Education Master Class

Preparing Future Engineers and Scientists for the Challenges of Digital Transformation

Martina Sciola



Digital Transformation Era



Machine Learning for Real-time Optimization of Energy Usage



MathWorks[®]



CETO, a Wave Farm built with Model-Based Design







Augmented Reality Visualization of blood flow with SLAM technology





Why Digital Transformation?



[From en.wikipedia.org]



- "Sample-size 1" Increasingly individualized products
- "Smart products"
 - Autonomous machines that do not require costly programming to meet new requirements
 - Intelligent products that collect data to optimize processes and develop new products
 - "Servitization" · Opportunities for innovative business models and services



What Tomorrow's Engineers and Scientists Need to Know

- Control, Signal Processing, Optimization, Computer Vision
- Abstraction, Modelling, and Simulation

AND

Multidomain System Development

AND

- Distributed and Connected Systems
- Using Cloud Platforms and Big Data Processing
- AI and Data Science







Project-Based Learning with MATLAB and Simulink

Treat engineering students like engineers Hands-on experience of working on hardware and software Solve authentic problems in myriad contexts Increase student interest and improve learning https://www.mathworks.com/hardware-support/home.html



Today's Topics: Three Exercises to Develop That Know-How

Quadcopter Simulation

- Develops Computational Thinking for complex systems
- Enables comparisons of theory and simulation
- Principles of control and path planning

Arduino Mobile Rover

- Model-Based Design for autonomous vehicle
- Integrates control, communication, path planning, and localization
- Multidisciplinary system

Triplex Pump Digital Twin

- Complex industrial application
- Combines engineering and data science
- Cloud computing



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Quadcopter Simulation



Develop Understanding of Technical concepts











— 📣 MathWorks[®]

Quadcopter: Control Design

Develop Understanding of Technical concepts







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Arduino Mobile Rover in Action

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Mobile Rover Basics





Workflow



2. Deploy to hardware



3. Integrate with localization using Wi-Fi









Modelling and Simulation Rover kinematics





Modelling and Simulation Path Planning and Motion Control





Workflow



3. Integrate with localization using Wi-Fi





Deploy to Hardware

눰 roverHwPath - Simulink





Deploy to Hardware







Workflow

1. Modelling and simulation



2. Deploy to hardware









Get Location Data over Wi-Fi



- RGB threshold applied
- Noise removed
- Centroid identified











Parrot Minidrones







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Triplex Pump





Predictive Maintenance Using Digital Twins



How can I teach students these concepts if I don't have a real pump?



Prevent system downtime



by sending Sensor Data

to a Predictive Maintenance algorithm





created using a Digital Twin and

Machine Learning model in MATLAB.





Triplex Pump

- Crankshaft drives three plungers
 - Each 120 degrees out of phase
 - One chamber always discharging
 - Smoother flow than single or duplex piston pumps







A MathWorks

Predictive Maintenance Workflow

- Sensor data isn't always available
 - Failure conditions difficult to reproduce
 - Time consuming or costly to generate

Solution: Build digital twin and generate sensor data using simulation

Developing algorithm is complex

 Requires complex concepts and analysis
 Solution: Use MATLAB to simplify process of developing and deploying algorithm





Bring these exercises to your classroom!

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Key takeaways

- Digital Transformation is revolutionizing the industry
- New graduates will be expected to address challenges like these
- Experience with tools and workflows used in industry make students more hireable







EDU

GOV

Bildungsnetzwerk Technik Österreich

Vision 2040: Austria is world leader in STEM education



[[]From Google Maps]

Mission

Strengthen STEM education and secure local industry in Austria

Strategy

Connect stakeholders in academia, industry and government. Initiate, and support high-impact STEM projects.

Projects Multicopter for teaching and research



COM





Bildungsnetzwerk Technik Österreich



Österreichische Mathematische Gesellschaft







Bundesministerium

und Forschung

Bildung, Wissenschaft

Gov

MATLAB EXPO 2019







Com



MathWorks[®]



CALL TO ACTION!



Build relationships
Partner
Design joint projects
Actively collaborate



Thank



you!