Notice of the Final Oral Examination
for the Degree of Master of Applied Science
of
OSMAN ULUOCAK
BEng (University of Victoria, 2015)

“Mass Streaming via Acoustic Radiation Pressure Combined with a Venturi”

Department of Mechanical Engineering

Friday, October 30, 2020
12:00 P.M.
Remote Defence

Supervisory Committee:
Dr. Andrew Rowe, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
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Abstract

Thermoacoustic (TA) engines and generators are one of the latest derivations of the two-century-old energy conversion devices that are based on the Stirling cycle. Unlike the traditional Stirling devices, the TA devices use the pressure wavefront of a standing wave created in the working gas, eliminating the power and displacement pistons. The lack of moving parts and the lubrication make these devices practically maintenance-free, making them ideal candidates for space and marine applications. The traditional method for delivering thermal energy to the working fluid (standing wave) would require a heat exchanger, absorbing energy from an external source, and a pump to deliver this energy to the working fluid, however, these components inherently have high losses as well as high cost, hindering overall efficiency. In thermoacoustic systems, the oscillating nature of the working fluid makes it possible to eliminate these components, with most widely applied method being the placement of an asymmetrical gas-diode in a heat carrying loop which is attached to the resonator. Such methods of creating a time-averaged nonzero flow-rate in a preferred direction is called Acoustic Mass Streaming. An alternative to the gas-diode technique to create such pump-less flows is to take advantage of the Acoustic Radiation Pressure (ARP) phenomenon, which is a time-averaged spatially varying pressure of second order amplitude, observed in standing wave resonators. Connecting a loop in two different locations to the resonator creates a pressure differential due to the spatial variance which can be further amplified with a converging-diverging nozzle, namely a Venturi. This thesis investigates the fundamentals of this novel acoustic mass streaming method, where the Acoustic Radiation Pressure is combined with a Venturi for increased efficiency. Using the thermoacoustic software DELTAEC, the effects of placing a Venturi with different dimensional parameters into the resonator is studied and the changes on the ARP is examined. Considering various types of acoustic losses, the maximum amount of fluid that can be circulated in the pumpless loop is investigated. Time-averaged minor-loss coefficients for converging and diverging acoustic flows at a T-Junction are also presented.