Politecnico di Torino

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ENERGETICS

DM 630/FEV - Analytical and experimental methodologies for the development of zero-CO2 and near zero emissions propulsion systems based on H2 DI ICEs

Funded By	FEV ITALIA SRL [P.iva/CF:09005180014] MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584]
Supervisor	MILLO FEDERICO - federico.millo@polito.it
Contact	PIANO ANDREA - andrea.piano@polito.it
Context of the research activity	The development of propulsion systems based on H2-fueled DI ICEs targeting zero CO2 levels and near-zero tailpipe emissions still presents relevant challenges, when a highly efficient, clean and fully controllable H2 combustion process must be developed. Progetto finanziato dal PNRR a valere sul DM 630/2024 - CUP E14D24002370004
Objectives	In particular, FEV is interested in developing a methodology within 1D simulation environment which is capable of: - predicting knocking (self/auto-ignition) events, - predicting NOx emissions, even at ultra-low levels, as functions of pressure, temperature, EGR/residuals and air-to-fuel (lambda) distribution inside the cylinder. In particular, the last dependency (lambda) becomes quite important in a DI ICE where it is quite challenging to guarantee a high homogeneity level of the mixture. To this purpose, a preliminary 3D-CFD study will be performed, based on which it will be possible to characterize the turbulence model within the 1D simulation environment. Once the turbulence is calibrated, a dedicated predictive combustion model will be designed to take into account the average air-to-fuel ratio at the IVC as well as the distribution of lambda inside the cylinder (e.g. in radial direction from the spark plug position). A model will be eventually developed capable of determining the knock tendency. Finally, the NOx emission model will be developed starting from literature models or via an innovative approach taking into account the air-to-fuel ratio distribution.

	Each of the described steps will be fully supported either by a large H2 DI ICEs experimental database or by a dedicated testing activity using a single-cylinder engine, for calibration and validation of the developed models.

Skills and competencies for the development of the activity	• Excellent knowledge of fluid-dynamics and engine thermodynamics • Knowledge of 1D/3D CFD simulation codes (such as GT-SUITE, CONVERGE CFD) • Good command of Matlab