

**MEM Department, Drexel University  
Ph.D. Dissertation Defense**

**Thermoacoustic Convection and Transport in Supercritical  
Fluids under Normal and Micro-gravity Conditions**

**Zhiheng Lei**

Advisors: Dr. Bakhtier Farouk and Dr. Elaine S. Oran (NRL)

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Time: **10:00AM**

Place: **MEM Seminar Room (162 Curtis)**

**Abstract**

The generation, propagation and dissipation of thermally induced and mechanically driven acoustic waves in supercritical nitrogen and carbon dioxide were studied. Supercritical fluids have high compressibilities, high thermal conductivities, low viscosities, and low thermal diffusivities. As the thermal diffusivity tends to zero near the critical point, acoustic waves are believed to be the primary reason of fast thermal equilibration in supercritical fluids. The compressible form of Navier-Stokes equations for Newtonian fluids was considered to model the supercritical fluids. A high-order explicit numerical scheme (FCT), along with an accurate wall density boundary condition, was applied to accurately track the acoustic waves. The property variations (pressure, internal energy, viscosity, and thermal conductivity) of the supercritical fluids (carbon dioxide and nitrogen) as functions of temperature and density were obtained from the NIST Reference Database 12. The flow fields induced by thermally induced acoustic waves in supercritical fluids were investigated numerically under normal and reduced gravity conditions. The flow fields and heat transport induced by mechanically driven acoustic waves in an enclosure driven by a vibrating wall were also numerically studied. The model developed was also used to investigate the interaction of thermally induced acoustic waves and mass transfer in supercritical fluids (naphthalene dissolution in supercritical carbon dioxide). The generation and propagation of thermally induced acoustic waves due to rapid heating of a solid wall in a confined supercritical fluid layer were also experimentally investigated. A high-pressure experimental facility was constructed to characterize the generation and decay of acoustic waves in supercritical nitrogen and supercritical carbon dioxide in an enclosure due to rapid heating of an end wall.