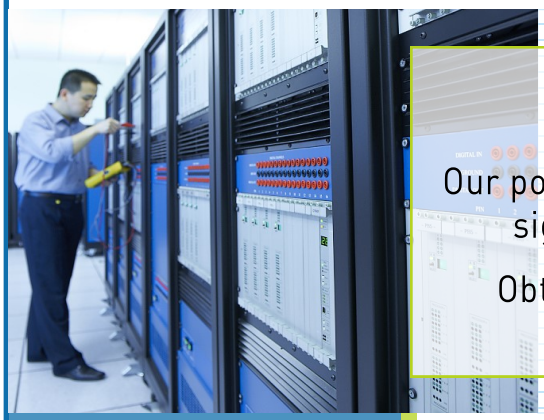
RTDS Technologies

RTDS NEWS



WHAT'S NEW: MARCH 2015

Our powerful new MMC models and MMC Support Unit V2 feature significantly more capable and flexible modeling options

Obtaining the frequency response of AVRs in a closed-loop system at NTC EES in Russia

Upcoming Training Courses

We are currently accepting registrations for the following courses. Please contact **christine@rtds.com** for more details.

INTRODUCTORY RTDS® SIMULATOR TRAINING

May 25 - 29, 2015
Winnipeg, Canada

Register by May 1, 2015

SMALL TIMESTEP SUBNETWORKS TRAINING

June 1 - June 4, 2015
Winnipeg, Canada

Register by May 8, 2015

Upcoming Events

SEAPAC (SE Asia Protection and Automation Conference)

Sydney, Australia
March 17-18, 2015

CAGRE (Algerian Large Electrical Network Conference)

Algiers, Algeria
March 24 - 26, 2015

RTDS North American User's Group Meeting

San Francisco, USA
May 5 - 8, 2015

Say hello to the MMC Support Unit V2

Our new and improved hardware and library components — developed in response to the needs of our customers — provide a more flexible representation of MMCs

RTDS Technologies is pleased to announce that we have released the MMC Support Unit (MSU) V2. This is the second generation of our MSU technology. The MSU houses a powerful FPGA board, which can be used to model either MMC-based valves or capacitor voltage balancing and firing pulse control. The FPGA board can also be used as a generic interface to the RTDS Simulator by using the GTFPGA netlist. In addition to the new hardware, we have also improved our MMC models. The new Generic Model (GM) offers many enhancements over our previous models. Among other advantages, the GM supports individual IGBT firing for both half and full bridge configurations, customized topologies, and additional internal faults. Due to the high density of calculation involved in this model, it can only be implemented on the MSU V2. RSCAD also includes other options for MMC modeling, including an additional FPGA-based model (U5) and processor card-based models (MMC5 and CHAINV5). For more details, **click here to visit our website**.

GUEST ARTICLE

Obtaining the frequency response of AVRs in a closed-loop system using the RTDS Simulator

D.A. Kabanov, A.N. Kushnir, Y. Shtefka, A.S. Zelenin — NTC EES, Russia

To provide a high level of power system reliability, and thus a high level of quality to customers, it is essential to study electromechanical transients. The proper functioning of automatic voltage regulators (AVRs) and power system stabilizers (PSSs) plays a significant role in the performance of the power system during electromechanical transients.

Since 2001, NTC EES has been doing research on AVRs and their impact on power system dynamic performance. For that research, it is essential to have verified mathematical models of AVRs and PSSs. The verification of AVR models is carried out by comparing the frequency response of full-scale AVRs to the response of their corresponding models. Presently, the frequency responses of AVRs are provided by the manufacturer, but NTC EES has endeavored to develop a method of obtaining this data experimentally in the laboratory. Such a method was developed by the authors of this article using the RTDS Simulator. The distinguishing feature of this method is that the AVR stays in its normal mode, i.e. the mode of synchronous generator voltage control.

Continued on next page

RTDS Technologies

Visit us online!

Visit the all new rtds.com today!

We are pleased to announce that we have launched a brand new website!

Click here to visit!

We have improved our site so that it's easier to navigate, more visually appealing, and more informative. The RTDS Simulator continues to be the world standard for real time digital power system simulation. Our new website reflects our position as the market leader and our resolute commitment to excellence in everything we do.

Here are some of the new features you'll find online:

- Our new **feedback form** provides a convenient venue for sending us feedback on our products, services, and events. We hope to hear from you!
- The **Downloads** page provides access to digital copies of our brochure, product info sheets, and more.
- The client login area has a new URL. Please update your bookmark to: **support.rtds.com/clientarea**

Click here to visit the new client area URL.

