

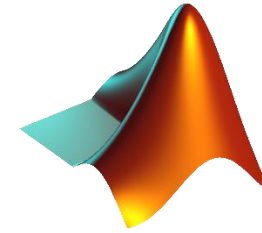
# MathWorks Info Veranstaltung für Professoren und Forscher : FAU 18 05 2021

Ann-Venette Christodoulou

Dr. Kathi Kugler

Manfred Noethen

# Ihr MathWorks Campus Team



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- Customer Success Specialist - **Ann-Venette Christodoulou**, [achristo@mathworks.com](mailto:achristo@mathworks.com)



- Account Manager - **Manfred Nöthen**, +49-89-45235-6791, [mnoethen@mathworks.com](mailto:mnoethen@mathworks.com)



- Installation Support - **Hergen Reising**, [emea-install@mathworks.com](mailto:emea-install@mathworks.com) / [Support page](#)

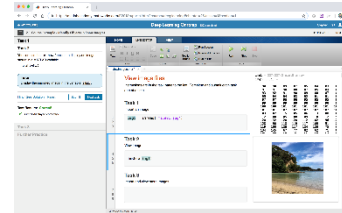
# Jeder der zum Campus gehört hat Zugriff auf alle MathWorks - Tools!



Anytime, Anywhere & Any Device



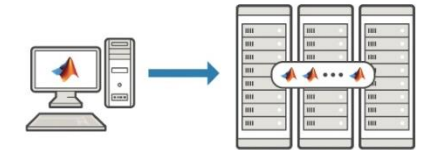
Network Licenses for Multiple Locations



Online Training



MATLAB Online



MATLAB Parallel Server



MATLAB Grader

- ✓ Zugang über das MathWorks [Portal](#)
- ✓ Zugang für alle Angehörigen der Universität
- ✓ Auf universitätseigenen und privaten Rechnern
- ✓ Zugang zu fast [allen\\*](#) MathWorks Tools

Einstiegshilfe zur Campuslizenz, Individual Lizenz, Portal:

[Videos](#)

Access

Training

Collaboration

# Unsere Kunden arbeiten in unterschiedlichen Industrien



**Aerospace and Defense**



**Automotive**



**Biological Sciences**



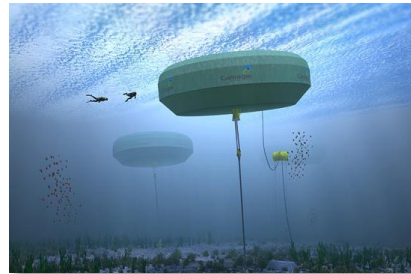
**Biotech and Pharmaceutical**



**Communications**



**Electronics**



**Energy Production**



**Financial Services**



**Industrial Machinery**



**Medical Devices**



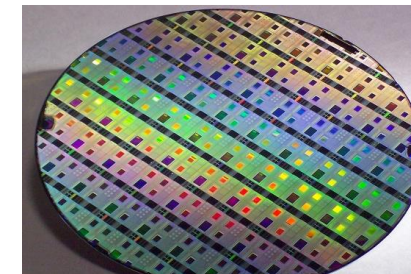
**Metals, Materials, and Mining**



**Neuroscience**



**Railway Systems**



**Semiconductors**



**Software and Internet**

# Produkte in der Campus Lizenz :

5G Toolbox  
 Aerospace Blockset  
 Aerospace Toolbox  
 Antenna Toolbox  
 Audio Toolbox  
 Automated Driving Toolbox  
 AUTOSAR Blockset  
 Bioinformatics Toolbox  
 Communications Toolbox  
 Computer Vision Toolbox  
 Control System Toolbox  
 Curve Fitting Toolbox  
 Data Acquisition Toolbox  
 Database Toolbox  
 Datafeed Toolbox  
**DDS Blockset**  
 Deep Learning HDL Toolbox  
 Deep Learning Toolbox  
 DSP System Toolbox  
 Econometrics Toolbox  
 Embedded Coder  
 Filter Design HDL Coder  
 Financial Instruments Toolbox  
 Financial Toolbox  
 Fixed-Point Designer  
 Fuzzy Logic Toolbox  
 Global Optimization Toolbox  
 GPU Coder  
 HDL Coder  
 HDL Verifier

Image Acquisition Toolbox  
 Image Processing Toolbox  
 Instrument Control Toolbox  
 Lidar Toolbox  
 LTE Toolbox  
 Mapping Toolbox  
 MATLAB  
 MATLAB Coder  
 MATLAB Compiler  
 MATLAB Compiler SDK  
 MATLAB Grader  
 MATLAB Parallel Server  
 MATLAB Production Server  
 MATLAB Report Generator  
 MATLAB Web App Server  
 Mixed-Signal Blockset  
 Model Predictive Control Toolbox  
 Model-Based Calibration Toolbox  
 Motor Control Blockset  
 Navigation Toolbox  
 Online Training Suite  
 OPC Toolbox  
 Optimization Toolbox  
 Parallel Computing Toolbox  
 Partial Differential Equation  
 Toolbox  
 Phased Array System Toolbox  
 Polyspace Bug Finder  
 Polyspace Code Prover

