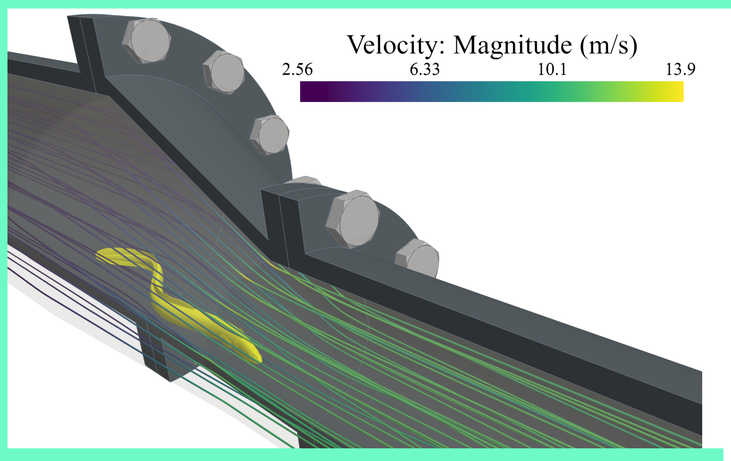
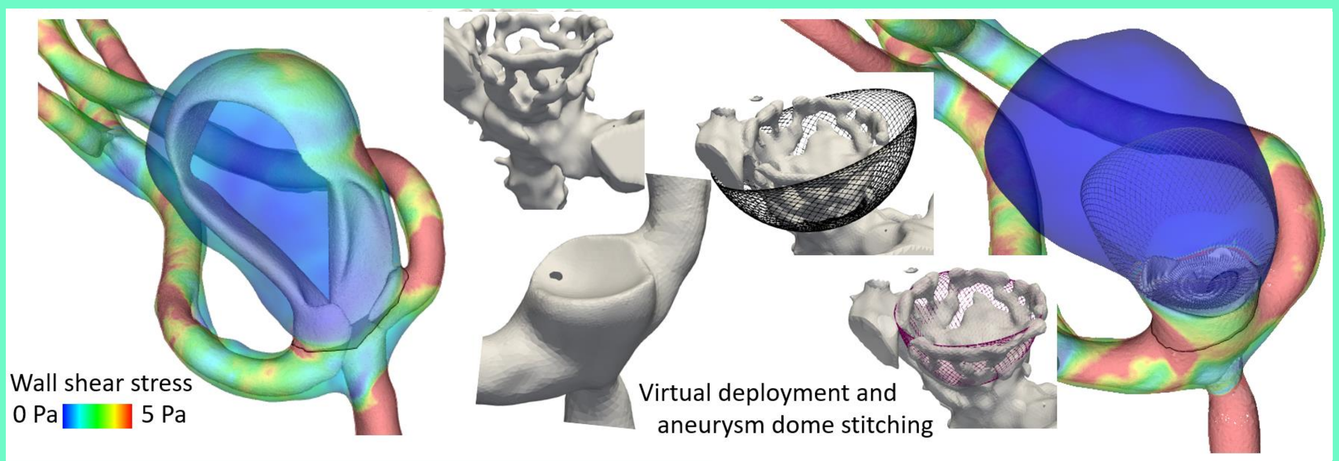
Fascinating simulations in fluid mechanics from 2024

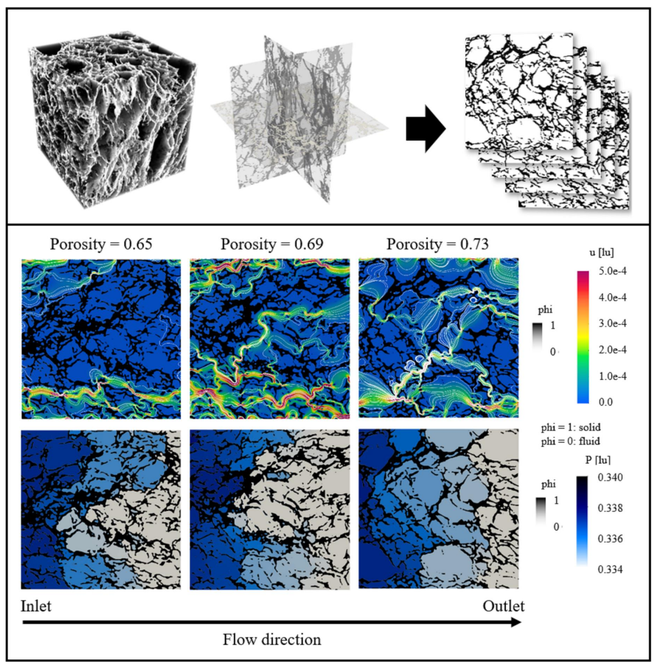


Numerical modeling of swimming silver eels in closed-conduit systems

Swimming activities of silver eels in closed-conduit systems are modeled. Dynamic Fluid Body Interaction (DBFI) is applied by solving the 6-DOF equations of motion coupled with the fluid flow. The DFBI approach was combined with mesh morphing to model the undulation motion of elongated anguilliform swimmers.

