MathWorks Special Session at ECC 2020

Special Session:

Teaching with MATLAB Live Scripts

Date: Friday, May 15

Time: 2pm - 3pm

Zoom meeting link

In this special session, Dr. Antunes Duarte will give a talk on how he's been using MATLAB Live Scripts for teaching an optimal control and dynamic programming course. You'll also hear from Dr. Craig Buhr on various resources that MathWorks provides for online teaching.

Abstract

Live Scripts integrate MATLAB code, equations, visualizations and narrative text in a single document. The use of notebooks, such as Live Scripts, to collaborate, communicate results and transmit knowledge in education and science is increasing at a very fast pace. This talk will describe how live scripts were used to transmit knowledge in the optimal control and dynamic programming course at TU/Eindhoven. It will address both researchers/lecturers who are curious about the potential of this tool and those wanting to know more about the workflow for converting course material into live scripts. Students' feedback reveals that Live Scripts can be interesting enablers for combining theoretical concepts with practical implementations.

About the Presenter

Antunes Duarte

Duarte Antunes is an Assistant Professor at Mechanical Engineering Department at Eindhoven University of Technology (TU/e). He is part of the Control Systems Technology Group. His teaching and research activities revolve around control theory. Duarte's research expertise lies in optimal and stochastic control and networked control systems. Another strong research interest is control systems interconnected by communication networks, such as a robot which off-loads computationally demanding tasks to the cloud.

Meet MathWorks Experts:

Dr. Craig Buhr received his Ph.D. degree from the School of Mechanical Engineering at Purdue University in 2003. His research interests include dynamic system modeling and identification, linear systems and control theory. He joined MathWorks as a Senior Developer for the Control System Toolbox in 2003, developing software tools to facilitate the design and analysis of control systems. He is currently the Senior Team Lead of the Control Design group.

Motor Control Blockset

New in 2020a

Motor Control Blockset™ provides reference examples and blocks for developing field-oriented control algorithms for brushless motors. The examples show how to configure a controller model to generate compact and fast C code for any target microcontroller (with Embedded Coder®). You can also use the reference examples to generate algorithmic C code and driver code for specific motor control kits.
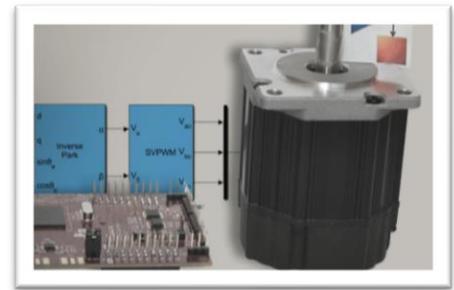
The blockset includes Park and Clarke transforms, sliding mode and flux observers, a space-vector generator, and other components for creating speed and torque controllers. You can automatically tune controller gains based on specified bandwidth and phase margins for current and speed loops (with Simulink Control Design™).

The blockset lets you create an accurate motor model by providing tools for collecting data directly from hardware and calculating motor parameters. You can use the parameterized motor model to test your control algorithm in closed-loop simulations.

> Check out the following video for an overview of Motor Control Blockset: *What is Motor Control Blockset?*
>
> Watch the following video series to learn how you can use Motor Control Blockset to estimate parameters of a PMSM motor, implement a field-oriented control algorithm, generate code from the algorithm, and deploy it on an embedded microcontroller: *Field-Oriented Control of PMSMs*

Reinforcement Learning Toolbox

2019a

Reinforcement Learning Toolbox™ provides functions and blocks for training policies using reinforcement learning algorithms including DQN, A2C, and DDPG. You can use the trained policies to implement controllers and decision-making algorithms for complex environments such as robots and autonomous systems modeled in MATLAB & Simulink. To improve training performance, you can run simulations in parallel on the cloud, computer clusters, and GPUs.
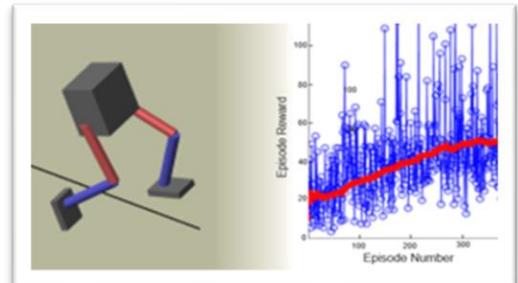
The toolbox lets you implement policies using deep neural networks, polynomials, or look-up tables. Through the ONNX™ model format, existing policies can be imported from deep learning frameworks such as TensorFlow™ Keras and PyTorch. You can generate optimized C, C++, and CUDA code to deploy policies on microcontrollers and GPUs.