Powertrain Blockset  
 Predictive Maintenance Toolbox  
**Radar Toolbox**  
 Reinforcement Learning Toolbox  
 RF Blockset  
 RF Toolbox  
 Risk Management Toolbox  
 Roadrunner  
 Roadrunner Asset Library  
 Robotics System Toolbox  
 Robust Control Toolbox  
 ROS Toolbox  
**Satellite Communications  
 Toolbox**  
 Sensor Fusion and Tracking  
 Toolbox  
 SerDes Toolbox  
 Signal Processing Toolbox  
 SimBiology  
 SimEvents  
 Simscape  
 Simscape Driveline  
 Simscape Electrical  
 Simscape Fluids  
 Simscape Multibody  
 Simulink  
 Simulink 3D Animation  
 Simulink Check  
 Simulink Code Inspector

Simulink Coder  
 Simulink Compiler  
 Simulink Control Design  
 Simulink Coverage  
 Simulink Design Optimization  
 Simulink Design Verifier  
 Simulink Desktop Real-Time  
 Simulink PLC Coder  
 Simulink Real-Time  
 Simulink Report Generator  
 Simulink Requirements  
 Simulink Test  
 SoC Blockset  
 Spreadsheet Link  
 Stateflow  
 Statistics and Machine Learning  
 Toolbox  
 Symbolic Math Toolbox  
 System Composer  
 System Identification Toolbox  
 Text Analytics Toolbox  
 UAV Toolbox  
 Vehicle Dynamics Blockset  
 Vehicle Network Toolbox  
 Vision HDL Toolbox  
 Wavelet Toolbox  
 Wireless HDL Toolbox  
 WLAN Toolbox



# MATLAB Parallel Server

- Rechenintensive MATLAB®-Programme und Simulink®-Modelle in einem Cluster ausführen.
- Remote-Ausführung von Batch-Jobs, damit Sie Ihren Computer für andere Zwecke verwenden können.
- Kann auf lokaler Hardware oder in der Cloud installiert werden.
- Integration mit bestehenden Schedulingern möglich.

Hinweis: Administratoren können Nutzer auf diese Lizenz-Option eintragen, um diese Produkte zu verwenden.



Client Computers



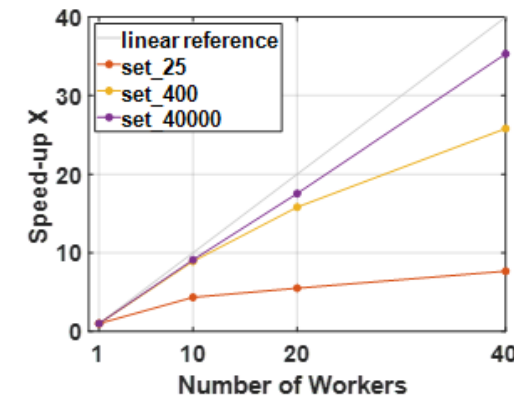
Computer cluster  
Running MATLAB



GPU



Multi-core CPU



# Zusätzliche Produkte

## Polyspace

- Überprüft Ihren Code anhand von formalen Methoden für C/C++ und hebt dessen Fehler hervor
- Ausführliche Tests, die sicherstellen, dass keine Laufzeitfehler, Probleme bei der Nebenläufigkeit oder Sicherheitslücken auftreten

## Roadrunner

- Ein interaktiver Editor, mit dem Sie 3D-Szenen erstellen können, um Systeme für das Autonome Fahren zu simulieren und zu testen.
- Gestalten Sie individuelle Straßen-Szenen, indem Sie regionenspezifische Verkehrszeichen und -Markierungen erstellen.
- Ermöglicht das Einfügen von Schildern, Ampeln, Schutzplanken und Straßenschäden, sowie Laubwerk, Gebäuden und weiteren 3D-Modellen.

```

static void pointer_arithmetic (void) {
    int array[100];
    int *p = array;
    int i;

    for (i = 0; i < 100; i++) {
        *p = 0;
        i++;
    }

    if (get_bus_status() > 0) {
        if (get_oil_pressure() > 0) {
            *p = 5;
        } else {
            i++;
        }
    }

    i = get_bus_status();

    if (i >= 0) {
        *(p - i) = 10;
    }
}
    
```