Abdelghafar, Bolland, Thévenin, Rubini, Wright, Hoerner





Flow simulation in bread microstructure using the lattice Boltzmann Method

The lattice Boltzmann method has been used to investigate fluid flow within realistic bread microstructures extracted via CT scanning. Understanding these flow details is crucial for exploring the relationship between permeability and the structural parameters of bread, ultimately helping to improve its quality and stability.

Zhou, Gharibi, Thévenin

Transverse sinus stenosis hemodynamics – Flow complexities at the temporal bone

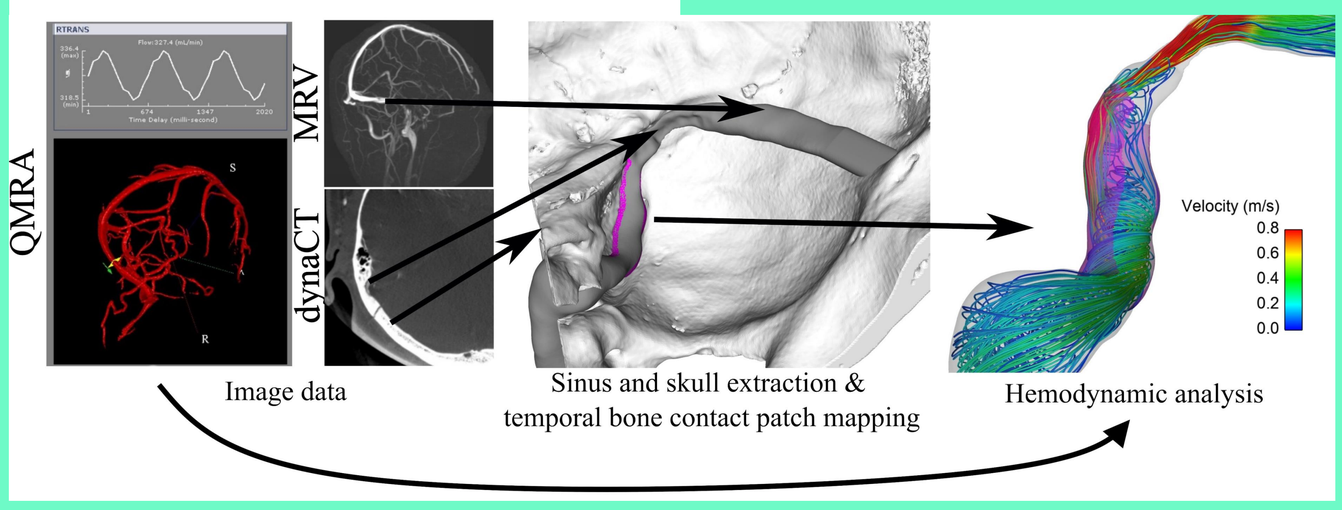
Transverse sinus stenosis may cause pulsatile tinnitus. Multimodal imaging of vasculature (QMRA, MRV) and the surrounding temporal bone (dynaCT) allows for patient-specific hemodynamic analysis. Flow complexities distal to the stenosis suggesting sound transmission to the ear through the temporal bone.

Stahl, Janiga, Berg

The Contour Neurovascular System shows robust longitudinal outcome

Patient-specific data were captured in vivo during deployment of the Contour Neurovascular System and in a follow up. Aneurysm and device data were segmented and adapted for simulation. Hemodynamic longitudinal simulations revealed a significant reduction in flow immediately after implementation.

