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Optimizing the Stack Length of Thermoacoustic Prime Movers
DAVID PEASE, BONNIE ANDERSEN, Utah Valley University — Thermoacoustics involves the fusion of thermodynamic and acoustic phenomena. Common applications of thermoacoustics include air conditioning and electricity generation. There are many components within a thermoacoustic device to optimize. The quarter-wave resonator used contains the heat exchangers and the stack. The temperature gradient between heat exchangers across the stack must exceed a critical temperature gradient for acoustic oscillations to be produced. The power of the device is also proportion the ratio of the two gradients minus one. The region between stack elements is the productive volume where the thermoacoustic effect takes place. Decreasing the length between heat exchangers will increase the temperature gradient, but will reduce the productive volume. This research tested four different stack lengths from 0.014" to 0.060" to find the optimum stack length for a temperature difference of 150 K. In order to do this, an optimum amount of stack, given the local ambient environmental conditions, operating frequency, and stack length had to be found first. With the optimum stack amount, the optimal stack length was found to be 0.030", giving a temperature gradient of 1970 K/cm.

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