A comprehensive overview on the gaseous fuels jets investigation for a sustainable combustion process

Alessandro Montanaro
STEMS, CNR Institute (Italy)
alessandro.montanaro@stems.cnr.it

The gradual decarbonization of means of transport is essential to achieve a sustainable mobility system, considering the sectors of road and off-road, industrial, naval and aeronautical transport. The contribution of a widespread, reliable and economical propulsion technology such as the internal combustion engine can be very important when using climate-neutral fuels, instead of conventional fossil fuels. Hydrogen and derived synthetic fuels (e-fuels) can play an important role in this area, making it possible to achieve zero CO_2 emissions, similarly to the case of electric vehicles, and tailpipe polluting emissions with near-zero impact. Overall, engines fed by hydrogen and non-fossil synthetic fuels can provide a complementary solution to the electrification of part of transportation, being based on reliable, flexible and economical technology, contributing to a rapid transition towards zero CO_2 emission mobility. Due to the possibility to apply different injection strategies as well as in-cylinder back pressures and temperatures, the comprehensive knowledge of gaseous injection process behavior and characteristics is fundamental for improving the combustion process in direct injection applications.

In this context, the seminar will focus on the characterization of gaseous fuel jets in terms of mass flow rate and morphology under a wide range of engine-like conditions using injectors appropriate for direct injection applications. A measuring system, suitable for gaseous fuels, is used for measuring instantaneous and total flow rates as well as the dynamic behavior of the entire injection system. The spatial and temporal evolution of highly under-expanded gaseous jets is studied by the Z-type schlieren optical setup injecting into a constant-volume combustion vessel at typical engine conditions.

The data can provide an useful database for the calibration of future numerical models for the simulation of the gaseous fuels direct injection process that could make it possible to give reliable results for the engine calibration to the full advantage of safety and development costs.