**Green: reliable**  
safe pointer access

**Red: faulty**  
out of bounds error

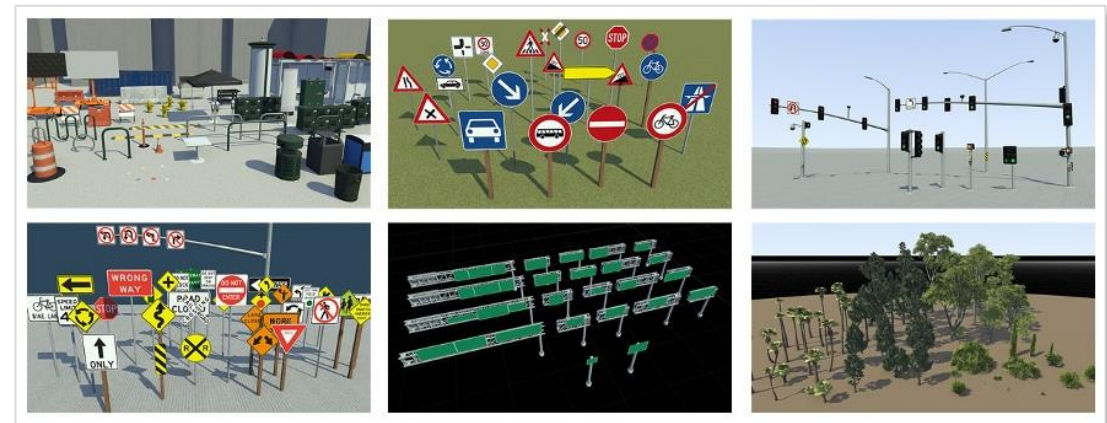
**Gray: dead**  
unreachable code

**Orange: unproven**  
may be unsafe for some conditions

**Purple: violation**  
MISRA-C/C++ or JSF++ code rules

**Range data**  
tool tip

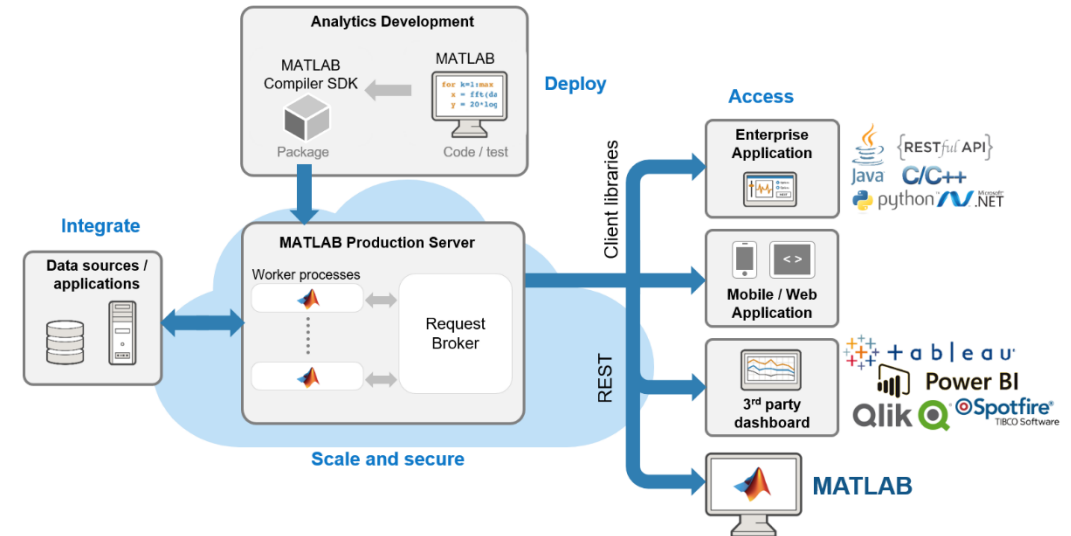
variable 'i' (int32): [0 .. 99]  
assignment of 'i' (int32): [1 .. 100]



# Zusätzliche Produkte

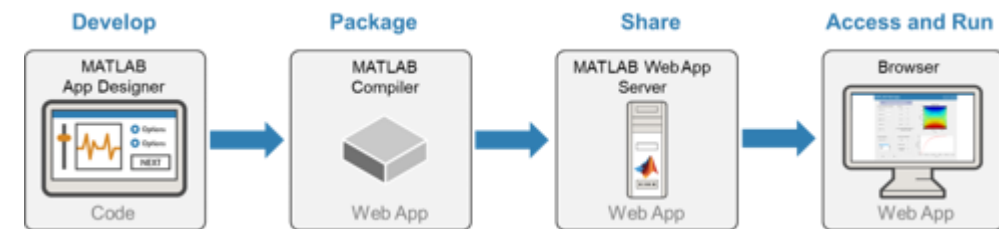
## MATLAB Production Server

- Integrieren Sie benutzerdefinierte Analysen in Unternehmensanwendungen im Bereich Web, Datenbanken und Produktion, die auf dedizierten Servern oder in der Cloud ausgeführt werden
- Sie können Algorithmen in MATLAB erstellen, sie mit dem MATLAB Compiler SDK paketieren und dann auf MATLAB Production Server bereitstellen, ohne erneut zu programmieren oder eine spezielle Infrastruktur erstellen zu müssen
- Skalierbar auf hunderte bis tausende gleichzeitige Anfragen



## MATLAB Web App Server

- Erstellen Sie MATLAB-Apps mit App Designer und Simulink-Simulationen und teilen Sie sie als interaktive Web-Apps
- Endbenutzer können dann mit einem Browser auf die Web-Apps zugreifen und sie ausführen, ohne zusätzliche Software installieren zu müssen