> **Reinforcement Learning Tech Talks** provide an overview of reinforcement learning concepts such as environments, rewards, policies, and learning algorithms.

> **Deep Reinforcement Learning for Walking Robots** video demonstrates an example of controlling humanoid robot locomotion using deep reinforcement learning.

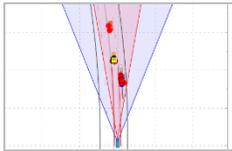# Learn More about MATLAB and Simulink Capabilities

Automated Driving
mathworks.com/solutions/automotive/automated-driving

Design automated driving system functionality including sensing, path planning, and sensor fusion and controls.
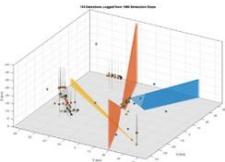
Model Predictive Control
mathworks.com/products/mpc

Design and simulate MPC controllers for adaptive cruise control, lane keeping assist and lane following control systems.

Sensor Fusion and Tracking
mathworks.com/products/sensor-fusion-and-tracking

Design and simulate multi-object trackers, sensor fusion filters, motion and sensor models, and data association algorithms that let you evaluate fusion architectures using real and synthetic data.

Resources for Learning and Teaching Control Systems

Low-Cost Hardware Support
mathworks.com/hardware

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

MATLAB Tech Talks
mathworks.com/tech-talks

Learn fundamental concepts in different topics such as controls, deep learning, state machines and reinforcement learning.

MATLAB Grader
mathworks.com/products/matlab-grader

Create interactive course assignments. Automatically grade student works and provide feedback. Run your assignments in any learning environment.

Resources for learning about curriculum support:

- Learn through interactive examples with MATLAB and Simulink Onramps: *matlabacademy.mathworks.com*

- Classroom training in MATLAB or other MathWorks products: *mathworks.com/training-schedule*

- Webinars of Teaching Examples: *mathworks.com/academia/webinars*

- Hardware for Project-Based Learning: *mathworks.com/academia/hardware*

- MATLAB Courseware: *mathworks.com/academia/courseware*

- MATLAB Licensing for Campus-Wide Use: *mathworks.com/academia/matlab-campus*

MathWorks®

Resources and Tools for Educators and Students

Explore these online resources to learn more about integrating MATLAB and Simulink into your teaching, research, and studies.

Get Started for Free with MATLAB Onramp and Deep Learning Onramp

matlabacademy.com

In just two hours, you can master the basics of MATLAB and start using MATLAB for deep learning through these online courses. With Deep Learning Onramp, try hands-on exercises that guide you through the deep learning workflow, which includes reading image data, classifying images, and evaluating performance.
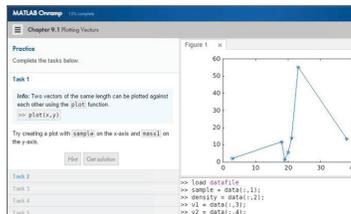
Interactive Notebooks – Live Editor

mathworks.com/products/matlab/live-editor

Live Editor allows you to accelerate exploratory programming, create an interactive narrative, and teach with live scripts
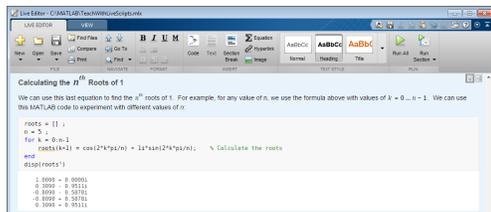
Automatically Grade MATLAB Code – MATLAB Grader

grader.mathworks.com

Create interactive MATLAB course problems for students. Automatically grade student work and provide feedback. Run your problems in any learning environment.

Online Learning Anytime, Anywhere – MATLAB Online and MATLAB Drive

mathworks.com/products/matlab-online

By running MATLAB Online directly from your web browser, you eliminate the need to download or install software. Plus, you're always using the latest version of MATLAB.

Use MATLAB Anytime, Anywhere with MATLAB Mobile

mathworks.com/products/matlab-mobile

Your figures and workspace persist across sessions, so you can resume work when you next log in.

