BACI/4C: Next-Generation Multiphysics Simulation for Real-World Problems

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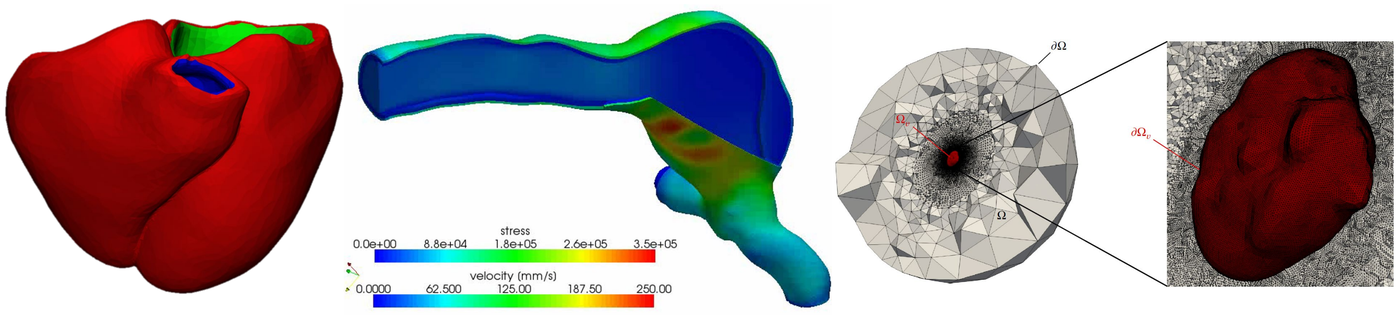
What is BACI/4C?

- A massively-parallel multi-physics research code in C++
- Employs advanced computational mechanics
- Provides a variety of physical models (solid, fluids, scalar transport, or porous media)
- Multiphysics-based on interactions between several physical fields
- Applied for aerospace, civil, chemical, or process engineering, medical applications and biophysics.
- >20 years, >400 publications, >60 PhD theses

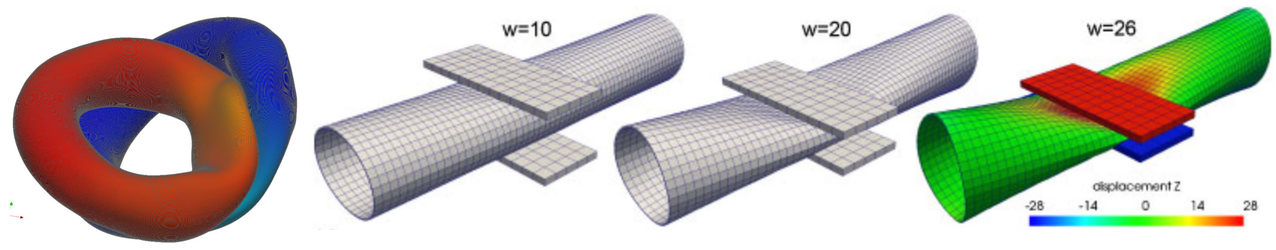
Why using it?

- Flexible and extensible framework especially for multiphysics
- Also usable out-of-the-box
- User can focus on his/her application topic and build up simulation on top of existing infrastructure
- Expanding documentation and active development community
- Can outperform commercial software on large problems
- Soon to be open-source

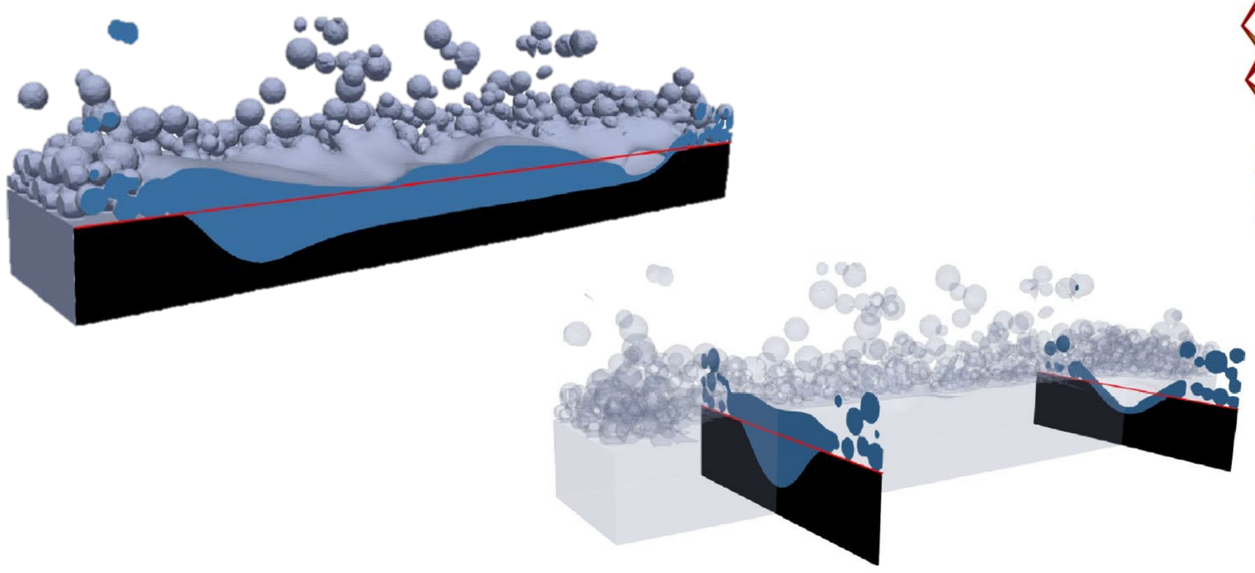


Blood flow in the human heart and through the abdominal aorta with abnormal, weak spot on blood vessel wall called aneurysm. Growth of a tumor in a human body. Analysis comprises fluid-structure interaction and growth and remodeling processes. (Gebauer et al., 2023, Biomech Model Mechanobiol; Maier et al., 2010, Ann Biomed Eng; Kremheller et al., 2021, Int J Numer Method Biomed Eng)

