



PhD position at IFP Energies nouvelles (IFPEN)

Studying abnormal combustion in direct injection spark-ignition engines based on Large-Eddy Simulation

Abnormal combustions as knock and super-knock, and the difficulty of predicting them precisely in the presence of cycle-to-cycle variability, are major limitations to improve the fuel efficiency of modern direct-injection downsized spark ignition engines. Reducing fuel consumption (and thus CO₂ emission) requires increasing the compression ratio, introducing more efficient cycles such as Miller, or increasing EGR rates. Consequently, the likelihood of abnormal combustion and cycle-to-cycle variability becomes higher as compared to current state-of-the-art spark-ignition combustion systems.

Since 15 years, IFPEN has developed a worldwide unique piston engine simulation approach based on Large-Eddy Simulation (LES) and on the high performance AVBP code, and has demonstrated its unique ability to predict non-cyclic combustion phenomena. The proposed PhD is part of a collaborative research project between IFPEN & Renault aiming at exploiting LES for engine design.

The objective of the PhD is to develop and validate a LES methodology for the prediction and study of abnormal combustion in direct injection spark-ignition engines. First, existing methodologies for indirect injection engines will be extended to address direct fuel injection, exploiting an available experimental database. The resulting validated LES models and methodology will then be applied to a modern downsized Renault GDI production engine, with the aim of formulating risk criteria that could be used in future industrial applications.

Academic supervisor	Dr. Olivier COLIN, IFPEN, Engine & Vehicle Modelling Dept.
Doctoral School	ED287 Sciences pour l'Ingénieur, http://www.ed.ecp.fr/
IFPEN supervisor	Dr. Christian ANGELBERGER, IFPEN, Engine & Vehicle Modelling Dept., christian.angelberger@ifpen.fr
PhD location	IFPEN, Rueil-Malmaison, France
Duration and start date	3 years, starting preferably on October 1, 2015
Employer	Renault, Lardy, France (CIFRE bursary)
Academic requirements	MSc in fluid mechanics, combustion or energetics
Language requirements	Fluency in English, willingness to learn French
Other requirements	Very good proficiencies in numerical simulation and programming; first relevant experience in 3D modelling appreciated

About IFP Energies nouvelles

IFP Energies nouvelles is a French public-sector research, innovation and training centre. Its mission is to develop efficient, economical, clean and sustainable technologies in the fields of energy, transport and the environment. For more information, see www.ifpen.fr.

IFPEN offers a stimulating research environment, with access to first in class laboratory infrastructures and computing facilities.