Internet of Things Analysis – ThingSpeak

thingspeak.com

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. It enables engineers and scientists to prototype and build IoT systems without setting up servers or developing web software.
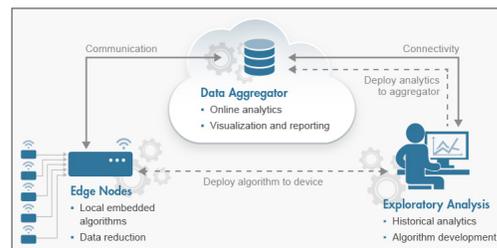
For Teaching and Research

Learn about the benefits of campus-wide access to MATLAB and Simulink *mathworks.com/campus-license*

Download MATLAB courseware to develop and enhance curriculum *mathworks.com/academia/courseware*

Discover examples to reference for demos and student assignments *mathworks.com/examples*

Learn how MATLAB and Simulink are used in industry and education *mathworks.com/academia-user-stories*

Find and install add-ons using Add-On Explorer *mathworks.com/add-on-explorer*

Discover, create, and share MATLAB apps *mathworks.com/matlab-apps*

Find MATLAB and Simulink resources for research *mathworks.com/academia/research*

Teach with MATLAB and Simulink in primary and secondary schools *mathworks.com/primary-secondary*

For Learning MATLAB and Simulink

Learn at your own pace with in-depth online course options *matlabacademy.com*

Get started by taking a MATLAB and Simulink video tutorial *mathworks.com/tutorials*

Browse MATLAB and Simulink based books *mathworks.com/books*

View on-demand webinars and videos *mathworks.com/academia/webinars*

Explore MathWorks supported student competitions *mathworks.com/student-competitions*

Join Our Online User Community

matlabcentral.com

Do You Need MATLAB and Simulink?

See all license options—including campus-wide, student, and home use *mathworks.com/academic-licenses*

Do You Need Help Using MATLAB and Simulink?

For installation or technical help *mathworks.com/support*

Connect to Hardware with MATLAB and Simulink

Hardware Connectivity – Support Packages

mathworks.com/hardware

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

Arduino Engineering Kit

mathworks.com/arduino-kit

Learn important engineering concepts while programming fun Arduino projects.

Live Data Streaming to and from Hardware

Directly receive and send real-world inputs and outputs from MATLAB and Simulink. Use for lab instruments, data acquisition systems, image and video acquisition and camera applications, audio streaming, and more.

Generating Code and Targeting Hardware

Automatically generate C, HDL, or PLC from your MATLAB and Simulink algorithms, and run them on microprocessors, FPGAs, and more.

Hardware Solutions include:

- iPhone and Android devices
- Robots
- Drones
- SDR

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mathworks.com

Accelerate Learning and Research with MATLAB and Simulink

MathWorks Licensing for Campus-Wide Use

At 6500 universities around the world, MATLAB and Simulink are used extensively in teaching, research, and student projects in engineering, science, business, medicine, and social sciences. More than 5 million students and faculty at over 1500 universities globally—including the 10 top-ranked universities—have unlimited access to MATLAB and Simulink through a Campus-Wide License.

A Campus-Wide License provides:

- Unlimited use of MATLAB and Simulink products to all students, faculty, staff, and researchers, on and off campus, on any device
- A wide range of resources to support teaching, learning, and collaborative research
- Open access to scaling for MATLAB programs and Simulink simulations to clusters, clouds, and HPC centers

These schools are among the thousands with a Campus-Wide License:

Aalborg University	Ohio State University	University of California
Carnegie Mellon University	Princeton University	Berkeley
Cornell University	RWTH Aachen University	University of Cambridge
École Centrale de Lyon	Sapienza Università di Roma	University of Melbourne
Georgia Institute of Technology	Seoul National University	University of Michigan
	Stanford University	University of Oxford
Johns Hopkins University	Tokyo University of Science	University of Science and
KTH Royal Institute of Technology	Tsinghua University	Technology of China
	TU Eindhoven	University of Sydney
Lund University	TU München	University of Toronto
Massachusetts Institute of Technology	University of Applied Sciences Augsburg	Vanderbilt University
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For students, knowing how to use MATLAB and Simulink opens the door to a wide range of disciplines and modeling methods. Each year, tens of thousands of new graduates enter the workforce with MATLAB and Simulink skills and experience. MATLAB is listed as a common skill among LinkedIn members with a technical background and is listed as a required skill in thousands of job postings.

