Turbomachinery

and Melvyn & Carolyn Miller for Innovation

Heat Transfer PI: Asst. Prof. Beni Cukurel, 15/12/16

Laboratory

**Acoustic Resonance Excited Heat Exchanger**

**Interim Report**

**Project Summary**

This project seeks to find a way to improve the heat transfer between a fluid and a wetted surface. This process is carried out in a roughened heat exchanger (HE) – that is, where a rough surface has been added to enhance the heat transfer. The underlying concept is based on applying a pressure wave (a standing acoustic wave). In preliminary work, a 25% increase in the heat transfer was achieved without incurring a drop in the pressure of the fluid flow. The results of the initial research have been published in leading scientific journals and a patent is pending for the process.

The preliminary basic scientific research will now be applied to develop technologies for industrial use. A feasibility study will be carried out on an existing industrial HE unit, which will be adapted to accommodate a tuned acoustic source that will create a standing wave inside the HE. The goal of the study is to raise the technology readiness level from 3 (analytical and experimental critical function and/or proof-of-concept) to 5 (system/subsystem/component validation in relevant environment), within the timeframe of the project. The two major research directions will be to determine the resonant frequencies of the acoustic wave that are suitable for the HE under investigation, and to find the acoustic source that will create these waves.

Over ten major HE industrial companies were approached to enlist their support and interest.

For a number of reasons, the most appropriate HE for this study was found to be the gasketed plate type HE. The reasons for this include:

* The plate's heat transfer area can easily be changed for different experiments.
* The flow in the HE is conducive to high levels of turbulence, which enhances the heat transfer
* The plate type HE is more compact and less costly than the equivalent shell-and-tube HE, and it does not suffer from other problems common to the latter (flow-induced thermal stresses, etc.)
* Maintenance and cleaning are easier in the plate-type HE
* This HE is the most common is current use and thus is of significant practical interest

Several candidate plates have been selected and are undergoing advanced experimental testing in our wind tunnel facility and simulation studies using COMSOL Multiphysics software. Illustrations of a CAD model and examples of the selected plates are provided.

In parallel, a dedicated HE test facility is being designed and will be constructed and launched in the upcoming stages of the project. A schematic of the test facility is provided.