

## **Post-doctorate position at IFPEN (France) : « Multi-criteria optimization of an innovative high efficiency combustion engine »**

### **Location :**

IFP Energies Nouvelles

Powertrain and Vehicle Division

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<http://www.ifpenergiesnouvelles.com/Research-themes/Innovative-transport>

### **Supervisors / Contacts:**

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### **Topic :**

Optimizing the energy efficiency of internal combustion engines is a major challenge in the field of transport. Minimize consumption allows to reduce the environmental impact and to meet regulation requirements but also to reduce the energy dependence on fossil energies. Current developments in internal combustion engines partially achieve these goals. Therefore, new innovative solutions are needed to significantly reduce CO<sub>2</sub> emissions.

In this context, IFPEN is working on the design of different architectures of innovative engines with complex/alternatives kinematics.

This consists in a multi-criteria optimization with a high number of variables, which should take into account the energy, mechanical and sizing aspects.

The steps of this complex process are mastered individually but require a long implementation and integration time. Thus, it is necessary to introduce simplified and robust methods adapted for the assumptions on energy and mechanical aspects.

In the framework of this post-doctorate, we will focus on the entire process of solution evaluation: implementing a parameterized engine model, formulating the problem in conjunction with appropriate optimization methods, and evaluating the methodology on a particular application.

The case study will be an innovative engine whose efficiency is shown particularly high but whose architecture involves difficulties in mechanical terms and for integration in a vehicle.

It is expected that the post-doctoral work validates an optimization methodology in order to automate the data processing and increase IFPEN ability to evaluate different architectures of combustion engines. This work will be the subject of scientific publications.

This multidisciplinary subject (energy, mechanics, optimization) involves a complex topical issue which represents a challenge for the development of efficient vehicles for IFPEN group.

### **Candidate profile:**

The candidate should have a PhD in applied mechanics, preferably in the field of engines, with a strong expertise in optimization and programming (Matlab). Knowledge of system simulation software in the field of transport will be appreciated (LMS Amesim, GT Power). He/She must be independent, pragmatic and open-minded.

### **References :**

- [ 1 ] Jiang S. and Smith M.H., *Geometric Parameter Design of a Multiple-Link Mechanism for Advantageous Compression Ratio and Displacement Characteristics*, SAE Technical Paper 2014-01-1627, 2014.
- [ 2 ] Xia S., Chen L.G., Sun F., *Engine performance improved by controlling piston motion: Linear phenomenological law system Diesel cycle*, International Journal of Thermal Sciences, 31/08/2011.
- [ 3 ] Naoe G., Watanabe S., *Research on Extended Expansion General-Purpose Engine – Characteristic of Vibration*, SAE Technical Paper 2008-32-0012, 2008.
- [ 4 ] Forrester A., Sobester A., Keane A., 2008, *Engineering Design via Surrogate Modelling: A Practical Guide*, John Wiley & Sons, ISBN: 978-0-470-06068-1.