"With MATLAB, we are combining computer science theory and concepts with problem-solving in engineering. MATLAB is the one language that we want our students to use—the one that we all use in our classrooms."
– Dr. James Craig, Georgia Institute of Technology

"One advantage of teaching with MATLAB is that our students are exposed to a tool that is used in the commercial world. The quality of the learning materials delivered online and onsite was excellent, enabling me to focus on teaching analytics and working with students."
– Dr. Daniel Hulme, University College London

Campus-Wide Access to Online Training Courses

To support users of the Campus-Wide License, MathWorks offers campus-wide access to self-paced online courses. Interactive online courses and tutorials help students quickly learn MATLAB skills for the classroom and beyond. Self-paced online training courses provide faculty, researchers, and students with hands-on practice sessions and help universities introduce industry-standard tools into the curriculum.

"When teaching with a flipped classroom, you cannot expect students to study on their own without proper tutorial materials and come to class prepared. The interactive MATLAB tutorials were perfect for engaging students and getting them up to speed quickly." – Dr. Yu-li Wang, Carnegie Mellon University

Campus-wide training also gives visibility to MATLAB and Simulink features that can be used in many fields to increase productivity, support multidisciplinary projects, and enhance student skills.

Learn more: mathworks.com/products/campus-wide-training

Save Time with MATLAB Grader

MATLAB Grader makes it easier to include graded MATLAB assignments in your course. With it, you can:

- Create assignments that require students to submit MATLAB code
- Set custom scoring rubrics and view detailed reports and learner analytics
- Automatically grade student work and provide instant feedback to improve learning
- Run web-based assignments in any learning environment

Learn more: mathworks.com/products/matlab-grader

mathworks.com/academia

Campus-Wide License Features

- Coverage for all faculty, staff, students, and researchers, on both university and personally owned devices
- Access on campus, in the lab and field, and at home, including off network
- Widest and most up-to-date array of products, supporting everything from introductory-level courses to advanced academic research
- Annual license that provides a more predictable cost model for budget planning
- One license, which eases license management and ensures software license compliance through central administration; it also integrates easily into bring-your-own-device (BYOD) programs
- Pricing proportional to the size of the student body, providing cost efficiencies per user

"One of the great advantages of using MATLAB and Simulink in our research is that new team members can come up to speed quickly on the project. Further, the modular approach we took with our models enables group members to work independently on their respective modules and then assemble the modules into a complete system."

– Dr. Christian Hatzfeld, TU Darmstadt

Onboarding Support

MathWorks has a dedicated Customer Success team to support you from license launch to campus-wide rollout and beyond.

MathWorks will work with you to prepare for license deployment, including license installation, federated identity management, and rollout across campus. All faculty, staff, and students will have self-serve access to software and resources through a MathWorks-hosted MATLAB portal.

Contact your MathWorks Account Representative to receive a price quote.

Learn more: mathworks.com/campus-license

Scale MATLAB and Simulink Computations to Clusters, Clouds, and HPC Centers

With MATLAB Parallel Server, you can scale MATLAB programs and Simulink simulations to clusters, clouds, and HPC centers. The Campus-Wide License includes access to MATLAB Parallel Server and allows every user on campus to run an unlimited number of simultaneous workers (MATLAB computational engines) on clusters that run on university-owned hardware or cloud resources.

Advantages for users
- Access cluster resources through a familiar MATLAB environment
- Run on multiple machines without algorithm changes
- Leverage preconfigured cloud clusters or local HPC resources

Advantages for IT
- Provide open access to scaling for MATLAB and Simulink throughout campus
- Provide access to cluster resources through MATLAB and your existing scheduler
- Simplify license management with a central license that accommodates all clusters

Learn more: mathworks.com/products/matlab-parallel-server/campus

Get Instant Access to MATLAB through Your Web Browser

With MATLAB Online, you can run the latest version of MATLAB, including features like App Designer and Live Editor, on the MathWorks Cloud through your web browser. MATLAB Online allows you to:
- Run MATLAB on any laptop, desktop, or Chromebook with no downloads, installations, or maintenance
- Store, manage, and access your MATLAB files anywhere
- Share your content and collaborate with others through direct sharing and publishing

Learn more:
mathworks.com/products/matlab-online

mathworks.com/academia