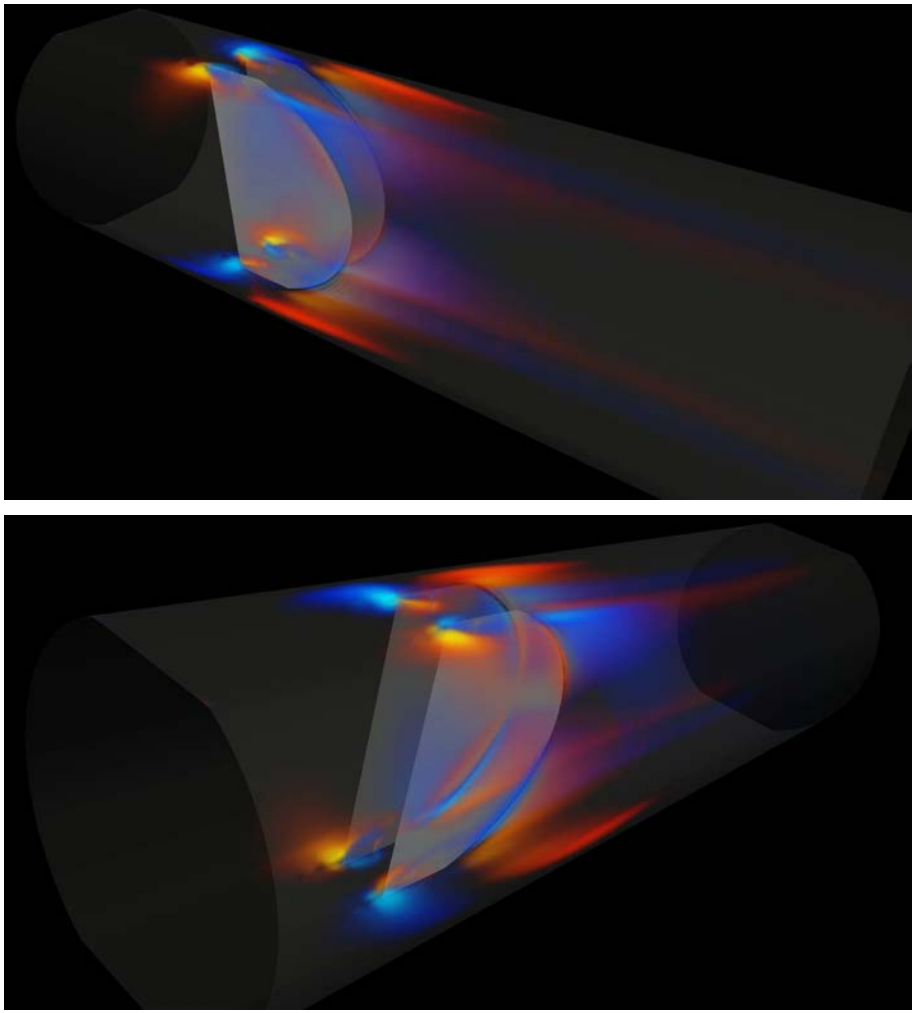


T★AFSM

WIAS RICE

Mechanical Aortic Valve

Helicity

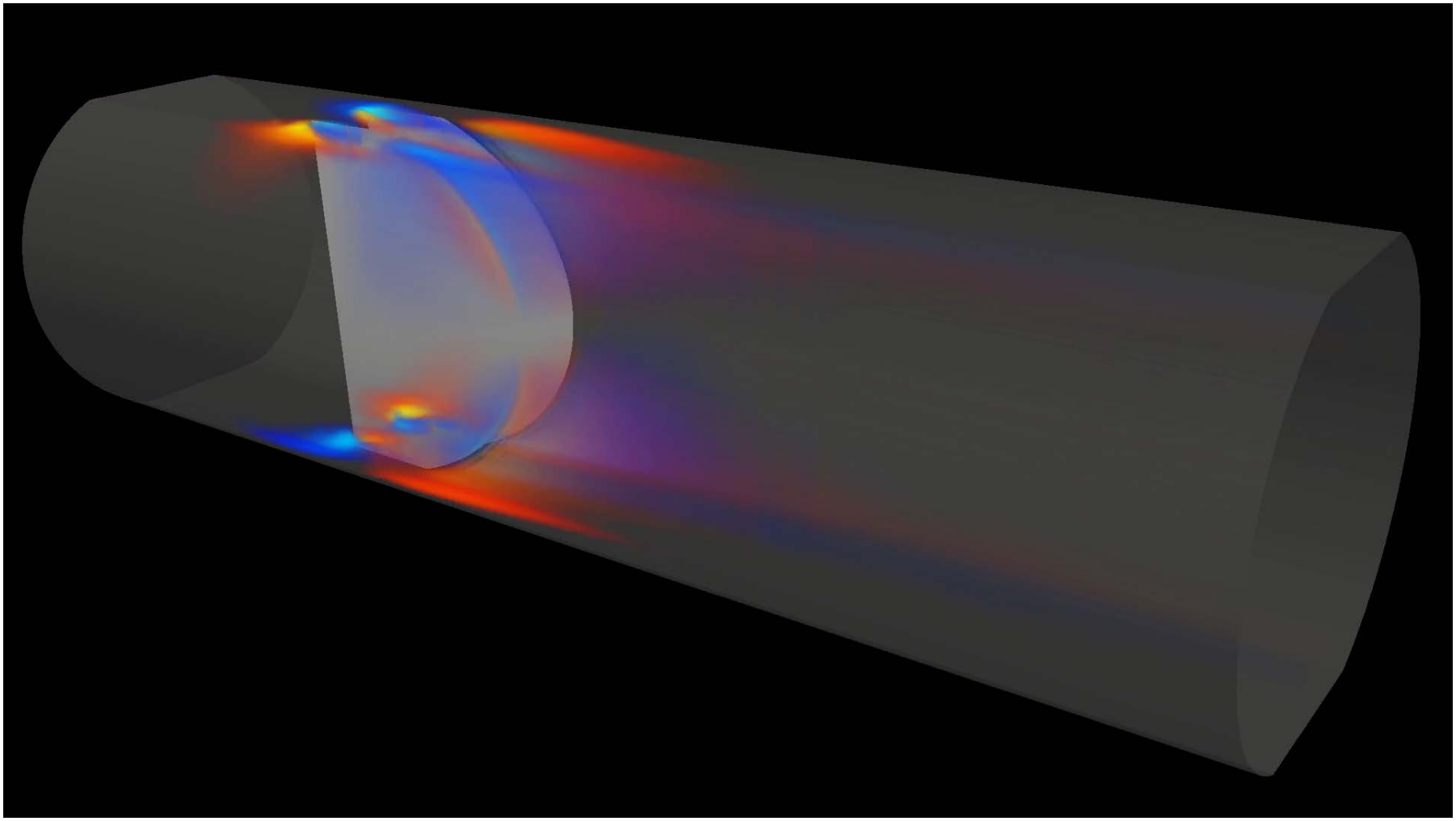


T★AFSM

WIAS RICE

