Abstract Submitted
for the 4CF10 Meeting of
The American Physical Society

Comparing heat exchangers of thermacoustic prime movers with a Van der Pol model[1] I. COX, M. JORGENSEN, B. ANDERSEN, Utah Valley University — A thermoacoustic standing-wave prime mover is a self-sustained oscillator whose initial growth of acoustic pressure into amplitude saturation can be modeled by the Van der Pol equation. The nonlinear Van der Pol equation is calculated computationally, using 4^{th} order Runge-Kutta. The Van der Pol model gives quantitative loss and gain parameters, when using a best-fit with experimental data. The engines tested in this study have an average frequency of 2700 Hz, which suggests that the first second of oscillations when using the Van der Pol model can reveal information about the steady-state performance of the device. This model is applied to studying the effect of different heat exchanger sizes. All sixteen possible permutations were tested using different copper wire mesh dimensions: 24X24, 40X40, 60X60, and 80X80 for the hot and cold heat exchangers (where ##X## indicates wires per inch). Plotting the steady-state acoustic pressure as a function of the gain term divided by the loss term shows roughly, a linear relationship. The engine with the highest gain term and smallest loss term was using 80X80 for the hot heat exchanger combined with the 24X24 for the cold heat exchanger and is consistent with the highest steady-state pressure achieved. The modeling process has been very successful and fits the Van der Pol equation.

[1]Supported by UVU College of Science and Health, UVU Scholarly and Creative Opportunities Program, and the Western Alliance to Expand Student Opportunities, WAESO.

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Date submitted: 13 Sep 2010 Electronic form version 1.4