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Numerical modelling of acoustic streaming in resonators

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The acoustic wave propagation in thermoviscous fluid can generate slow phenomena, such as streaming and thermoacoustic effects, by nonlinear processes localised mainly in the viscous and thermal boundary layers. The model presented consists in computing numerically by the finite element method, (i) first, the harmonic solution for linear acoustics in thermoviscous fluid including the boundary layers, and (ii) second, the unsteady solution for the acoustic streaming and heat transfer. The model formulation is based on the mass and momentum conservation equations for the streaming, and the energy conservation equation for heat transfer. The streaming is presented as a standard form of an incompressible flow for velocity vector for mass transport, where the nonlinear effects of acoustics are considered as excitation forces for the streaming and sources for heat transfer. As the performance of thermoacoustic devices is limited by the convective heat transfer of the streaming, this study is suited for the optimisation of these systems. Another application is the development of microfluidic devices.