Mechanical Aortic Valve

Helicity

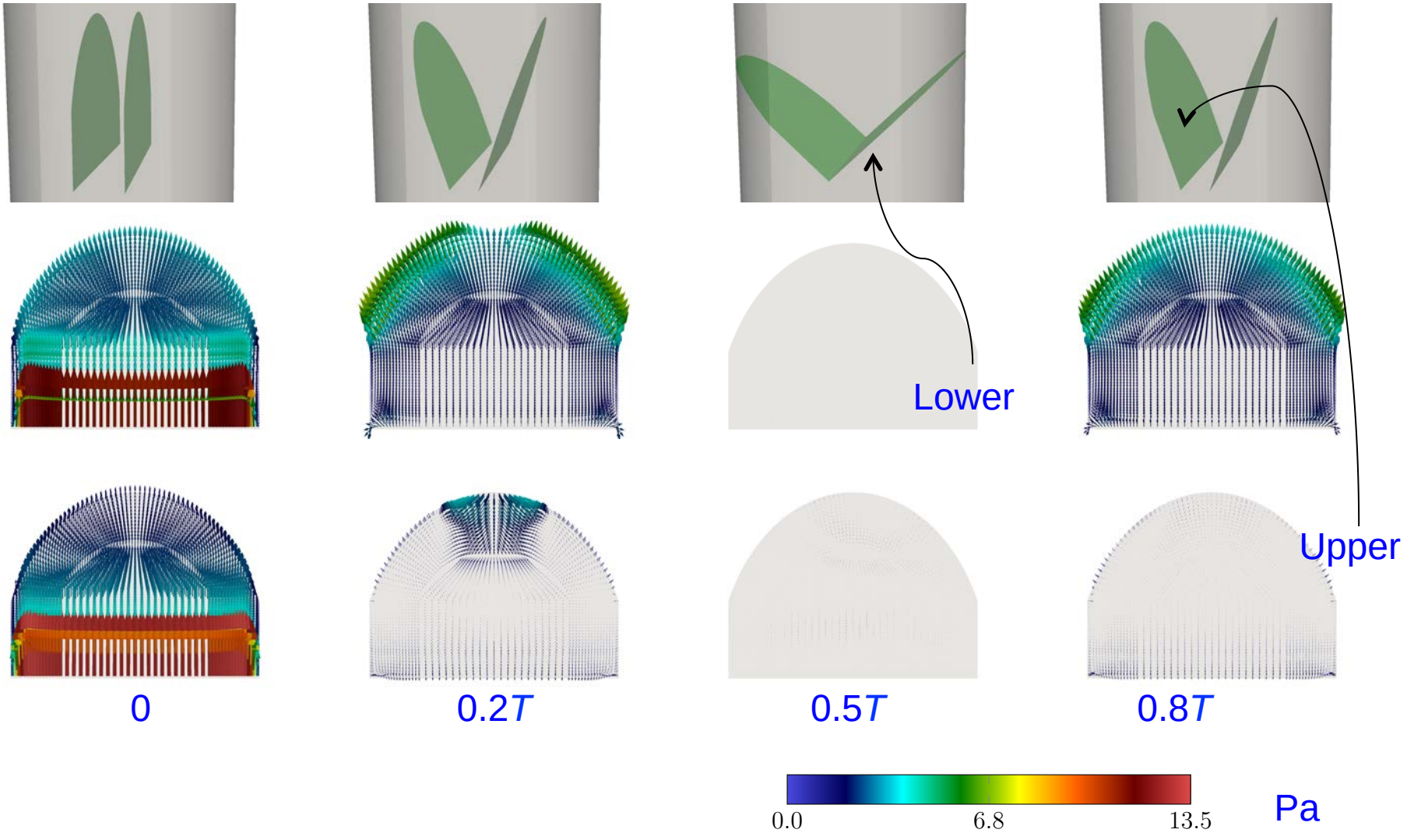


T★AFSM

WIAS RICE

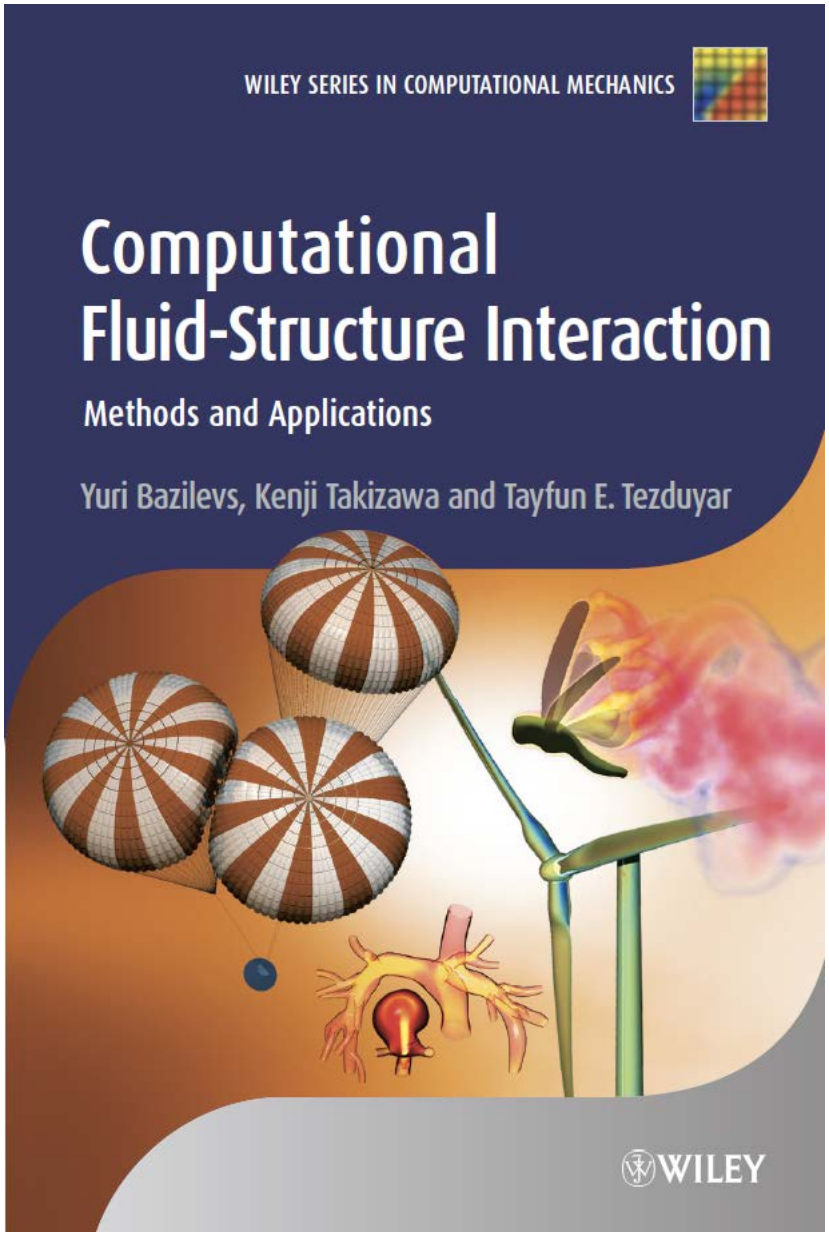
Mechanical Aortic Valve