# Übergang von der Universität zur selbstständigen Firma

Campus  
Lizenz



Startup → Industrie



Hochschule  
für angewandte Wissenschaften  
Würzburg-Schweinfurt



ZOLLHOF – Tech Incubator



## Applications

- Explore alternatives
- Develop prototypes
- Bring products to market

## Industries

- Medical Devices
- Robotics
- Autonomous Vehicles

# MathWorks Portal



Regionales Rechenzentrum Erlangen (RRZE)  
Der IT-Dienstleister der Friedrich-Alexander-Universität (FAU)

HARD- & SOFTWARE ▾ INTERNET & E-MAIL ▾ SERVERDIENSTE ▾ MEDIEN & ENTWICKLUNG ▾ FORSCHUNG ▾

- Hard- & Software
- Hardware
- Software
- Dienstliche Nutzung
- Produkte
  - Autodesk
  - COMSOL Multiphysics
  - IBM SPSS
  - LabVIEW
- MATLAB Campusvertrag für Studierende und Forschende der FAU und der UK**
- Microsoft
- PTC
- Private Nutzung
- Software Asset Management
- Betriebssysteme
- Investitionsprogramme

Sie sind hier: [Startseite](#) » [Hard- & Software](#) » [Software](#) » [Dienstliche Nutzung](#) » [Produkte](#) » [MATLAB](#) der UK

## MATLAB Campusvertrag für Studierende und Forschende der FAU und der UK

Die FAU und das UK haben einen [MATLAB-Campus-Vertrag abgeschlossen](#). Damit kann das Universitätsklinikums Erlangen MATLAB und die dazugehörigen Toolboxes unbegrenzt nutzen.

Die Installation ist auf dienstlichen und privaten Rechnern erlaubt.

### MATLAB (Individual)

- Matlab Individual ist ein **persönliches Abo** und **kann nur von einer (1) Person** genutzt werden.
- Die Aktivierung **muss jährlich erneuert** werden!
- Für ortsfeste Rechner auf dem FAU-Campus, die von mehreren Anwendern genutzt werden können, ist [MATLAB \(Concurrent\)](#) zu wählen.

### Persönliches Abo für Matlab (Individual) beantragen

Registrieren Sie sich mit ihrer [@fau.de](#) oder [@uk-erlangen.de](#) E-Mail-Adresse am [MATLAB-Portal](#) [portal/fau-31563700.html](#)

### Einstiegshilfe

<https://de.mathworks.com/academia/campus/resources/quick-start.html>

### Online-Training-Material

<https://matlabacademy.mathworks.com>

Universität Erlangen-Nürnberg

[Get Software](#) | [Learn MATLAB](#) | [Teach with MATLAB](#) | [What's New](#)

MATLAB Access and Support for Everyone at  
**Universität Erlangen-Nürnberg**

MATLAB and Simulink are

- used in 100,000+ companies from market leaders to startups
- referenced in 4 million+ research citations

Where will MATLAB and Simulink take you?

**Get MATLAB and Simulink**

[See list of available products](#)

**Desktop. Online. Mobile.**

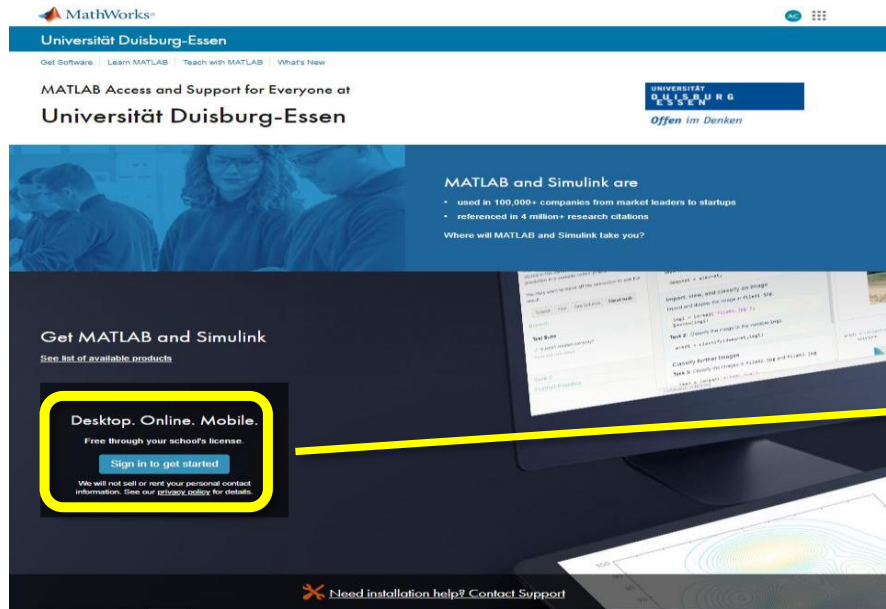
Free through your school's license.

Sign in to get started

We will not sell or rent your personal contact information. See our [privacy policy](#) for details.

