“Teaching virtualization is a great start!”

Master’s degree students learn model-based engine calibration at HAW Hamburg

Hamburg University of Applied Sciences (HAW) runs a Master’s degree program in automotive engineering that teaches model-based engine calibration from scratch. Over two periods of 16 weeks each, students get the chance to put their theoretical knowledge into practice. As Professor of Thermodynamics and combustion engines, Hanno Ihme-Schramm plays a key role in motivating his students to master the use of virtualization methods. This energy and enthusiasm is something that industry would do well to harness.

Professor Ihme-Schramm, what makes you so committed to the academic side of teaching prospective engine calibration engineers and function developers?

Function developers and engine calibration engineers are playing an increasingly important role in vehicle development, but there is a noticeable lack of rigorous academic training. Faced with the worldwide challenge of stricter emissions regulations and climate change mitigation targets, the automotive industry needs people who have expertise in established methods based on engine measuring technology as well as virtual methods, and who know which method is the most appropriate in each case. That’s why it is so important to familiarize the new generation of engineers with the opportunities offered by virtual engine development. Young people tend to be open to the idea of using new methods. They are not set in their ways to exploit the potential of virtual methods. If our graduates can offer the expertise these methods require, that will help the industry establish solutions that are fit for the future. And, of course, the potential offered by virtualization is not limited to powertrain systems.

How did you design the course to help students keep track of engine correlations and interactions in the complex process of model-based calibration?

Building on four engine-related lectures in the highly practical Bachelor’s program, we came up with two new lectures on “Engine management and engine calibration” and “Design of experiments and simulation” for the students on our Master’s program.

And are the new lectures proving to be popular?

Statistics and methodologies are not always instantly appealing! But I do my best to systematically link the topics to practical examples and build on a solid basic understanding of engine management. Our students learn the complex process flow of model-based engine calibration step by step, from design of experiments and measuring to modelling and evaluation. For most students, this is the first time they have been confronted with multi-dimensional parameter spaces, and it teaches them how to design experiments themselves. The model verification process gradually gives them a feeling for model accuracy, recalibration and map parameterization. They get an overview of the complete chain and can delve deep into the details in the comprehensive training exercises that we run in our engine calibration laboratory.

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What equipment do you have in the laboratory?

Twelve PC workstations that specifically support the application of virtual methods. That teaches students to think in abstract terms and enables them to work largely independently in the two 16-week periods of practical sessions. The computers run design of experiments (DoE) software from a range of providers, including ETAS ASCMO. ETAS also gave us the go-ahead to install INCA on the computers, and our students can practice using it whenever they like using a self-study program. The same applies to our own DoE-based engine simulator, because there is no need to worry about any expensive test bench systems getting damaged. The students are free to test their knowledge of engines down to the very last detail and practice deploying complex processes on the simulator. Essentially, it’s the simulator that is testing the students. Students leave our Master’s program with an excellent grasp of the relevant methods and a thorough understanding of model-based engine calibration. Half the students express an interest in using virtual methods in their final thesis, however skeptical they may have felt at the start.

How easy is it to transfer that enthusiasm into industry?

Numerous engineers specializing in engine development support the topic of model-based engine calibration in Hamburg, and I’m very grateful for that. But, over the course of my career, I have also noticed how companies are often skeptical about new methods. I have been working on the theory and practice of model-based engine calibration for more than 18 years, and I’m amazed how long it takes for method-oriented approaches to become accepted, despite all their advantages. Much of that comes down to people’s attitudes: a certain amount of trepidation and rejection is inevitable when you try to change well-established processes. But the way in which function developers and engine calibration engineers communicate and interface with each other can also be problematic, because they are basically two separate areas that think in different ways. That’s one of the reasons we teach both fields in a single module, because we want to make students aware of this interfacing issue. But we should probably do even more, for example by teaching engine students about the human factor and about change processes in day-to-day work. I have already made a start by incorporating relevant approaches from business psychology into my teaching. In order to cope with the impending switch to electrified powertrain technology and automated driving, the automotive industry not only needs new methods and trained specialists, but also people who have a deep technical and emotional appreciation of change processes and the ability to bring them to fruition. Teaching virtualization is a great start!

Interviewee

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