Preparing Students for Impactful Careers in Industry

Dr. Moiz Khan, MathWorks
Considerations for an Engineering Educator

Student
I want to build exciting systems and land a job!

Learning Center
Are we utilizing our hybrid curriculum model?

Corporate Relations
Are we collaborating with industry?

All
Are we continuously adapting to engineering megatrends?

Dean
Is our Digital Learning environment and Software Infrastructure in order?

Research Groups
We need more bandwidth to generate quality proposals.

Industry
Are your students ready to work on complex systems?
Leadership
Academic excellence and positioning

Faculty
Securing funding for research and teaching activities.

Students
Learning transferable skills for the job market.

Industry
Employing students with technical and professional skills.
CURRICULA

COLLABORATION

DIGITALIZATION
CURRICULA

COLLABORATION

DIGITALIZATION
Engineering Systems are Multidomain = Curricula Should Be As Well
Engineering Systems are Multidomain, so curricula should be as well
Emerging Trends for Multidomain Engineering Systems

MathWorks collaborates with engineering education institutions to address these trends in curriculum.
Teaching Using Self-Paced Online Courses

- Deep Learning
- Computer Vision
- Machine Learning
- Signal Processing
- Circuits
- Power Electronics
- MATLAB
- SIMULINK
- SIMSCAPE
- OPTIMIZATION
- IMAGE PROCESSING
- OBJECT-ORIENTED
Professional Skills Development is Enhanced by Interdisciplinary Curricula

Critical Thinking  Teamwork  Project Management  Communication
Supported Course Design: Incorporated a drone-based competition into an Avionics course.

New to the course: Team-based curriculum, developing and deploying image processing algorithms.
CURRICULA  COLLABORATION  DIGITALIZATION
Inter-Department Collaboration

- Reinforce Concepts
- Applying theory
- Project-based Learning
- Multi-domain Systems
Department Collaboration: Robotics Example

Robot Kinematics

Robot Controls

Robot Algorithms

Robot Applications
MathWorks Provides Multi-Domain Content to Assist Teaching and to Prepare Students

Modeling Multibody Mechanical Systems with Simscape
Learn to model multibody mechanical systems; create custom geometries and compound bodies; assemble, guide, and verify mechanisms; and import CAD files.

Robot Kinematics

Control System Design with Simulink
Learn to design and model control systems with Simulink. Topics include system identification, parameter estimation, control system analysis, and response optimization.

Robot Controls

Computer Vision with MATLAB
Learn to perform object detection, tracking, and motion estimation on images and videos. The course also covers camera calibration, point clouds, and 3D reconstruction.

Robot Algorithms

Embedded Coder for Production Code Generation
Develop Simulink models for deployment in embedded systems. Topics include code structure and execution, code generation options and optimizations, and deploying code to target hardware.

Robot Applications
Excellence in Innovation: Capstone Projects/ Thesis

Deep Learning for UAV Infrastructure Inspection

- Photo Realistic Simulation
- Create Controls in Stateflow
- Low Fidelity Animation
- Virtual Lidar Sensor
- Train AI Models with Yolov2
Bosch and National Institute of Technology Calicut Collaborate on EV Course to Prepare Students for Industry

“The collaboration between NIT Calicut, MathWorks, and Bosch narrowed the gap between academia and industry, producing an electric vehicle system engineering course that has been both well received by our students and highly useful for them as well.”

— Dr. Kumaravel Sundaramoorthy, NIT Calicut
Academia and industry partner to make students automotive-ready

- Electric and Conventional Vehicles
  Chalmers University of Technology

- Hybrid Vehicles
  Chalmers University of Technology

- Model-Based Automotive Systems Engineering
  Chalmers University of Technology

- Multi-Object Tracking for Automotive Systems
  Chalmers University of Technology

- Sensor Fusion and Non-linear Filtering for Automotive Systems
  Chalmers University of Technology
Learn Relevant Industry Tools

Why MATLAB and Simulink?

Millions of engineers and scientists worldwide use MATLAB and Simulink.

- 100,000+ business, government, and university sites
- The top 10 auto manufacturers
- All of the top 10 aerospace companies
- Three of the top five internet companies

1. OICA: 2016 World Motor Vehicle Production
2. PWG: Aerospace and Defense 2017 Year in Review
Find Ready Workforce

Sr. PHY Design Verification Engineer

Summary
Would you like to join the growing wireless silicon development team? Our wireless SOC organization is responsible for all aspects of wireless silicon development with a particular emphasis on highly energy efficient design and new technologies that transform the user experience at the product level, all of which is driven by a world-class vertically integrated engineering team spanning RF/Analog architecture and design, Systems PHY/MAC architecture and design, VLSI/RTL design and integration, Simulation, Design Verification, Test and Validation, and HW/SW engineering.