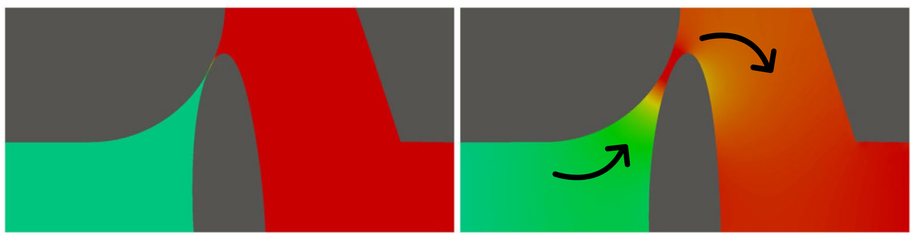
Dynamic failure of steel ropes modelled on the scale of individual wires based on Cosserat continua employing a beam element formulation. (Meier et al., 2017, Comput Methods Appl Mech Eng)



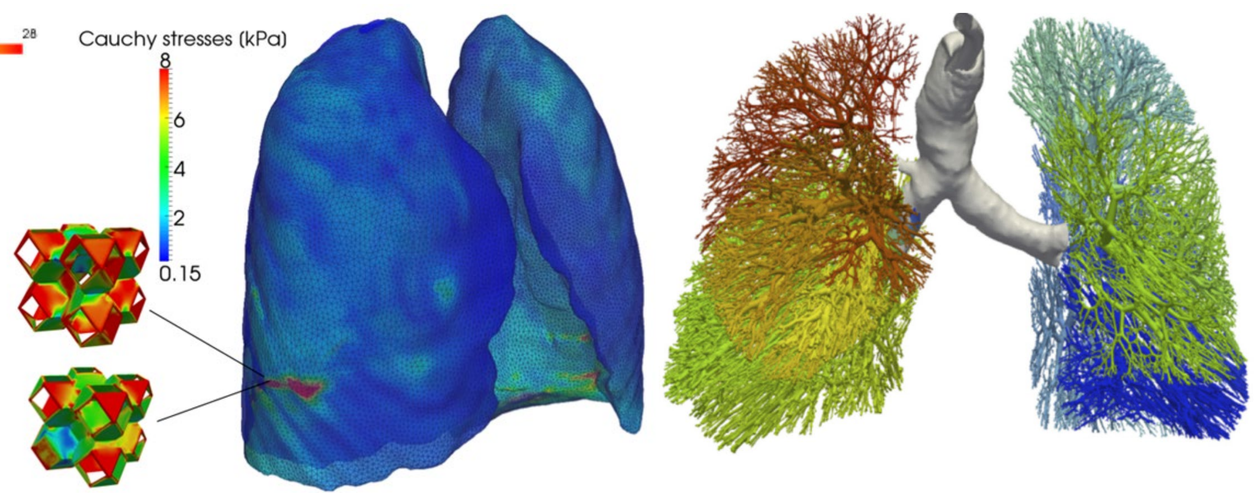
Large-scale dynamic contact analysis of 3D (thin-walled) solids undergoing finite deformations based on mortar-type contact formulation with semi-smooth Newton strategies. (Popp et al., 2010, Int J Numer Methods Eng)



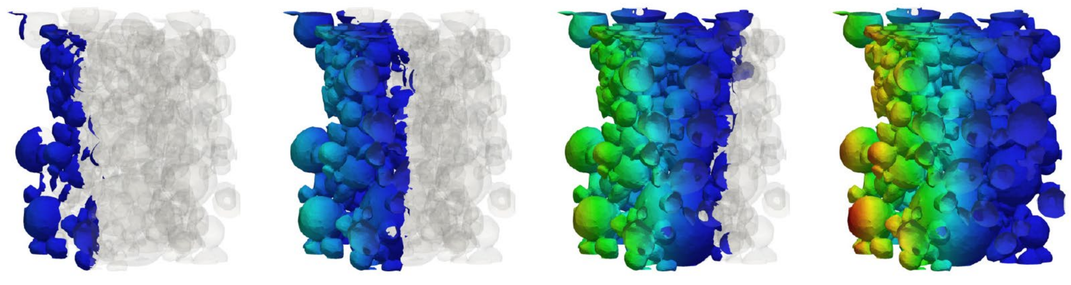
Additive manufacturing with a powder feedstock: Smoothed particle hydrodynamics (SPH) framework to handle different phases. (Fuchs et al., 2022, Eng Comput)



Fluid-structure-contact interaction in a non-return valve with a poroelastic layer to model the rough microstructure. Combination of Finite Element method with a CutFEM approach. (Ager et al., 2019, Int J Numer Methods Eng)



Simulation of the human lung to analyze clinical ventilation maneuvers: multi-scale simulation incorporating a 3D representative volume element to 3D-1D-0D coupled systems. (Roth et al., 2016, J Appl Physiol; Wiechert et al., 2010, Comput Methods Appl Mech Eng)



Dynamic analysis of electro-chemical processes in lithium-ion batteries: 3D microstructures and local film thickness in different charging scenarios. (Fang et al., 2022, J Comput Phys)

https://baci.pages.gitlab.lrz.de/website SCAN ME

Jointly developed by Helmholtz-Zentrum hereon, Technical University of Munich, Universität der Bundeswehr München, Universität Augsburg University

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