Wall Shear Stress Vector



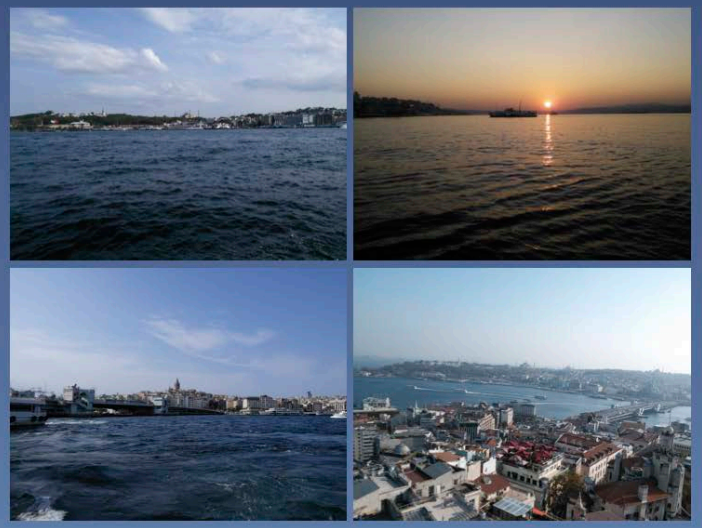
T★AFSM

WiAS RICE



Computational Fluid–Structure Interaction

A Short Course in Istanbul

