

# Master thesis project 30 credits – 3D CFD simulations of Hydrogen Engine Combustion

Sodertalje

Scania is now undergoing a transformation from being a supplier of trucks, buses and engines to a supplier of complete and sustainable transport solutions.

## Background

Climate change mitigation is an absolute priority, requiring the evaluation of all the possible technology solutions with the potential to limit greenhouse gas and other pollutant emissions in the transport sector. Adapting conventional engines to run on a carbon-free fuel like hydrogen will enable a drastic reduction of tailpipe CO<sub>2</sub> and soot emissions, via relatively limited technology modifications. To this purpose, coupling CFD simulation and engine testing allows faster development and a deeper understanding of the combustion process.

## Target

This master thesis project is part of an R&D collaboration between Scania, Westport and Lund University focused on the preliminary investigation of a novel hydrogen combustion concept for heavy-duty engine applications.

Master students from any university are welcome to apply. Two groups at Scania working with combustion simulation (CFD) and powertrain predevelopment are involved in the thesis project.

The first goal of the thesis is to evaluate and improve the predictivity of an existing CFD model for hydrogen combustion in internal combustion engines with high-pressure direct injection (HPDI). The second goal is to use the CFD model to identify optimal injector configurations and injection strategies in order to improve efficiency and decrease emissions. In this thesis work, CFD simulations will be performed using the software CONVERGE.

## Tasks

This thesis work is a continuation of an ongoing master thesis project at Scania and a close collaboration with a PhD project in Lund University. The following tasks are intended as modular and will be calibrated on a total of 30 academic credits:

- Perform a literature review on H<sub>2</sub> internal combustion engine technology and combustion modelling;
- Simulate H<sub>2</sub> HPDI combustion with a pilot injection of diesel to trigger ignition at various engine conditions (different injection timings and loads);
- Calibrate combustion parameters and validate the simulation model based on the

comparison between CFD results and available experimental data (in-cylinder pressure, apparent rate of heat release, specific fuel consumption, NOx emissions);

- Investigate the boundary condition of H2 injection in the engine combustion chamber, focusing on the impact of the in-cylinder pressure on H2 injection rate;

Possible alternatives:

- Simulate gas direct injection in a constant volume combustion vessel for calibrating injection parameters based on existing experimental results.

## Education

The ideal candidate shows initiative with a positive and curious mindset, has a systematic work approach and good communication skills. The project has a high degree of engineering novelty and involves working in a multidisciplinary environment.

We are looking for a master student in a related engineering program – including but not limited to mechanical, aerospace, energy or chemical engineering.

Knowledge of CFD acquired through university courses and/or projects is advantageous. Previous experience with CONVERGE, OpenFOAM, Star CCM+ or any other CFD software is preferable. Familiarity with engine combustion (testing or modelling) is also advantageous.

The project will be carried out at the Scania Technical Center in Södertälje.

Number of students: 1 or 2

Start date: May-June 2023 or according to the agreement in the recruitment process.

Project duration: 20 weeks. The project will be paused for around 4 weeks during the summer break, from mid-July to mid-August.

## Contact persons and industrial supervisors:

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## Application

Your application should include CV, cover letter and academic transcripts.

Recruitment is conducted continuously.

Scania is a world-leading provider of transport solutions. Together with our partners and customers we are driving the shift towards a sustainable transport system. In 2020, we delivered 66,900 trucks, 5,200 buses as well as 11,000 industrial and marine power systems to our customers. Net sales totalled to over SEK 125 billion, of which over 20 percent were services-related. Founded in 1891, Scania now operates in more than 100 countries and employs some 50,000 people. Research and development are mainly concentrated in Sweden. Production takes place in Europe and Latin America with regional product centres in Africa, Asia and Eurasia. Scania is part of TRATON GROUP. For more information visit: [www.scania.com](http://www.scania.com).

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