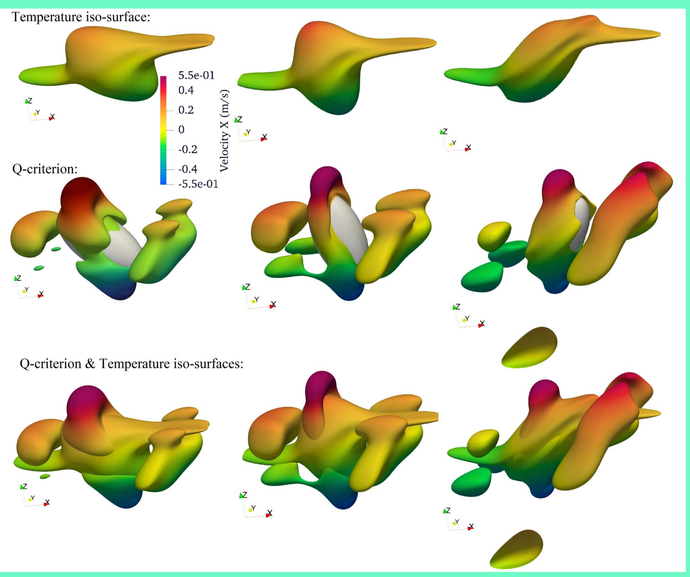
Korte, Gaidzik, Spitz, Berg

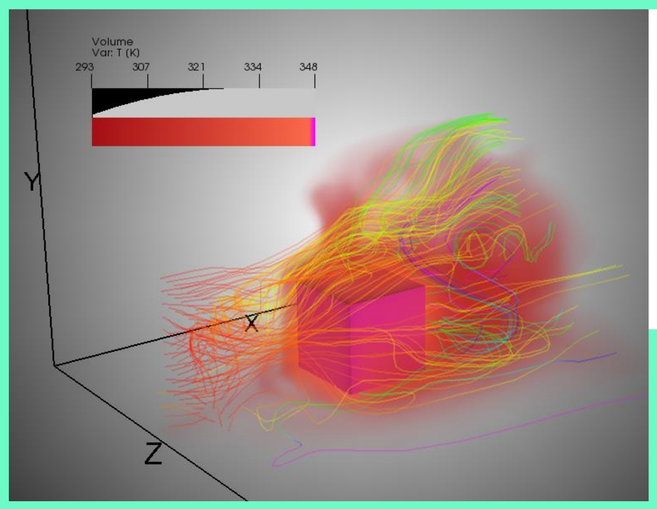


Investigating governing phenomena of non-spherical particle dynamics in shear flows

Using an Enhanced Hybrid Lattice Boltzmann Method, we studied spheroidal particle equilibrium bifurcation in isothermal and non-isothermal shear flows. Above a critical Reynolds number, the isothermal particle undergoes pitchfork bifurcation, while the hot particle does not. The study employed approximately 3 million core-hours of HPC resources.

Gharibi, E. Fard, Thévenin

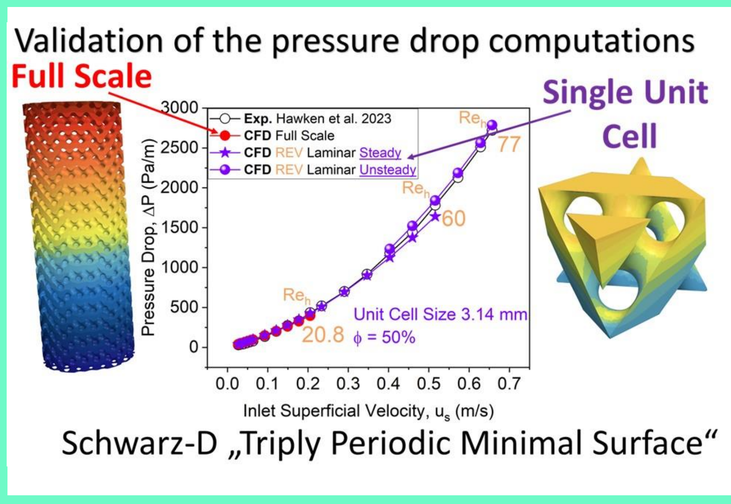




Flow past a heated non-homogeneous wall-mounted cube

The heat transfer around a heated non-homogeneous wall-mounted cube at a Reynolds number of 3584 is computed to validate a novel ghost-cell immersed boundary method coupled with conjugate heat transfer implemented in DINO code.

Guan, Chi, Abdelsamie, Thévenin



CFD analysis of the flow in Schwarz-D TPMS structures

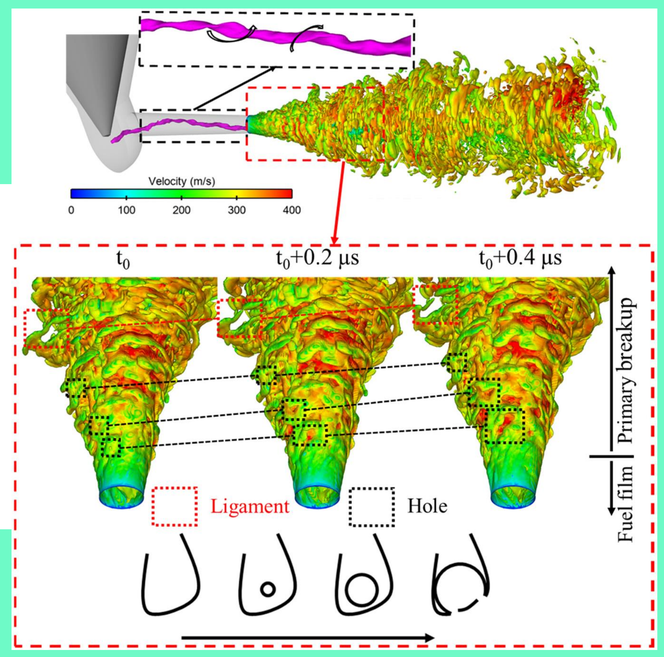
This study investigates flow dynamics in Schwarz-D TPMS structures using CFD simulations, validated against experimental data. CFD simulations at both the full scale and REV scale were conducted to explore the pressure drop and friction factor properties of the structure.

