

## MathWorks Special Session at ECC 2023

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

**Date / Time:** Friday, June 16 / 12:20 p.m. EET

**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.

### Meet MathWorks Experts:



**Drew Davis** received his M.S., degree of the School of Mechanical Engineering at the University of Rhode Island in 2014. His research interests include dynamics system modeling, path planning, optimal control and reinforcement learning. He is currently a Senior Developer for the control systems organization, focusing on the Simulink Control Design and Reinforcement Learning products.

**Dr. George Amarantidis** received his PhD in Control Systems from the School of Engineering at the University of Birmingham

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.

### About the Presenter:



**Professor 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.



and an MEng in electrical and electronic engineering from Loughborough University. His research interests include physical modelling, adaptive control, system identification, signal processing, predictive maintenance, and AI for time-series analysis. He joined MathWorks in 2021, where he works as a technical specialist in education. He actively collaborates with universities in teaching, research and outreach activities. Before joining MathWorks, he developed algorithms and designed software for embedded touch sensors and medical devices.

## Learn More about MATLAB and Simulink Capabilities

### Automated Driving

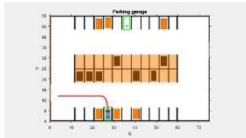
[mathworks.com/solutions/automotive/automated-driving](https://mathworks.com/solutions/automotive/automated-driving)



Design automated driving systems including driving scenario simulation, sensing, path planning, and sensor fusion and controls.

### Model Predictive Control

[mathworks.com/products/mpc](https://mathworks.com/products/mpc)



Design and simulate MPC controllers for developing automated driving applications such as adaptive cruise control, lane keeping assist, parallel parking and lane following control systems.

### Reinforcement Learning

[mathworks.com/products/reinforcement-learning](https://mathworks.com/products/reinforcement-learning)



Design and train policies using reinforcement learning. Generate code from trained policies for deployment to embedded devices.

## Resources for Learning and Teaching Control Systems

### Low-Cost Hardware Support

[mathworks.com/hardware-support](https://mathworks.com/hardware-support)



Download hardware packages for Arduino, Raspberry Pi, and LEGO.

### MATLAB Tech Talks

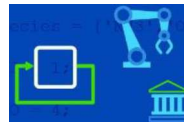
[mathworks.com/tech-talks](https://mathworks.com/tech-talks)



Watch tech talks to learn fundamentals of control systems, deep learning, systems engineering, reinforcement learning and many more engineering concepts.

### Teaching Controls with MATLAB and Simulink

[mathworks.com/academia/courseware](https://mathworks.com/academia/courseware)



Explore controls teaching resources including a sampling of course curricula, virtual labs, educational videos, code examples and auto grading tools.

### Instructor resources for teaching with MATLAB and Simulink:

- Learn through interactive examples with MATLAB and Simulink Onramps: [matlabacademy.mathworks.com](https://matlabacademy.mathworks.com)
- Classroom training in MATLAB or other MathWorks products: [mathworks.com/training-schedule](https://mathworks.com/training-schedule)
- Online teaching with MATLAB and Simulink: [mathworks.com/academia/online-teaching](https://mathworks.com/academia/online-teaching)
- Hardware for Project-Based Learning: [mathworks.com/academia/hardware](https://mathworks.com/academia/hardware)
- Virtual Labs and Projects with MATLAB and Simulink: [mathworks.com/academia/online-teaching/virtual-labs](https://mathworks.com/academia/online-teaching/virtual-labs)
- MATLAB Licensing for Campus-Wide Use: [mathworks.com/academia/matlab-campus](https://mathworks.com/academia/matlab-campus)