Implicit Large Eddy Simulations of 2D Flow and Heat Transfer in Thermoacoustic Resonators

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Abstract

The reduction of energy consumption in the building sector (nearly 40% of the energy consumption in Europe) is a real challenge to achieve the objective of the "2020 European climate and energy package".

In recent years, great interest is observed for the Stirling thermoacoustic machines. Nonlinearities due to the high level of acoustic pressure generate DC flows that are superimposed on the oscillating flows present in thermoacoustic machines. Despite their low level, they result in significant energy conversion in dissipative flow, thereby reducing the energy efficiency of these machines. The rather abundant literature dealing with the subject is mainly dedicated to the understanding of this phenomenon and its modeling in academic settings. In addition, some works dealing with the subject have used statistical methods that are numerically too dissipative and therefore are not accurate enough to enable the modeling of streaming flows occurring in a thermoacoustic machine. The purpose of this study is to simulate the flows in the Swift-Backhaus motor composed mainly of the resonator, a hot space, cold space and regenerating space (stack). The objective is to describe the nonlinear effects accompanying the acoustic wave.

A detailed modeling, which describes the acoustic streaming due to the stack-exchangers coupling, will be developed.
The results of this simulation will be compared to those of the experiment.

Figures used in the abstract

Figure 1

Figure 2

Figure 3

Figure 4