In this highly visible role, you will be at the center of a silicon design group with a critical impact on getting functional wireless products to hundreds of millions of customers quickly.

Key Qualifications
- BS and 10+ years of relevant industry experience.
- Work closely with system/design team to review and understand PHY subsystem microarchitecture, create verification plans from specifications.
- Develop and execute both directed and constrained random tests, debug failures, manage bug tracking, and work with designers to drive closure of issues found.
- Create and analyze block/subsystem level coverage model, and add test cases to increase coverage.
- Support PHY subsystem validation using Palladium and/or FPGA.
- Work with team members to improve methodology and flow.

Description
- Verification experience of wireless/wired communication block/subsystem.
- Excellent knowledge and experience of ASIP verification flows including test bench development.
- Knowledge of wireless protocols such as Bluetooth, Wi-Fi, or ZigBee a plus.
- Proficient in shell and Perl scripting, Python skills a plus.
- Experience of Palladium/FPGA validation a plus.
- Should be a team player with excellent communication skills, self-motivated and well-organized.

Modeling/Simulation Design Engineer,

What You’ll Bring
- BS in Electrical Engineering, Mechanical Engineering, Mechatronics, or equivalent of experience and evidence of exceptional abilities.
- 5+ years’ experience with controls system development, modeling, and implementation.
- Excellent background in linear systems analysis, stability, and controller design.
- Creating dynamic models of electrical, mechanical, and thermal systems.
- Experience, understanding, and intuition for the physics of basic electric propulsion, motion control systems, and heat transfer.
- Knowledge in control systems including, spring loaded inverted pendulum, Zero Moment Control, Model Predictive Control, Motor controls, etc.
- Modeling knowledge in inverse kinematics, inverse/forward dynamics, impedance control, torque control, etc.
- Basic design of electric motors & power electronics & control circuits.
- Familiar with gear reduction mechanisms including: Planetary, Belt drives, Harmonics Drives, Magnetic Gears, etc.
- Strong mechanical skills, including design, manufacturing limits, mechanical linkages, design for manufacturing.

Experience of using Matlab/C reference model and bit-accurate verification a plus.

Strong programming skills in Matlab/Simulink, Python, C++, SQL, etc.

Strong skills in CAD (CATIA, NX, Inventor, Solid Works, etc.)
“This high-level, abstract understanding of complex systems is a skill set that is highly sought after in the automotive industry these days.” *Joe Martin, former University of Michigan student*

“They were confident that I had the knowledge to excel in the position because the tasks I completed in EcoCAR were almost the same tasks that full-time controls engineers do.” *Jessica Britt, former Georgia Institute of Technology student*
Digitalization in Engineering Education

Digital Skills for Students

Digital Tools for Teaching and Learning

- Power Point
- Web & Mobile Apps
- LMS
- ChatGPT/Language Models

1990s - 2000s - 2010s - Future
MathWorks Enables Digital Skills in Students
Effects of Digital Tools on Teaching and Learning

- Cost Effective
- Accessibility
- Assessment
- Collaboration
- Engagement
- Industry Prepared

Digital Classroom
Arizona State University: AI and IoT for First-Year Students

New computing exercises for First-Year Engineering:

- **Artificial Intelligence**
- **Internet of Things**

“When I started teaching Introduction to Engineering, there were just a handful of female students. Today, about a quarter of the class is female. Activities like the deep learning and IoT module, which seems appealing to female students, are likely to encourage them to continue in the engineering program.”

- Chao Wang, PhD, Arizona State University
Students at ETH Zurich Develop a Jumping Robot for Final Project

- Students evaluated basic movement of 20 designs using MATLAB
- Tuned and deployed a balancing algorithm to a prototype robot
Effects of Digital Tools on Teaching and Learning

MATLAB Online

Virtual Labs

MATLAB Live Scripts

Cost Effective

Accessibility

Engagement

Industry Prepared

Assessment

Collaboration

Digital Classroom

MATLAB Online Courses

MATLAB Grader

Project Based Learning
HTW Dresden: Converting a Physical Lab to a Virtual Teaching Lab

- App created to simulate signal generator, oscilloscope, and tunable filters.
- Used as a standalone virtual lab and as an extension of the physical laboratory time.
Teaching and Automatic Grading with MATLAB Grader
Opportunities

CURRICULA

COLLABORATION

DIGITALIZATION
Considerations for an Engineering Educator
Consideration for an Engineering Educator

Student
- Project Based Learning

Learning Center
- MATLAB Online Courses

Corporate Relations
- Student Competitions

All
- Examples on Trending Topics

Dean
- MATLAB Grader

Research Groups
- Tools to Teach or Research

Industry
- Industry Standard Tools
Thank you