Figure 1 shows the "Synchronous machine – infinite bus" scheme which was modeled in RSCAD. In this scheme, the generator model with shaft speed input was used. The full-scale AVR was connected to the RTDS, functioning in its normal state in the closed-loop system.

Modern AVRs can contain different types of regulation channels. For obtaining the frequency response of one regulation channel we are using FreqChar software developed by NTC EES. A PC with an installed ADC-DAC card is connected to the RTDS, as shown in Figure 1. After that, FreqChar sends a sinusoidal signal to the infinite bus voltage input or frequency input and shaft speed input of synchronous generator. Due to the modulation signal, oscillations with a frequency of the signal appear on the power system. Frequency response is a measure of magnitude and phase of the output as a function of frequency, in comparison with the input. FreqChar records the input and output signals of the AVR and calculates the magnitude and phase at one point of the frequency response. FreqChar takes the filtered field voltage as an AVR output signal. What is taken as the AVR input signal depends on the regulating channel. For example, if we are obtaining the AVR's PI channel frequency response, FreqChar takes the synchronous generator's RMS voltage oscillations as an input signal. To get other points, FreqChar sends a modulation signal of another frequency. If one or more regulation channels of the AVR can't be disabled, multiple tests must be performed. The number of tests depends on the number of channels. For example, if two channels are at work, two tests with different amplification factors must be performed. FreqChar can derive the frequency response of each channel by solving the system of linear equations.

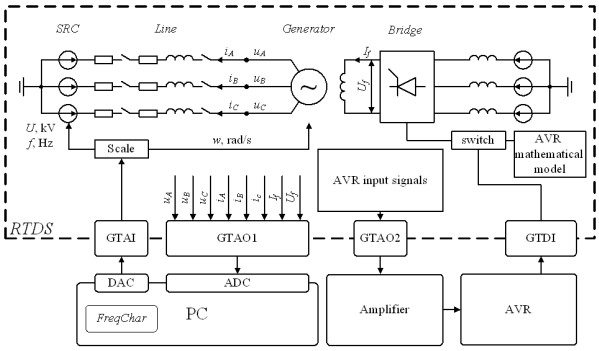


Figure 1. Scheme for obtaining AVR's frequency response

The method was approved by getting the frequency response of the AVRs modeled in RSCAD and comparing results with the frequency response calculated in MathCad (Figure 2a). Measurement error was estimated and it doesn't exceed 5%. A number of full-scale AVRs have been tested. Results show that the frequency response of the AVRs may differ from the frequency response of mathematical models provided by manufacturer (Figure 2b).

This article has been abridged. The full article is available upon request.

Contact us for the full length article.

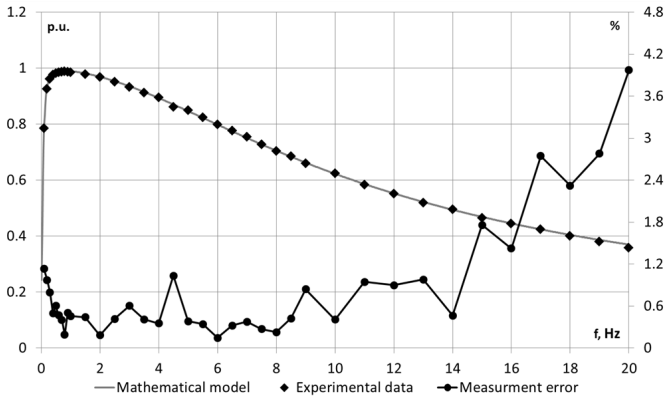


Figure 2a. Magnitude plot of frequency response (RSCAD vs. MathCad)

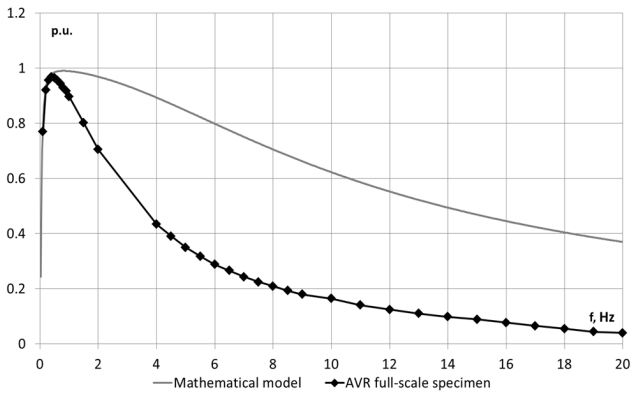


Figure 2b. Magnitude plot of frequency response (RSCAD vs. full-scale AVR)