MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Thursday, January 8 2026, at 14:00-14:30, Lady Davis Building, Room 250

Comparative Assessment of Fuel-Cell Type on CETC Cycle

Nir Navon

Adviser: Prof. Leonid Tartakovsky

The global transition toward sustainable transportation necessitates the development of high-efficiency powertrains with minimal environmental impact. This study presents a comprehensive comparative assessment of different fuel cell (FC) technologies integrated into a novel Combined Electro-Thermo-Chemical (CETC) cycle. The CETC cycle synergistically combines an internal combustion engine (ICE), a chemical reformer, and a fuel cell stack, utilizing thermochemical recuperation (TCR) to convert engine waste heat into hydrogen-rich reformate.

To address the limitations of previous simplified cycle models, a detailed modular simulation framework was developed using GT-Suite. Three distinct fuel cell types- Solid Oxide Fuel Cell (SOFC), Molten Carbonate Fuel Cell (MCFC), and High-Temperature Proton Exchange Membrane (HT-PEM), were modeled and calibrated against experimental data to capture real electrochemical and thermodynamic characteristics. The performance of each configuration was evaluated through a dynamic case study of a heavy-duty delivery vehicle operating on an urban driving cycle.

Key results demonstrate that the CETC cycle significantly outperforms conventional ICE systems, achieving a mean efficiency improvement of up to 22.4% compared to a baseline ICE. Among the evaluated technologies, the SOFC configuration provided the most substantial fuel economy benefits, yielding a 9.95% relative improvement in fuel consumption over the driving cycle. Furthermore, the MCFC configuration achieved the highest mean efficiency for the full cycle at 47.30%. These findings highlight the potential of the CETC cycle to overcome the low power density of standalone fuel cells while addressing the efficiency and emission challenges of traditional internal combustion engines.

Keywords: CETC Cycle, Fuel Cells, Internal Combustion Engine, Thermochemical Recuperation (TCR), SOFC, MCFC, GT-Suite, Efficiency Optimization.

Note: the seminar will be given in Hebrew

Seminars Coordinator: Prof. Sefi Givli.