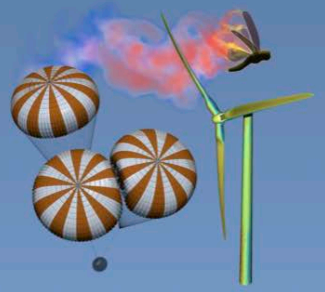


Dates
May 9–10, 2015

Venue
Hotel Erboy, Istanbul, Turkey
See also http://www.tafsm.org/AFSI2015/

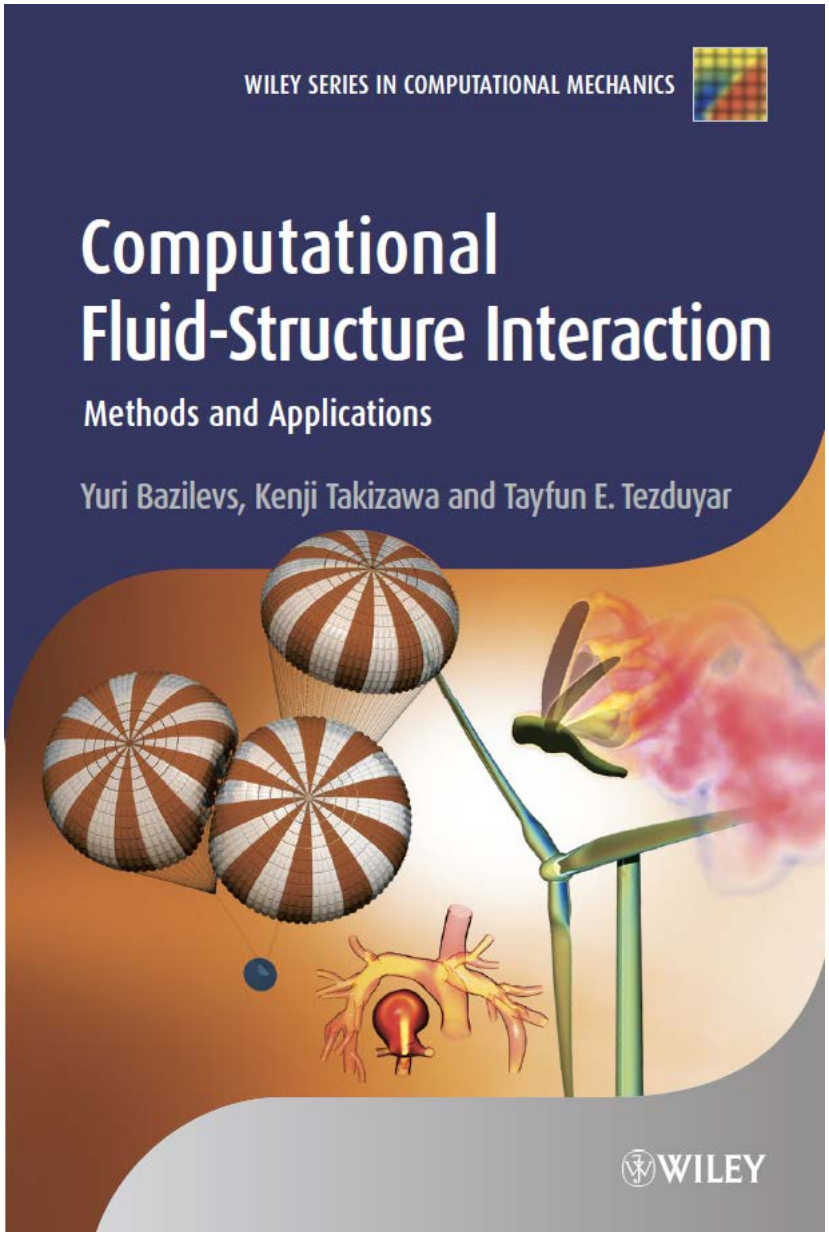
Short-Course Instructors
Yuri Bazilevs (University of California, San Diego)
Kenji Takizawa (Waseda University, Tokyo)
Tayfun Tezduyar (Rice University, Houston)

