The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

Simulation of Coated Bubbles in Cavitation

Ahmed Basil Kottilingal[1*], Stephane Zaleski[2]

[1*] Sorbonne University, 4 Place Jussieu, Paris. www.sorbonne-universite.fr. Email : ahmed_basil.kottilingal@dalembert.upmc.fr

[2] Sorbonne University, 4 Place Jussieu, Paris. www.sorbonne-universite.fr. Email : stephane.zaleski@sorbonne-universite.fr

Keywords: *Coated Bubble, Targeted Drug Delivery, Front Tracking*

Controlled oscillation of microbubbles in a blood vessel using ultrasound can be used to modify the permeability of the vessel wall. This technique which is called sonoporation can be potentially used for gene therapy and targeted drug delivery for cancer treatment, etc. In this work we are focusing on the response of coated bubbles to high frequency ultrasound waves. This study uses an all-mach formulation to simulate compressible multi-phase simulation of bubble and liquid. The multiphase flow solver which is based on front tracking method includes surface tension and viscous forces in the formulation.

In targeted drug delivery, coated bubbles are preferred for insonification due to their stability. Due to the presence of coating on the bubble surface, the bubble-liquid interface shows surface dilatational elastic and surface dilatational viscous properties. Computation of interface forces in front tracking method involves, calculation of tangents, curvature and surface derivatives of curvature. In front tracking, rather immersed boundary methods in general, advection of markers produces small amplitude, high frequency errors in the marker positions. Thus interface force which involve higher order derivative of marker positions have errors which can create numerical instability. So we employs a smoothing algorithm which ensures that all the terms involved in the computation of interface forces are smooth and have second order convergence.

REFERENCES

[1] Popinet, Stéphane, and Stéphane Zaleski. *A front-tracking algorithm for accurate representation of surface tension.* International Journal for Numerical Methods in Fluids 30, no. 6 (1999): 775-793.

[2] Fuster, Daniel, and Stéphane Popinet. *An all-Mach method for the simulation of bubble dynamics problems in the presence of surface tension.* Journal of Computational Physics 374 (2018): 752-768.