Technion-Israel Institute of Technology
Faculty of Mechanical Engineering

הטכניון-מכון טכנולוגי לישראל
הפקולטה להנדסת מכונות

סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, **במסגרת הדוקטורט** שתתקיים ביום ד' 5.06.2019 (ב' בסיון, תשע"ט), בניין דן קאהן, חדר 316, 13:30.

מרצה: סולל אמויאל

מנחה: פרופ' סטיבן פרנקל

על הנושא:

High-fidelity low-Mach number simulations of reacting flows using accelerated chemistry

The seminar will be given in English

תקציר ההרצאה:

Combustion provides the vast majority of the world's produced energy. Despite its importance, many of the physical processes involved are still relatively misunderstood and it therefore remains at the heart of academic and industrial research. Unsteady combustors are key for development of a clean, high-efficiency power source such as those used for propulsion, petroleum and power generation applications. The physical processes involved sit at the intersection between fluid dynamics and combustion, and a comprehensive understanding of both is paramount for future developments.

For a couple decades now, numerical simulations has been an important tool to further understand some of the complex dynamics involved in combustion systems. Numerical combustion is however very computationally expensive and a detailed description of the chemical mechanisms is often prohibitive. Complex, unsteady flame dynamics such as flame ignition, blow off, extinction and pollutant formation are prominent in industrial combustors but can only be described by detailed chemistry.

The objective of the current PhD thesis is to develop a robust, stable and efficient high-order numerical tool for low-Mach turbulent reacting flows. The solver combines high-order finite difference schemes with a projection-method while the energy and scalar equations are advanced through a Strang operator split formulation. Furthermore, a sparse Jacobian algorithm has been developed for constant-pressure combustion to accelerate the integration of the chemical source term and coupled with the In-Situ Adaptive Tabulation technique.

The solver is validated extensively with the Method of Manufactured Solutions and other benchmark problems and is shown to be 2nd and 5th order in time and space, respectively. The accuracy and efficiency of the chemistry acceleration algorithms are tested in different configurations and fuels and show a speed-up factor of up to 12 with respect to the standard stiff solver integration. Numerical simulations of a V-gutter premixed propane flame is studied and compared to experimental data with good agreement. Finally, preliminary lean blow-out studies of propane premixed flames are presented using different mechanisms.

בברכה,

פרופ"מ מתי סאס
מרכז הסמינרים