DEPARTMENT OF AEROSPACE ENGINEERING

Research field: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Acoustic Flow Control of Low Reynolds - High Lift Airfoils

Please provide a paragraph describing the research topic:

Turbine airfoils are known to suffer severe performance degradation at off-design conditions that can be mitigated by active flow control methodologies. In the present study, acoustic excitation is used to control the separation over such airfoils and different strategies are developed to determine flow and excitation parameters for optimum control of separation for varying airfoil shapes. These guidelines are developed based on detailed experimental campaign measuring surface pressure and velocity field around the airfoils. Experiments are performed using an in-house low speed acoustic wind tunnel facility equipped with laser diagnostic techniques (PIV) and other relevant instrumentation (static pressure probes, flow velocity meter and thermocouples). The excitation parameters (amplitude and frequency of global excitation), flow parameters (velocity) and shape of airfoils are individually varied. These experiments not only bring out the most favorable conditions but also enable us to uncover the flow mechanisms leading to desired modifications in airfoil performance.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Turbomachinery Aerodynamics, Aeroacoustics, Flow Control, Advanced Measurement Techniques.
- 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: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Transonic Fan Test Facility

Please provide a paragraph describing the research topic:

Towards enabling high quality testing of modern high-pressure ratio turbomachines, the laboratory is establishing a new test facility driven by a 315kW ABB motor with variable speed drive. The tested geometry is scaled and connected to the motor via a step-up gearbox with a ratio of 15.5:1. The duct and the test section will be instrumented and beyond measuring the aerothermal performance via pressure and thermocouple probes, the facility is intended to allow performing detailed acoustic measurements using range of microphones, signal conditioners and amplifiers. Baseline noise measurements will be conducted in the far field via free-field microphones evenly spaced between 0-180°, while the duct measurements will be performed through a rotating inlet, with microphones in two opposite axial rows. Rotation is added due to the three-dimensional behavior of a sound propagation, which allows to obtain an accurate sound footprint of the tested geometry. In addition, EMFi surface microphones (piezo layers sandwiched between two metal sheets with a total thickness of 100µm) can be attached to the stators and the housing in order to quantify the unsteady pressure field.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Aero-Thermal Design of Gas Turbines, Turbomachinery Aerodynamics, Acoustics, Advanced Measurement Techniques.
- Expertise in finite element / volume solvers (such as COMSOL, ANSYS, Fluent, CFX), and proficiency in 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: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Development of an Additive Manufactured Micro Gas Turbine with 300W Electric Power Output

Please provide a paragraph describing the research topic:

Electronic military equipment weight as well as MAV flight time is highly dependent on achievable electric energy density. Therefore, the development of a 300W kerosene driven Ultra Micro Gas Turbine (UMGT) prototype is proposed, which is foreseen to triple energy density compared to current Li-Ion batteries. UMGT developments of previous research projects did not achieve useful electric power output due to manufacturing limitations and unstable air bearings. To encounter these shortcomings, the proposed project will facilitate an additive ceramic manufacturing approach, allowing outstanding design flexibility and material properties. As current high-end ball bearing technology is suitable for the demanding operating conditions of UMGTs, ceramic hybrid bearings will lead to reliable operation of the turbine rotor. In accordance with experimental tests, an analytic engine model will be established to evaluate multiple engine configurations, leading to a highly redundant development process that will result in a multi-parameter optimized UMGT prototype.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Cycle Analysis, Aero-Thermal Design of Gas Turbines, Turbomachinery Aerodynamics, Optimization.
- 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.

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Research field: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Cold Flow Mixing Process in Micro-Combustors

Please provide a paragraph describing the research topic:

Understanding the scalar dissipation dynamics of the fluid inside the combustion chamber of a gas turbine is important from the stand point of mixing. Current numerical design tools stem from RANS simulations which have turbulence closure issues and arbitrary corrections factors such as turbulent Schmidt number. Fluid mixing can be studied easily through the dissipation rate of the scalars in a given region of investigation. In this experimental research, a non-reactive flow field inside the micro-combustor is resolved in a specially designed experimental facility, which includes a rectangular test section which simulates the flow inside an annular combustion chamber with multiple port of fuel injection at different directions. The flow field is dominated by the cross flow and the impinging flow/co-flow regimes. The research aims to study the dissipation rate of the introduced scalar in a geometry representative of micro combustors by resolving instantaneous scalar and vectoral fields. This is intended to provide a benchmark validation test case for future numerical investigations.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Fluid Mechanics, Advanced Measurement Techniques.
- 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.

