

MathWorks Special Session at ECC 2023

Title: REIMAGINE Lab: Scaling Control Labs with Digital Twins and Extended Reality Technologies

Speaker: Professor Aleksei Tepljakov, TalTech University

Abstract: Control systems are crucial in various industries, but poorly tuned controllers can lead to decreased performance and wasted energy. Many real-world control systems suffer from this issue due to the complex plants and processes involved in manufacturing and production, as well as a lack of scalable and sustainable hands-on training for control engineers.

Enter Relmagine Lab, a novel approach to delivering control engineering education that combines various control lab modes, including virtual, remote, and hands-on experiments. Relmagine can be an effective tool for engineering education in both higher education and vocational schools, as well as for company personnel training. Relmagine is powered by Digital Twins created with MathWorks products and Extended Reality environments built with Unreal Engine 4/5.

Relmagine Lab has already had a trial run in TalTech University. The students appreciated the possibility to directly interact with digital twins, and not just with mathematical models, and as a result, the understanding of related control concepts was easier to transfer as part of experiments designed using the Relmagine platform.

In this talk, we shall discuss the Relmagine approach to control system education. The participants will learn:

- About the Relmagine framework, its origins and overall design;
- How MATLAB/Simulink can be used for implementing digital twins from the perspective of mathematical modeling and system identification, as well as control design;
- How the Unreal Engine 4/5 side of digital twins is implemented and connected with MATLAB/Simulink;
- How Extended Reality contributes to enhancing the learning processes with Unreal Engine and various VR and AR headsets.

Speaker bio: Aleksei Tepljakov received the Ph.D. degree in information and communication technology from the Tallinn University of Technology, in 2015. Since November 2021, he holds a Senior Research Scientist position at the Department of Computer Systems, School of Information Technologies, Tallinn University of Technology. His main research interests include the study of cyber-physical systems: fractional-order modeling and control of complex systems and developing efficient mathematical and 3D modeling methods for virtual and augmented reality for educational and industrial applications. He is a Senior Member of the IEEE with more than 12 years of service. He has been a member of the IEEE Control Systems Society, since 2012, and the Education Society, since 2018. Aleksei is also known as the developer and maintainer of FOMCON toolbox — a popular MATLAB toolbox for fractional-order modeling and control — on which he has been working for more than 11 years. Aleksei has also been working with extended reality and digital twin technologies for more than 8 years with the goal of extending and improving control systems education and creating novel user interfaces for SCADA systems. He has previously given keynotes on both FOMCON toolbox for MATLAB, and on extended reality and digital twins during EuroVR'2019 conference.