Need installation help? Contact Support

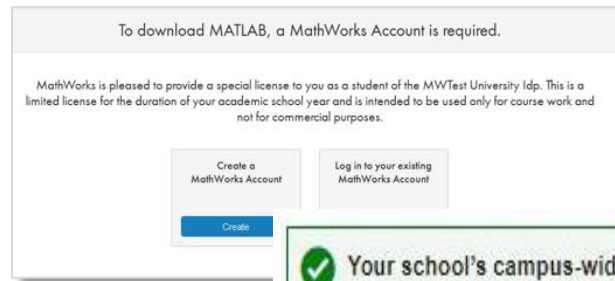
# Wie komme ich zu meiner Lizenz



## Endnutzer-Workflow

Endnutzer beginnen mit **Registrieren Sie sich jetzt** im Campusweiten Lizenz-Portal

### Erstellen/Login MathWorks-Konto



### Profil-Felder ausfüllen

To finish creating your profile, provide the following information for

Email Address:  ✓

First Name:  ✓

Last Name:  ✓

User ID (Optional):

You will need to verify your email address

### Download

MathWorks Account

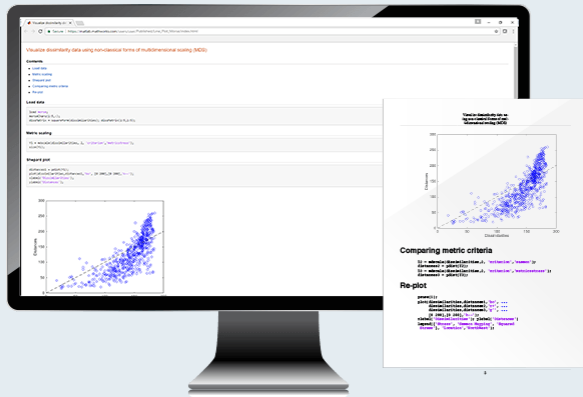
My Account | Profile | Security Settings | Quotes | Orders | Community Profile

✓ Your school's campus-wide license is now linked to your MathWorks Account.

Use MATLAB Online | Install MATLAB

License	Label	Option	Use
Do Not Edit	Designated Computer	Staff	⬇️ ⬆️ ⬇️
ot Edit	Designated Computer	Staff	⬇️ ⬆️ ⬇️
ot Edit	Designated Computer	Staff	⬇️ ⬆️ ⬇️
ot Edit	Total Headcount	Staff	⬇️ ⬆️ ⬇️

# Zugriffsoptionen für Individual Lizenz Nutzer



## MATLAB for Desktops

Zugriff auf MATLAB auf universitären und persönlichen Rechnern und Laptops



## MATLAB & Simulink Online

Zugriff auf MATLAB über den Web-Browser



## MATLAB Mobile

Zugriff auf MATLAB vom iOS/Android-Gerät aus

# Campusweiter Zugriff auf Online Training

## Getting Started

<p><b>MATLAB Onramp</b> FREE</p> <p>Get started quickly with the basics of MATLAB.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>Simulink Onramp</b> FREE</p> <p>Get started quickly with the basics of Simulink.</p> <p><a href="#">Details and launch</a></p>	<p><b>Machine Learning Onramp</b> FREE</p> <p>Learn the basics of practical machine learning methods for classification problems.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>Deep Learning Onramp</b> FREE</p> <p>Get started quickly using deep learning methods to perform image recognition.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>Stateflow Onramp</b> FREE</p> <p>Learn the basics of creating, editing, and simulating state machines in Stateflow.</p> <p><a href="#">Details and launch</a></p>
<p><b>Reinforcement Learning Onramp</b> NEW FREE</p> <p>Master the basics of creating intelligent controllers that learn from experience.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>Image Processing Onramp</b> NEW FREE</p> <p>Learn the basics of practical image processing techniques in MATLAB.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>Signal Processing Onramp</b> NEW FREE</p> <p>An interactive introduction to signal processing methods for spectral analysis.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>Simscape Onramp</b> NEW FREE</p> <p>Learn the basics of simulating physical systems in Simscape.</p> <p><a href="#">Details and launch</a></p>	<p><b>Control Design Onramp with Simulink</b> NEW FREE</p> <p>Get started quickly with the basics of feedback control design in Simulink.</p> <p><a href="#">Details and launch</a></p>

## Data Science

<p><b>Machine Learning with MATLAB</b></p> <p>Explore data and build predictive models.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>Deep Learning with MATLAB</b></p> <p>Learn the theory and practice of building deep neural networks with real-life image and sequence data.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>MATLAB Fundamentals</b> Core MATLAB</p> <p>Learn core MATLAB functionality for data analysis, modeling, and programming.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>MATLAB for Data Processing and Visualization</b> Core MATLAB</p> <p>Create custom visualizations and automate your data analysis tasks.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>	<p><b>MATLAB Programming Techniques</b> Core MATLAB</p> <p>Improve the robustness, flexibility, and efficiency of your MATLAB code.</p> <p><a href="#">Launch</a> <a href="#">Details</a></p>
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Über 80 Stunden  
Aufbaumaterial zu MATLAB