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Research field: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Linear and Rotational Micro-Turbine Research Facilities

Please provide a paragraph describing the research topic:

Beyond the inherent design complexity, the physics associated with micro gas turbines are complicated by dimension-specific challenges. Hence, to obtain positive cycle efficiencies, the same design guidelines cannot be applied to large and miniaturized engines. Currently, among the main technological barriers of advanced micro gas turbine development is the lack of relevant scientific knowledge on the hot gas section, which is commercially confidential and export-controlled. In this light, we are building Israel's first turbine research facility, which will enable developmental projects to be structured around a versatile closed-loop pressurized high speed turbine facility. Incorporating an interchangeable test section to provide hot (~600K) transonic conditions for fixed blade cascade and rotating high/low pressure turbine stages of micro-engines, it is intended to provide unique research capabilities to the global research environment. The final specifications include maximum turbine diameter up to 350mm, closed loop turbine pressure ratio up to 6:1, maximum mass flow rate of 0.9 kg/sec, transonic Mach distribution on the blades, rotational rate of up to 90,000 rpm and flow to metal temperature ratio of up to 2:1. Matching all engine similarity conditions for high pressure turbine stages of micro-engines, the continuously running rig will enable full aero-thermal performance characterization of the turbine independent of other sub-components and contribute to advances in the areas of advanced thermal management, active tip clearance control and aerodynamic/thermal loss minimization.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Aero-Thermal Design of Gas Turbines, Turbomachinery Aerodynamics, Heat Transfer, Advanced Measurement Techniques.
- Expertise in MATLAB and LabView is a strong benefit.
- High level of English language proficiency is desirable.
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Research field: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Inverted Brayton Bottoming Cycle for Hot Gas Energy Recovery

Please provide a paragraph describing the research topic:

In numerous widely-used application (such as micro gas turbines, fuel cells and internal combustion engines) significant amount of thermal energy is expelled with hot waste gas. The inverted Brayton bottoming cycle (IBC) offers a way to utilize this expelled heat and boost the overall thermodynamic performance of the system. It makes use of high temperature exhaust gas in near-atmospheric conditions by expansion into vacuum. This avoids issues of backpressure and increases the potential energy recovery from exhaust heat. Our research project focuses on the design, development and validation of the IBC system concept in application-relevant conditions with the ultimate goal of assessing the actual impact on the system performance.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Cycle Analysis, Advanced Measurement Techniques, System Design and Integration.
- Expertise in MATLAB and 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: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description: Effusion and Skin Cooling for Micro Gas Turbines

Please provide a paragraph describing the research topic:

As the power and thrust requirements from modern micro turbomachines increase, they pose new challenges on the thermal management of the units. As such, the turbines of these devices are operating in increasingly harsher thermal environments and as the micro turbine are currently mostly uncooled, new cooling paradigms have to be explored to further promote the state of the art. Therefore, we are using our turbine research facilities to develop effusion and skin cooling methods for micro gas turbines. Previously used only in their larger counterparts, the transition of these methods to smaller scales is not trivial and requires significant scientific and experimental inputs in order to provide viable cooling solution for micro turbines

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Turbomachinery Aerodynamics, Heat Transfer, Advanced Measurement Techniques.
- 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.
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Research field: Turbomachinery

Degree: MSc/PhD

Offer starting date: Immediately

Offer description*:* Adaptive Cycle Micro-Turbofan Engine

Please provide a paragraph describing the research topic:

As the operational envelope of unmanned air vehicles expands into the high sub-sonic and transonic speed range, the engine design process requires compromises in thrust, weight, fuel consumption, size, reliability, and manufacturing cost. Moreover, the engine requirements for multiple operating points, consisting of loitering during reconnaissance and high-speed flight during cruise, are conflicting as design criteria for an efficient propulsion system. In general, micro-turbojet engines may offer a simple design capable of providing high levels of thrust, but are marked by poor fuel consumption, hindering range. In contrast, larger platforms utilize turbofan engine architectures due to their greater propulsive efficiency at low flight velocities. The goal of our project is the development of a variable cycle micro gas turbine engine, which operates via integration of a fan by a continuously variable transmission into an existing micro-turbojet with an adaptive bypass nozzle. The developed solution significantly improves maximum thrust, reduces fuel consumption by maintaining the core independently running at its optimum, and enables a wider operational range, all the meanwhile preserving a simple single spool configuration. Moreover, the introduction of a variable fan coupling allows real-time optimization for both "fly-fast" and "loiter" modes.

Requested profile (background and skills):

- A pre-existing solid background, or a strong desire to acquire knowledge, in the following subjects is essential: Cycle Analysis, System Design and Integration, Turbomachinery Aerodynamics.
- Expertise in finite element / volume solvers (such as COMSOL, ANSYS, Fluent, CFX), and proficiency in MATLAB and LabView is a strong benefit.
- High level of English language proficiency is desirable.
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