Vhora, Thévenin, Janiga, Sundmacher

Three-dimensional reconstruction of string cavitation and jet spray

As wrinkled string cavitation migrates toward nozzle exit, the behavior of the downstream jet breakup is impacted and exhibits asymmetry due to a non-coaxial interaction of vapor structure and nozzle exit. This jet spray shows a hollow cone.

Guan, Thévenin



Flow field comparisons using turbulent kinetic energy

These URANS simulations show how two different blade shapes can give completely different results at the same conditions (inflow = 0.8 m/s, tip speed ratio = 1.9), highlighting the importance of optimal blade shapes for vertical axis tidal turbines.

Ruiz-Hussmann, Delafin, Hoerner

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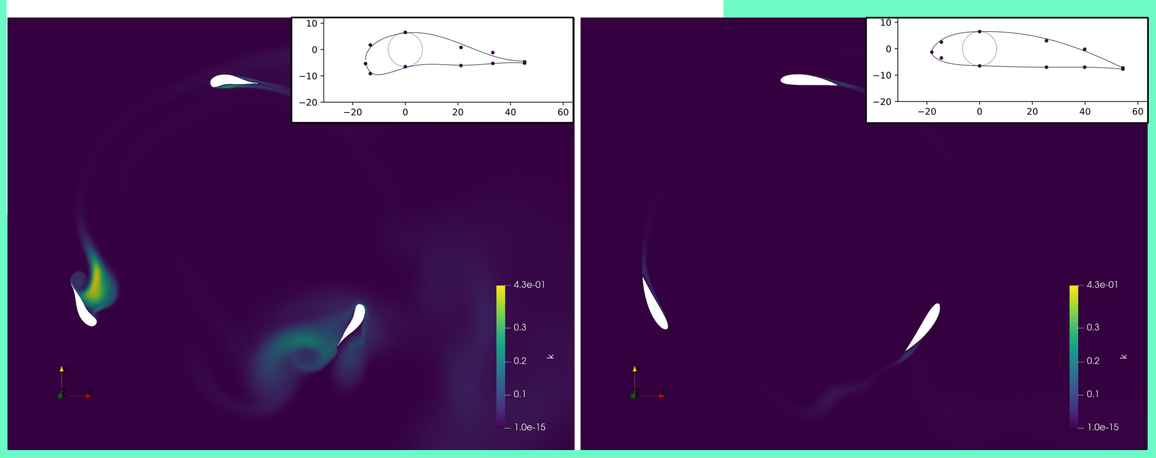

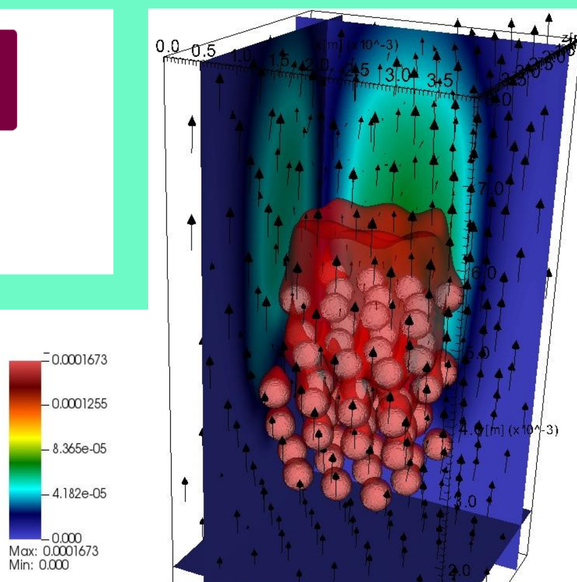

Iso-surface of heat release rate colored by H2 mass fraction. The arrows show the velocity vectors of water.

Direct Numerical Simulation of supercritical water gasification of polypropylene plastic particles

This is the first 3D-DNS of gasification of polypropylene (PP) plastic particles in supercritical water. 60 fully-resolved PP particles (diameter: 400 μm) are staggered in a supercritical water flow at *T*=900 K and *P*=250 bar. Particle Reynolds number is 70. The computational domain of 4 x 8 x 4 mm is resolved using 33 million grid points.

Abdelsamie, Thévenin