

## The development of novel measurement techniques as enablers for cleaner and more robust engines

Bernhard Rossegger, Martin Vareka, Ansel Higgs, et. al. | LEC GmbH

As described in the abstract, large engines will play a major role in the energy and transportation sector. This future prospect calls for more sustainable and greener engine technologies. Two major pathways of meeting these demands are the development of even more efficient high-speed and high-power engines on the one hand, and the use of alternative carbon-free fuels on the other hand. In the end, both measures will lead to greater stress on engine components, caused by higher mean effective pressures, combustion anomalies or chemical interferences of the tribological properties.



Figure 1: Piston instrumented with a telemetry system

In order to trace down and finally cease such effects, it is of high importance to provide key technologies capable of measuring currently unattainable physical parameters on moving parts inside the harsh environment of a combustion engine. These parameters include but are not limited to temperatures and pressures on the piston and in the ring grooves, bearing temperatures as well as the kinetics of the piston rings just to name a few. Figure 1 shows a piston for a large engine, fully instrumented with temperature sensors and respective micro-electronics for wirelessly transferring the data from inside the fired

engine to the test bench operating system. A Pecha-Kucha presentation at the CIMAC Congress 2023 will show how the development of such measurement technology proceeds within the research at the LEC and which results can be achieved with the help of these newly developed technologies.

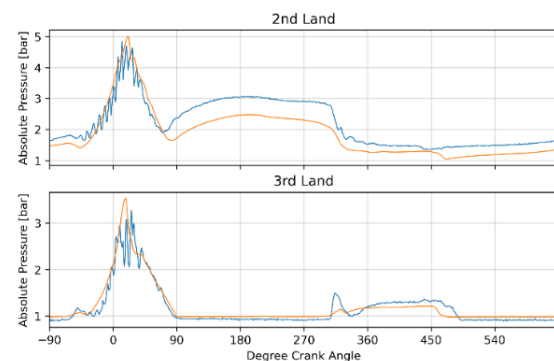


Figure 2: Simulation vs. experiment

Some of the insights gained by these measurement campaigns can be useful to directly derive measures for designing more robust and efficient engines. Additionally, these results can help to create more powerful simulation models for predicting the behavior of an engine before even producing and testing a prototype. As an example, Figure 2 shows example measurement data. In this case, a piston was equipped with pressure sensors between the piston rings, thus being capable of measuring the inter-ring pressure. The blue curve depicts experimental measurement data, whereas the red curve expresses simulation results. It shows, how precise measurement data can help improving simulation models and optimize the respective parameters in order to foster the power of simulations as an early stage of combustion engine development.

**Contact Details** Main Author  
Name: Rossegger, Bernhard  
E-Mail: [bernhard.rossegger@lec.tugraz.at](mailto:bernhard.rossegger@lec.tugraz.at)  
Phone: +43 316 873 30072  
Team Lead Advanced Sensorics

**Contact Details** Co-Author  
Name: Vareka, Martin  
E-Mail: [martin.vareka@lec.tugraz.at](mailto:martin.vareka@lec.tugraz.at)  
Phone: +43 316 873 30074  
Team Lead Advanced Chemical Solutions