הטכניון מכון טכנולוגי לישראל TECHNION Israel Institute of Technology

הפקולטה להנדסת מכונות Faculty of Mechanical Engineering

SEMINAR - סמינר

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ב' 04.10.21
(כ"ח בתשרי תשפ"ב), בשעה 14:30 באמצעות הזום: https://technion.zoom.us/j/98149639984

מרצה:

Assistant Professor Madan Kumar, PhD.
Mechanical Engineering Department, Chiba University, Japan

על הנושא:

Transient Combustion Control of Internal Combustion Engines Fed with Renewable Fuels

The seminar will be given in English

להלן תקציר ההרצאה:

Use of renewable fuels faces several limitations in internal combustion (IC) engines due to their combustion complexity/stability, production, and storage/transportation costs etc., which altogether restrict their wider acceptance in the transportation sector. Current knowledge of transient behavior of engines fed with renewable fuels is insufficient but highly in demand to meet the current transportation requirement. The spark-ignition IC engines, with hydrogen direct injection were proven to have high engine power output and efficiency with low emissions. However, the injection timing directly affects mixture homogeneity, which adversely influences engine performance and emissions. Hence, mixing of charge and combustion stability need to be controlled and optimized for a friendly use of hydrogen energy in engines especially in their transient operation.

This presentation will provide an overview of IC engines sustainability and development for future power sources focusing on mixing and combustion stability control, aimed at improving the engine transient behavior. For the transient behavior analysis and control, a cycle-to-cycle transient model including the residual gas fraction was developed and validated on a gasoline engine. Then, cycle-based in-cylinder air-fuel ratio was estimated, and a control system was implemented which showed fast response than sensor-based control. Also, post-oxidation processes were enhanced with the mixing improvement in exhaust manifold by the bypass adapter design and hence thermal efficiency showed some improvement.

In the future research an on-board thermo-catalyst reformer (TCR) will be introduced between ammonia tank and the engine to reform ammonia into hydrogen and utilize it in real-time as an engine fuel. The energy required for the ammonia reforming will be recovered from the exhaust gas waste heat and if necessary, from the post-oxidation process. This mechanism can short out the on-board hydrogen storage problem as ammonia can be stored cheaply and safely. In order to achieve a better thermal efficiency along with combustion stability and exhaust emissions reduction, pre-heating of intake air (by exhaust waste heat recovery or post-oxidation process), injection and ignition timing and air-fuel ratio will be tuned and optimized with several multi-input and multi-output control applications. Planned also are numerical investigation and experimental testing of air-fuel mixing aimed at its improvement by the ignition and injection strategy/orientation. The engine transient operation (variation with engine speed and load) is to be investigated by sensors and model-based control to achieve the engine fast response and low NOx emission.

מארח: פרופ' אמרי' מיכאל שפירא

בברכה,

פרופ"ח מתן סוס
מרכז הסמינרים