[matlabacademy.mathworks.com](http://matlabacademy.mathworks.com)

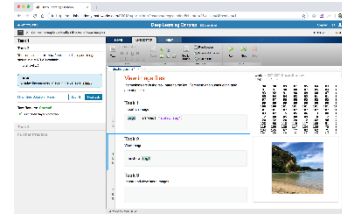
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- ✓ Zugang zu [allen\\*](#) MathWorks Tools

Einstiegshilfe zur Campuslizenz, Individual Lizenz, Portal:

[Videos](#)

Access

Training

Collaboration

[MathWorks PORTAL](#)

# Interdisziplinäres Arbeiten über diverse Anwendungsgebiete



**Aerospace and Defense**



**Automotive**



**Biological Sciences**



**Biotech and Pharmaceutical**



**Communications**



**Electronics**



**Energy Production**



**Financial Services**



**Industrial Machinery**



**Medical Devices**



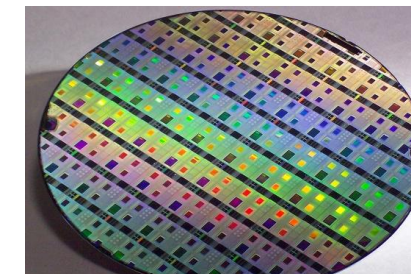
**Metals, Materials, and Mining**



**Neuroscience**



**Railway Systems**



**Semiconductors**



**Software and Internet**



# Battelle Neural Bypass Technology Restores Movement to a Paralyzed Man's Arm and Hand

## Challenge

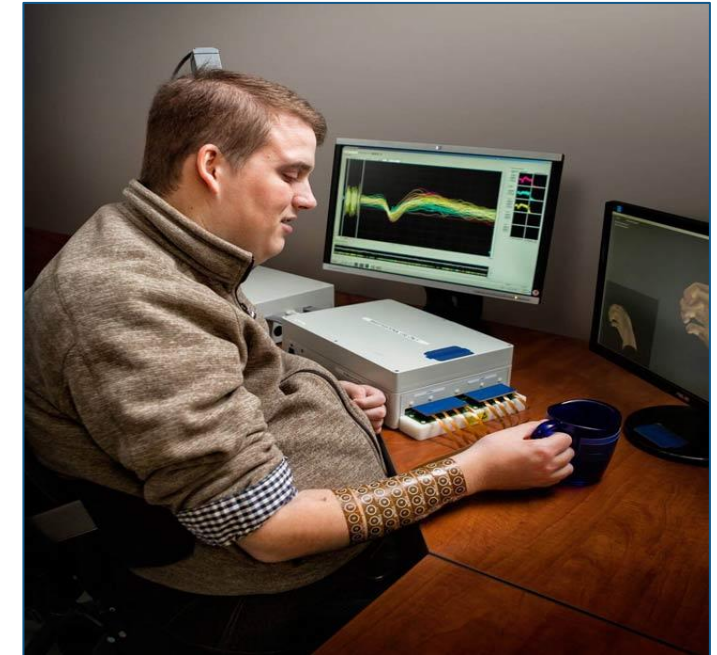
Restore arm and hand control to a quadriplegic man by processing signals from an electrode array implanted in his brain

## Solution

Use MATLAB to analyze signal samples, apply machine learning to classify patterns mapped to movements, and generate actuation signals for a neuromuscular electrical stimulator

## Results

- Control over paralyzed hand and arm restored
- Real-time processing performance achieved
- Interdisciplinary collaboration enabled



Patient using the Battelle NeuroLife system.

*“The algorithms we developed using MATLAB gave the participant back basic control of his arm and hand. By the end of the study, he could grip a bottle, pour out its contents, and set it down, as well as pick up a stir stick and execute a stirring motion.”*

*- David Friedenber, Battelle*

# MATLAB Courseware

## MATLAB Courseware

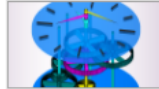
[Educator Home](#) | 
 [Classroom Resources](#) ▾ | 
 [Hardware Support](#) | 
 [License Options](#) ▾ | 
 [Research](#)

### Introduction to Engineering



#### Engineering Models I

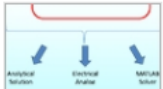
*Professor Kathleen Ossman*  
*Professor Gregory Bucks*  
 University of Cincinnati



#### Engineering Models II

*Professor Kathleen Ossman*  
*Professor Gregory Bucks*  
 University of Cincinnati

### Bioengineering and Biological Sciences



#### Bioengineering Mass Transport and Systems

*Professor Alyssa Taylor*  
 University of Washington



#### Instrumentation, Measurement and Control in Biological Systems

*Professor Kumar Mallikarjunan*  
 Virginia Polytechnic Institute & State University

