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Design road-map for thermoacoustic refrigerators

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The main purpose of this work is to develop a road-map to enhance the design procedure and performance analysis of thermoacoustic refrigerators (TAR).
The basic mechanism of TAR is very simple and is based on the wave interaction processes of gas particles with their surrounding environment. As known, the performance of a TAR system is highly dependent to the number of gas particles involved in the process.
The essential components of TAR include a sound generating device, a resonance tube, a stack of plates, and heat exchangers. In this paper, the parameters influencing the performance of a TAR system are grouped into four blocks: (I)Operation (drive ratio, operating frequency), (II)Fluid (Prandtl number), (III)Geometry (blockage ratio, tube diameter, stack length, stack positioning), and (IV)Material.
A parametric study is executed to determine the optimized design of a TAR system for fixed Block II and IV scenario. First, an analysis is made on obtaining the optimum number of gas particles to be involved in the process. Then, based on this, an optimization approach is carried out to identify the best drive ratio, blockage ratio, stack positioning, stack length, and resonance tube diameter. Finally, results are compared with experimental data.