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Simulating shock-bubble interactions at water-gelatin interfaces[1]
STEFAN ADAMI, JAKOB KAISER, Technical University of Munich, IVAN BERMEJO-MORENO, University of Southern California, NIKOLAUS ADAMS, Technical University of Munich — Biomedical problems are often driven by fluid dynamics, as in vivo organisms are usually composed of or filled with fluids that (strongly) affected their physics. Additionally, fluid dynamical effects can be used to enhance certain phenomena or destroy organisms. As examples, we highlight the benign potential of shockwave-driven kidney-stone lithotripsy or sonoporation (acoustic cavitation of microbubbles) to improve drug delivery into cells. During the CTR SummerProgram 2016 we have performed axisymmetric three-phase simulations of a shock hitting a gas bubble in water near a gelatin interface mimicking the fundamental process during sonoporation. We used our multi-resolution finite volume method with sharp interface representation (level-set), WENO-5 shock capturing and interface scale-separation and compared the results with a diffuse-interface method (Kobayashi et al., Phys. Med. Biol. 56(19), 2011). Qualitatively our simulation results agree well with the reference. Due to the interface treatment the pressure profiles are sharper in our simulations and bubble collapse dynamics are predicted at shorter time-scales. Validation with free-field collapse (Rayleigh collapse) shows very good agreement.

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Stefan Adami
Technical University of Munich

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