### Earth, Ocean, and Atmospheric Sciences



#### Teaching Geoscience with MATLAB

from *SERC@Carleton*

**Download:**  
 Lecture Notes  
 Project Ideas  
 Accompanying Code

# Getting Help: Online Teaching and Community Resources

MathWorks® Products Solutions Academia Support Community Events

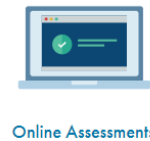
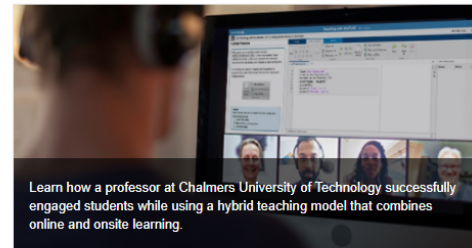
Get MATLAB

Search MathWorks.com

Teach with MATLAB and Simulink Curriculum Resources Online Teaching Campus-Wide License

## Online Teaching with MATLAB and Simulink

Whether you are transitioning a classroom course to a hybrid model, developing virtual labs, or launching a fully online program, MathWorks can help you foster active learning no matter where it takes place. Here you will find resources and ideas for providing hands-on experiences with MATLAB and Simulink, plus tools for delivering instruction, engaging students, and assessing outcomes.



### Create Engaging, Interactive Course Materials

Make your courses more interactive, promote self-directed learning, and increase student engagement through Live Editor and MATLAB apps.

Use MATLAB on the desktop or MATLAB Online to create live scripts. Share live scripts with students through your university's learning management system or using MATLAB Drive. Learn more about creating and sharing live scripts for applications such as flipped classrooms on the [Instructional Resources page](#).

In addition, you can host and run a collection of MATLAB apps on your own MATLAB Web App Server at your university.

MathWorks® Products Solutions Academia Support Community Events

Distance Learning Community

Search Dis

MATLAB Central Home Explore Contribute My Activity

### Keep Teaching through Distance Learning

Posted by Loren Shure, March 23, 2020

As many universities are moving quickly to distance learning, it is vital for educators to think carefully about how to adapt their approach to still deliver key learning outcomes for students in an online setting.

» Read more...

### Discussions

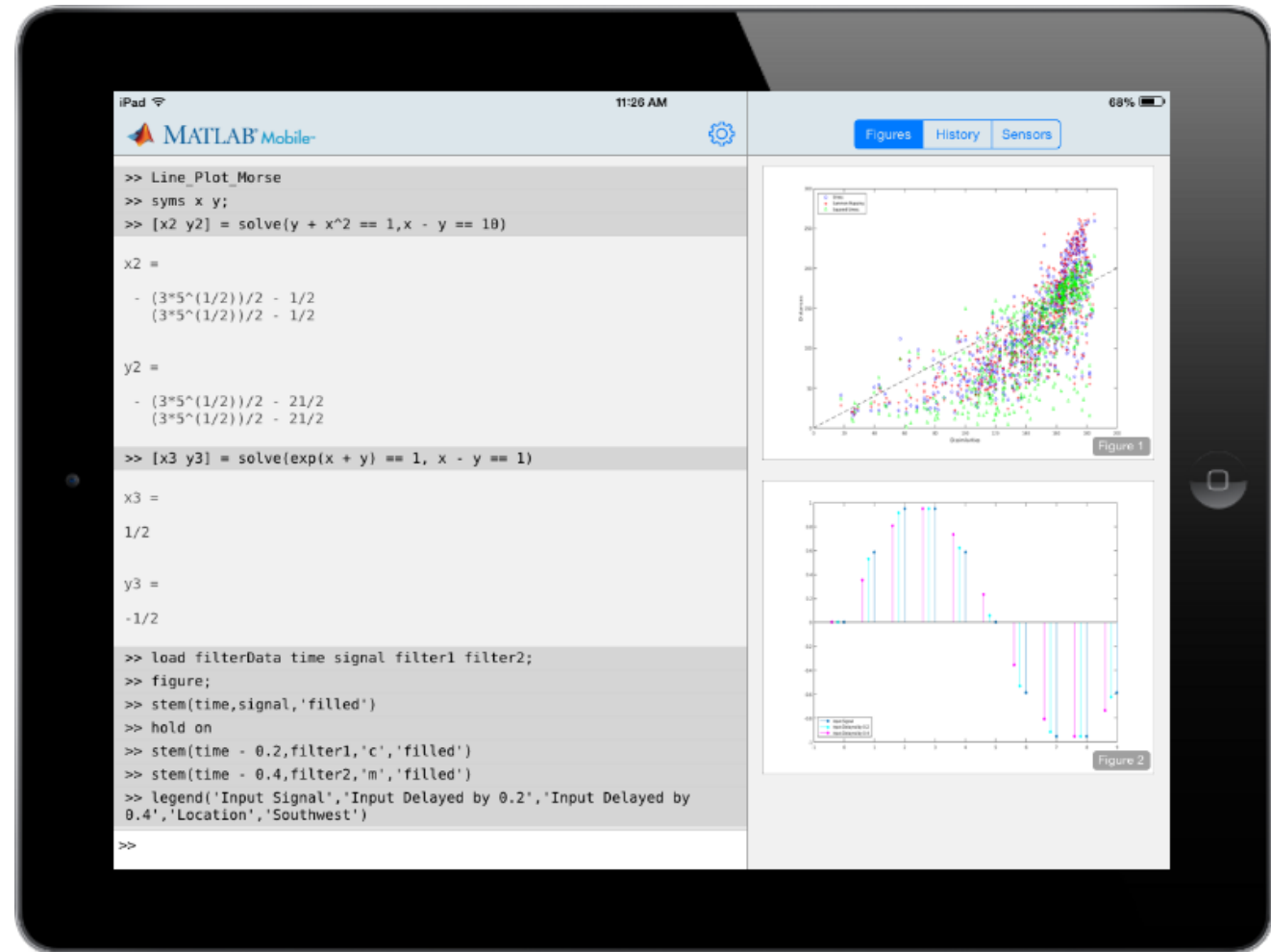
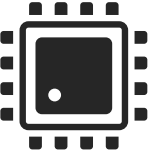
Start a discussion

