

Reducing the evaluation period through a high-speed user-friendly motor HILS!



Yamaha Motor Co., Ltd.
Design Group 2, System Development Div.



Mr. Nakagawa

Testing Group, Component Development Department



Mr. Tanaka



Mr. Hosokawa



Mr. Takai

◆What type of work do you do?

The Design Group No. 2 of the System Development Div. designs the engine control, SMG^{*1}, EV, and other control units. The Testing Group of the Component Development Div. is responsible for functional tests of the electronic control system as a whole, and our task is to evaluate whether functional requirements have been realized at the system level. We are currently working on establishing an environment for automatic and desktop evaluations using HILS^{*2}.

●HILS and simulators are commonly used in design, but are they actually used in testing?

Initiatives began approximately ten years ago, but only became full-fledged four or five years ago. Even as the development and design departments used them, the evaluation division also actively pursued automation and other means of proceeding efficiently.

●When you say control units, does that also include inverters?

We don't go as far as evaluating inverters. We mainly focus on the evaluation of software.

●Some customers use them for fault simulation and fault detection, among other applications. Is that also how you use them?

We do check for hardware-related faults, but mainly we input fault-equivalent signals into the microcontroller and verify the software behavior. We are not actually causing the hardware to fail.

◆Tell us about the challenges you face in your work

Current mainstream motorcycles use internal combustion engines, but carbon neutrality initiatives spurred by social demand are causing an increase in the number of SMG-equipped models and to developing EV models.

To accelerate this initiative more efficiently, we worked on introducing MBD^{*3} and developing a simulation environment to shorten the development period.

In addition, working on motor control technology, which differs from existing internal combustion engine technology, presented the challenge of setting up a motor control simulation environment while capitalizing on the existing engine control simulation environment to build a single system.



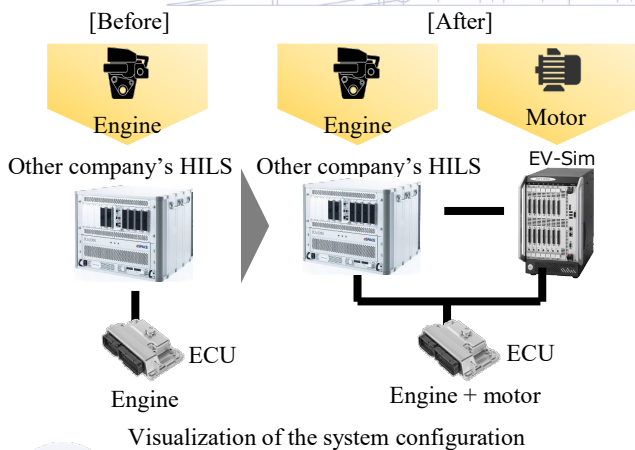
Smart motor generator

*1 SMG: smart motor generator

*2 HILS: hardware in the loop simulator

*3 MBD: model-based development

Contributing to a 90% reduction in motor evaluation time through a HILS environment while maximizing the use of existing systems!



NMAX 155
equipped with
an SMG

◆What are the requirements for successfully addressing issues?

- 1) High-speed computational performance and response capability to follow the gate signals of the motor drive circuit and inverter.
- 2) The system must have high simulation accuracy.
- 3) Since few engineers are well-versed in motor HILS, the system must be user friendly, and parameters must be easy to set.

◆Could you tell us why you choose TTDC?

First, there are two factors that are unique to our situation. One is that we wanted to make maximum use of our existing systems wherever possible. The other is that, because the SMG is integrated with the engine and mounted coaxially with the crankshaft, it is controlled through crankshaft signal synchronization. As a result, it cannot be controlled simply by using a commercially available packaged solution. Based on these factors, we assumed that some level of customization would be necessary. While looking for a partner who could support both the modifications and operational requirements, we came across TTDC at an exhibition.

As we began communicating with TTDC and discussing our requirements, we found that they provided accurate and timely responses to each question we raised from the very initial consultation stage. They were also able to provide answers backed by their extensive knowledge and experience. In addition, they approached the project in a clear and structured way, taking each step carefully, which gave us a strong sense of their professionalism. The benefits and drawbacks of building a new system versus adapting an existing one were clear, and each meeting included proposals with a well-defined schedule. In addition, we were able to keep system building costs down, and TTDC also already took subsequent operational aspects into account and made proposals exceeding our expectations, allowing us to make decisions quickly.

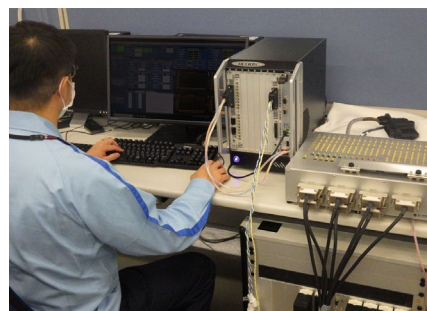
On the hardware side, setting up the HELIOS motor HILS made by A&D as a single module also benefitted us by helping us realize the usefulness of thinking of subsequent operation steps.

◆What were the benefits of adopting it?

We anticipate that adopting a motor HILS and developing a test automation system will reduce SMG evaluations currently performed manually by engineers by 90%. The ability to make use of the accuracy of the system not only in evaluations, but also in design assessments within the design departments went beyond our expectations.

We still have not found a task that the adopted system could not perform.

This new motor HILS is easy to combine with engine HILS and is user-friendly and simple to use. We are very pleased with our choice as we consider future operations.



Work environment

◆Could you tell us about your plans for the future?

We plan to introduce another unit, continue evaluations using the two units for a period of time, and verify their effectiveness. In addition to SMG evaluation, I believe there is also potential to expand its use to other areas in the future, such as EV evaluation. We also plan to share this with other departments and introduce them to this technology.



Back row, from the left: Mr. Nakagawa,
Mr. Takai, Mr. Hosokawa, and Mr. Tanaka

Front row, from the left: Mr. Kitano and Mr. Shikata of TTDC