הטכניון – מכון טכנולוגי לישראל **הפקולטה להנדסת מכונות**

סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ד׳ 11.01.17 (יג׳ בטבת, תשע״ז), בניין דן-קאהן, קומה 0, אודיטוריום 1 , 13:30.

יוצר: יהונתן פוקס

מנחה: פרופ׳ ערן שר, הפקולטה להנדסת אוירונאוטיקה וחלל
מנחה שותף: ד״ר לאוניד טרטקובסקי

על הנושא:

Phase Change Material Engine for Micro Air Vehicle

The seminar will be given in Hebrew

להלן תקציר ההרצאה:

The PCM based engine offers many advantages and in some cases, may be superior relative to the current systems. Compared to internal combustion engines, the PCM engine is a non-complex system, with very few parts which makes it very lightweight and reliable. The PCM engine could be built in a very small scale using small capsules as tanks, few pipes and a micro turbine for propulsion. In contrast to internal combustion engines, it offers a very low sound signature and practically no heat signature, making it a strong candidate for military use. The PCM engine is an anaerobic engine that requires no oxidizer to operate so it may also be used underwater. Although it carries less energy per weight than the standard internal combustion engine, the latter is very limited regarding miniaturization due to its steep efficiency degradation with its size reduction.

In our current work, we propose a design for an open system PCM based engine that could be built in a miniature scale. Its principles and behavior are described using a thermodynamic analysis and numerical tools and its advantages and possible drawbacks that might be overtaken are carefully examined. The proposed system is optimized on MAVs most important features such as specific size and weight, it is accomplished through a fundamental thermodynamic parametric study to the most important and defining parameters such as temperatures, pressures, volume, and power. Results show that a nitrogen based PCM engine producing 100[W] and running for 20[min] could provide specific power levels of about 30-35[W/kg], specific energy of 10-12[W-h/kg] and efficiency levels of 20-25%.

Different cryogenic fluids are examined as the PCM fluid, finding behavior advantages and pointing to the best alternatives – Hydrogen, Neon, Methane and Nitrogen and what are the thermodynamic qualities that makes them optimal. The proposed system is analyzed for stability – proving that stabilization actions must be taken, thus a feedback control systems for stabilization of the process including two alternative control methods – proportional and a simple ON-OFF are offered.

Finally, a large-scale system is built which serves two goals – Firstly, a proof of concept and comprehending the notion in where a theoretical design is limited. Secondly, it serves as a test bench, comparing empirical and theoretical results. The empirical phase of the research proved that a PCM engine is feasible and practical, an accumulated period of hours of operation revealed a reliable system with a steady power output thanks to the stable process achieved through the control system and offers an insight to a miniature scale design of an operational system

בברכה,

פרופ״א שמואל אוסובסקי
מרכז הסמינרים