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Multiple Scales Analysis of a Thermoacoustic Heat Pump
MICHAEL MILLER, SHREYAS MANDRE, Brown University — Thermoacoustics utilizes the temperature and density oscillations inherent to acoustic vibrations coupled with heat conduction near a wall to produce heat transfer from sound (or sound from a heat source). In the heat pump setup, thermal energy is transferred to the wall from an element of gas during compression and taken from the wall during rarefaction. In thermoacoustic phenomena, acoustic oscillations occur on a very short time scale while heat transfer occurs over many acoustic cycles. Therefore, multiple scales analysis is well suited to describe the physics. We present a multiple scales analysis for a narrow two-dimensional channel between two thin, non-stationary plates resulting in an integral equation for the temperature distribution along the channel as a function of the long time scale. We solved this equation numerically to find a steady state solution for a given set of parameters.

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