

## ACOUSTICS2008/765 Numerical simulation of a thermoacoustic wave amplification

Omar Hireche<sup>a</sup>, Catherine Weisman<sup>a</sup>, Diana Baltean-Carlès<sup>a,b</sup>, Luc Bauwens<sup>c</sup>, Maurice-Xavier François<sup>a,b</sup>  
and Patrick Le Quere<sup>a</sup>

<sup>a</sup>LIMSI-CNRS, BP 133, F-91403 Orsay, France

<sup>b</sup>Université Pierre et Marie Curie (UPMC), 4 place Jussieu, 75005 Paris, France

<sup>c</sup>University of Calgary, Department of Mechanical and Manufacturing Engineering, 2500 University Drive  
NW, Calgary, AB, Canada AB T2N 1N4

We performed a numerical study of the thermal and physical phenomena occurring in thermoacoustic wave generators. The goal of the simulation is to predict the amplification due to thermoacoustics of a wave initially of small amplitude. Therefore, we focus on the stack and the two heat exchangers, which we call the active cell, which is acoustically compact. The resonator area is split into two parts: the active cell, in which heat transfer takes place, and a resonator, in which the flow is acoustic. The flow in the two-dimensional active cell can be approximated as a low Mach number viscous, conductive flow, subjected to spatially uniform pressure fluctuations. This model is formally derived using asymptotic expansions in terms of Mach number. The focus here is heat transfer between two successive stack plates. The two-dimensional time-dependent problem resulting from this model is solved numerically. Outside the active cell, flow in the resonator is described by a reversible acoustic one-dimensional model. The coupling between the two zones is obtained by matching the velocity at the interface. The acoustics in the resonance tube can be solved using the d'Alembert solution, relating velocities at the interface to velocity values at an earlier time.