MECHANICAL ENGINEERING PhD SEMINAR

Thursday, August 21, 2025, at 13:30-14:20, D. Dan and Betty Kahn Building, Room 217

Rotary Engines in a Low-Carbon Future: Advancing Thermal Efficiency and Integration within Sustainable Energy Systems

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This doctoral research explores the rotary combustion engine (RCE) as a platform for advancing high-efficiency, low-emission propulsion technologies. With its compact geometry and high power-to-weight ratio, RCE offers strong potential for performance improvement and integration into sustainable energy systems. However, combustion in its rotating chamber, which is characterized by a high surface-to-volume ratio, remains underexplored and presents technical challenges for further efficiency gains. To address these issues, detailed three-dimensional unsteady Reynolds averaged Navier-Stokes (RANS) simulations are performed, combining reactive flow modeling with conjugate heat transfer in dynamic engine geometries. These simulations are used to analyze in-cylinder flow, transient combustion, and thermal loading under realistic operating conditions reconstructed from experimental measurements. Novel contributions include the application of optimized ignition strategies, the use of thermal barrier coatings, and the integration within a combined electro-thermo-chemical (CETC) propulsion system. Special emphasis is placed on flame dynamics and flame-wall interaction, identified as a major factor limiting RCE efficiency. Using a large eddy simulation (LES) approach in canonical experimental configurations, the study provides new insights into transient flame quenching, stretch dynamics, and wall heat loss. The analysis also accounts for heat transfer effects associated with wall translation and curvature, which are inherent to the RCE configuration. To assess the broader impact of RCE implementation, the research incorporates a consequential life cycle assessment (LCA), evaluating the decarbonization potential of advanced propulsion systems under constraints of sustainable electricity availability. Together, these contributions enhance both the fundamental understanding of RCE combustion and the design of next-generation low-carbon powertrains.

Note: the seminar will be given in English.

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Seminars Coordinator: Assoc. Prof. Shmuel Gal