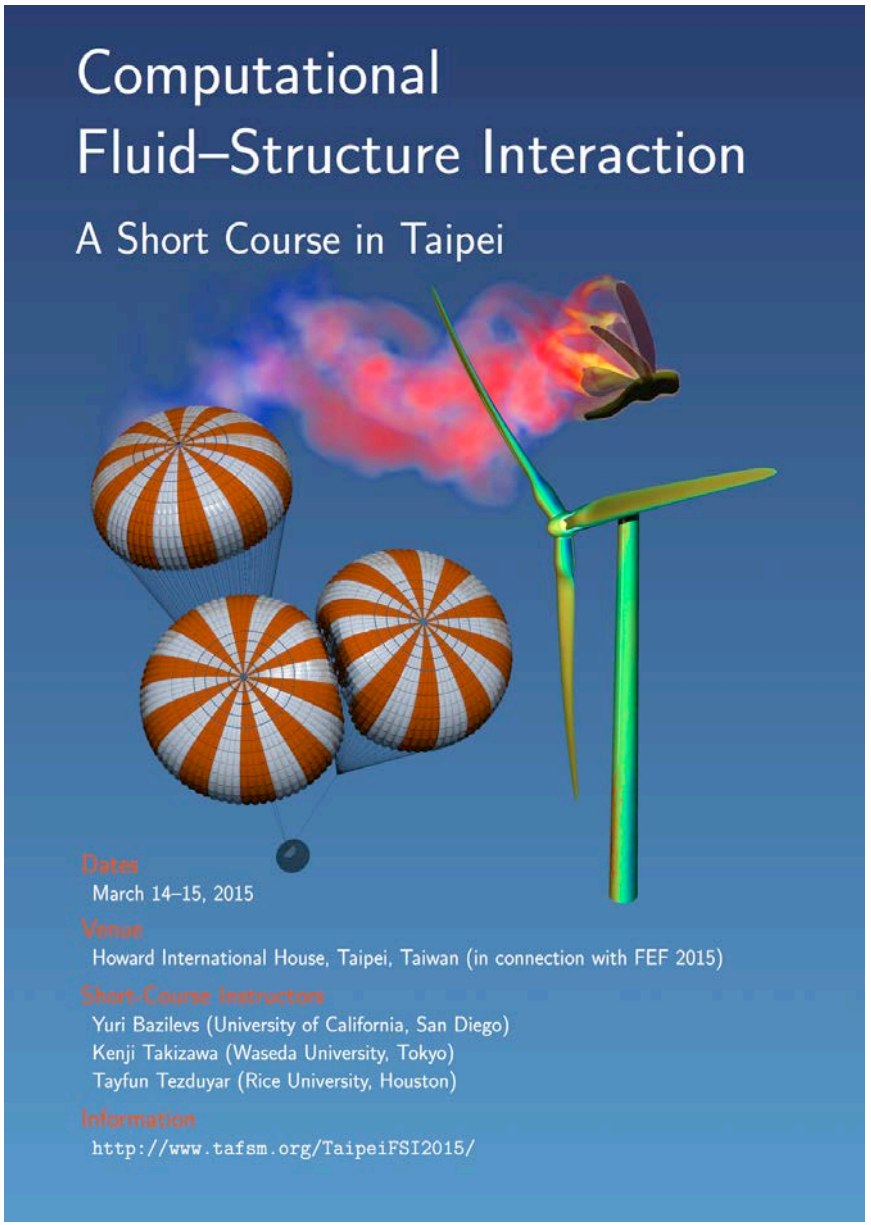
Information
http://www.tafsm.org/IstFSI2015/

