Research field: Basic and Applied Heat Transfer

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Active Turbomachinery Noise Cancellation via Thermo-Acoustic Transducer

Please provide a paragraph describing the research topic:

Majority of current investigations focus on attenuation of tonal frequencies by active and passive techniques, as well as local noise cancellation at the point of the recipient. However, the anticipated drastic progress on noise reduction can likely stem from sound cancellation at the source. Forming equal-amplitude and opposite-phase pressure waves to the noise, the sound emanating from the system can be negated. Thus far, the technological issue hindering the practical implementation of this approach has been absence of devices, which can be mounted on the entire noise generating surface without affecting the intended operation. Although the moving-coil loudspeaker has seen the most scientific development over the past 150 years, other forms of sound reproduction exist. In particular, thermophones utilize periodic Joule heating of an electrically conductive body to create surface temperature fluctuations, which are then converted into pressure waves by the thermo-acoustic effect. To date, a comprehensive model, which captures the exact mechanism of heat transfer in such devices, does not exist. Therefore, we have been working on a semi-analytical solution that couples the dual-phase-lag hyperbolic heat conduction problem with the ballistic transport on the surface. Considering the wave nature of conduction in small time-scales, our model predicts the existence of thermal shocks, thermal resonances, and thermal interference patterns. Based on these estimates, we have engineered thin solid and epoxy media, stretched it between copper electrodes and excited with a combination of direct and alternating currents. Applying this formation on top of a conventional loudspeaker, our method has achieved acoustic cloaking by 500-fold reduction of the generated sound pressure levels. The next stage of the project focuses on reducing the aero-acoustic noise generated by the rotor-stator interaction in a small-scale ducted fan engine, where the thermophone will be deposited on the stators

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Basic and Applied Heat Transfer, Multiphysics Modelling, Acoustics.
- Expertise in finite element / volume solvers (such as COMSOL, ANSYS, Fluent, CFX), and proficiency in MATLAB is a strong benefit.
- High level of English language proficiency is desirable.

- Candidates are expected to be self-motivated, hardworking and team players.

Application should be sent to: beni@cukurel.org

Your website: https://bcukurel.net.technion.ac.il/

Research field: Basic and Applied Heat Transfer

Degree: MSc/PhD

Offer starting date: Immediately

Offer description*:* Acoustically Enhanced Forced Convection in Compact Heat Exchangers

Please provide a paragraph describing the research topic:

Towards enhancing the efficiency of gas turbines, most thermodynamic cycles require heat to be either added or dissipated by a heat exchanger, which operates by associating two streams of different thermal potential. Due to form factor limitations of many size restrained applications, the state of the art is advancing towards more compact designs. This forms the need towards higher performance and efficiency heat exchangers - enabling more heat transfer for the same size heat exchanger unit with an unchanged pressure drop. Therefore, we focus on studying the convective heat transfer ramifications of acoustically excited smooth and turbulated walls. Determined by the resistance of the thermal boundary layer, convective heat transfer is undoubtedly a surface phenomenon, only dependent on the near wall region. Therefore, by acoustic streaming of wall bound flow and formation of a coupled Stokes layer, a local influence on the fluid-solid interface can be achieved without simultaneously affecting the mainstream flow motion - increasing heat transfer performance. However, when the net heat exchange of the flat surface is still insufficient, pertubrators are used to promote transport phenomena by improved mixing with the free stream. In order to improve the efficiency of this periodically reattaching flow problem, we use acoustic resonance driven standing waves to trigger a complex instability dynamic. The instability initiates a process of wavelength conversion by Tolmien-Schlichting waves that are later amplified into Kelvin-Helmoltz instability mechanisms in the free shear layer. Globally, considering the closely confined internal air flow inside highly branched heat exchangers, the coupled resonance behavior of interconnected passages and cavities exert a strong influence on the internal convection heat transfer, absent of additional pressure penalty. Neither of these engineering problems has previously received much prior attention.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Basic and Applied Heat Transfer, Energy Systems, Advanced Measurement Techniques.
- Expertise in MATLAB and / or LabView is a strong benefit.
- High level of English language proficiency is desirable.
- Candidates are expected to be self-motivated, hardworking and team players.

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Research field: Basic and Applied Heat Transfer

Degree: MSc/PhD

Offer starting date: Immediately

Offer description*:* Heat Transfer Enhancement by Pulsating Coaxial Impinging Jets

Please provide a paragraph describing the research topic:

In complex applications, where liquid-based cooling is not an option, cooling by impinging jets is an attractive alternative. Several studies have already observed that coaxial impinging jets improve the rate of heat transfer from a body in comparison to a single jet. The goal of the present research is to achieve a further augmentation in the rate of heat transfer by implementing appropriate jet control strategies, such as pulsation of the coaxial jets and addition of swirl component to velocity. The hypothesis is that this pulsation will modulate the strength and the frequency of the primary toroidal vortices that are generated due to the shear layer instabilities in the mixing regions of coaxial jets, and that heat transfer enhancement can be optimized for specific range of the inner and outer jet diameters ratio and pulsation frequency. The investigation entails a systematic study of the spatio-temporal heat transfer characteristics on a heated thin-foil by high-speed infrared thermography, and its detailed correlations to the flow-field measured by phase-locked tomographic particle image velocimetry. The results of the study are expected to significantly enhance heat transfer coefficients in impinging air jet applications and change the way impinging jet cooling is implemented in modern applications.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Basic and Applied Heat Transfer, Advanced Measurement Techniques.
- Expertise in MATLAB is a strong benefit.
- High level of English language proficiency is desirable.
- Candidates are expected to be self-motivated, hardworking and team players.

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