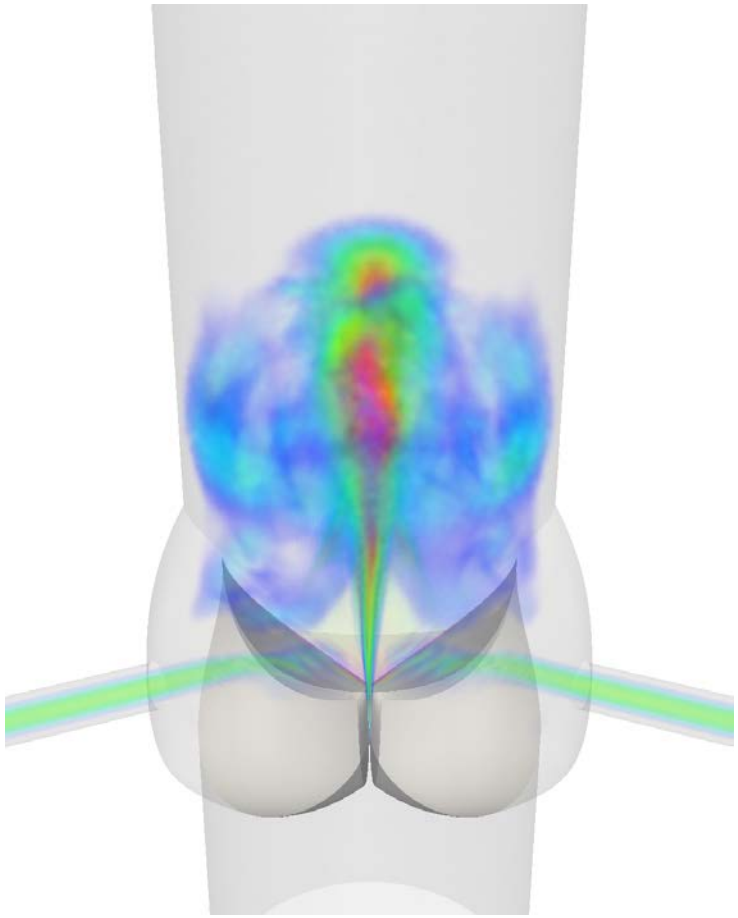


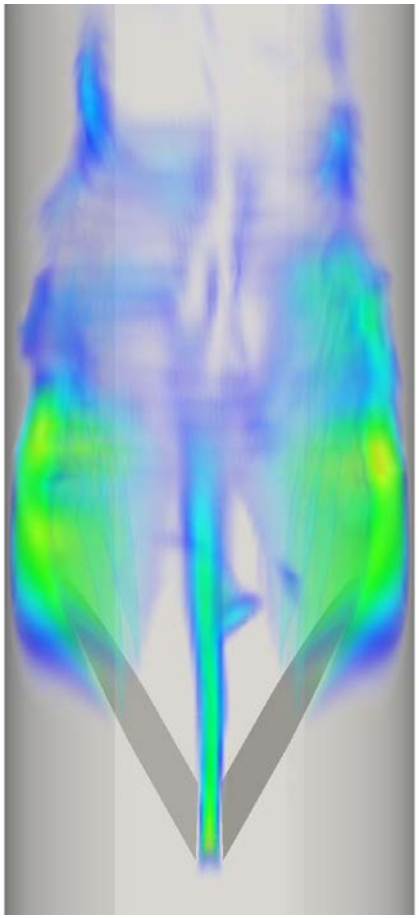
T★AFSM

WiAS RICE









Thank you!