- Welcome to the Distance Learning Community**  
 Latest activity by jiro on 30 Mar 2020 at 13:17  
 Tags: distance\_learning  
 0 replies
- Tell us your story**  
 Latest activity by jiro on 30 Mar 2020 at 13:05  
 Tags: distance\_learning  
 0 replies

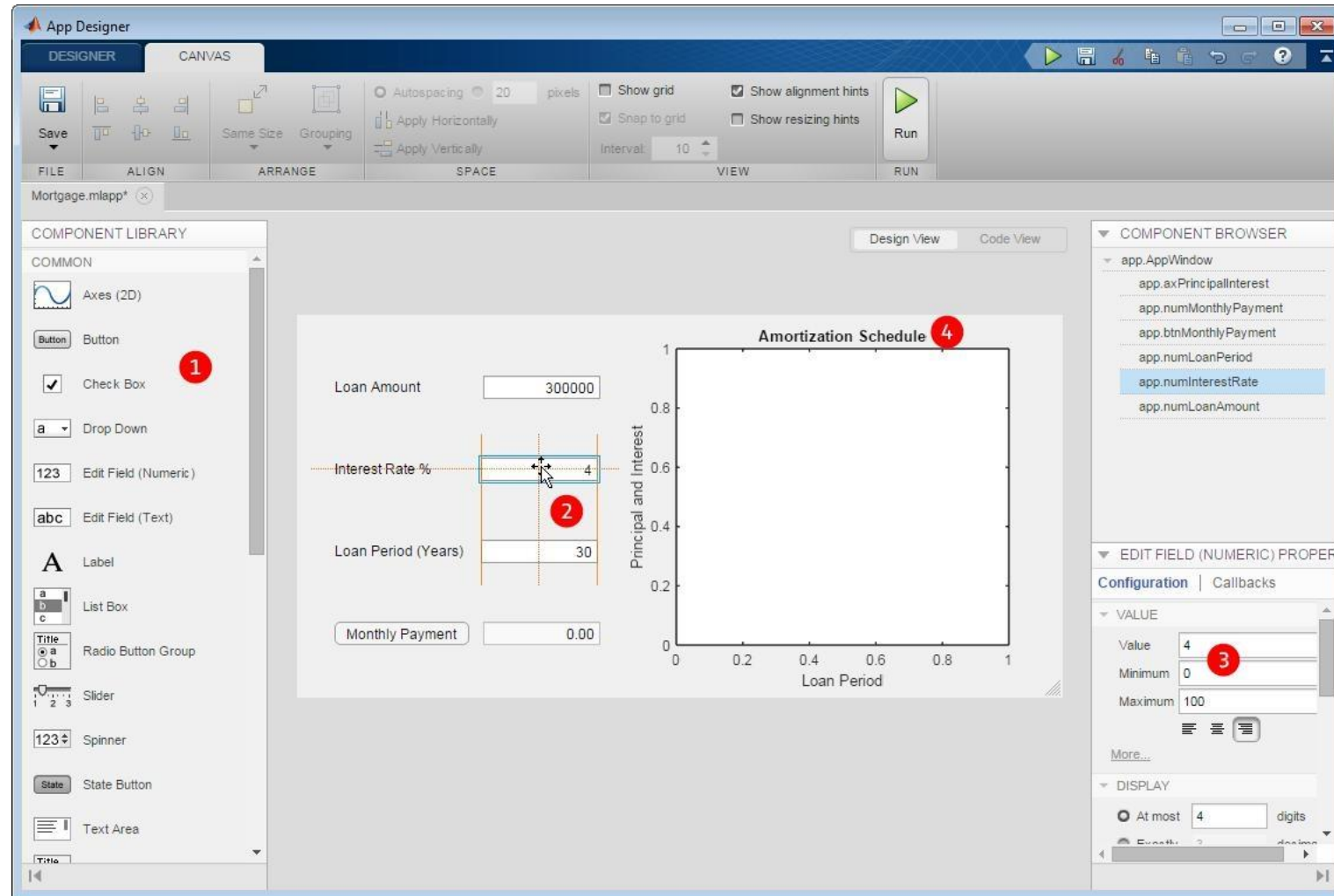
» View all discussions

# MATLAB Mobile

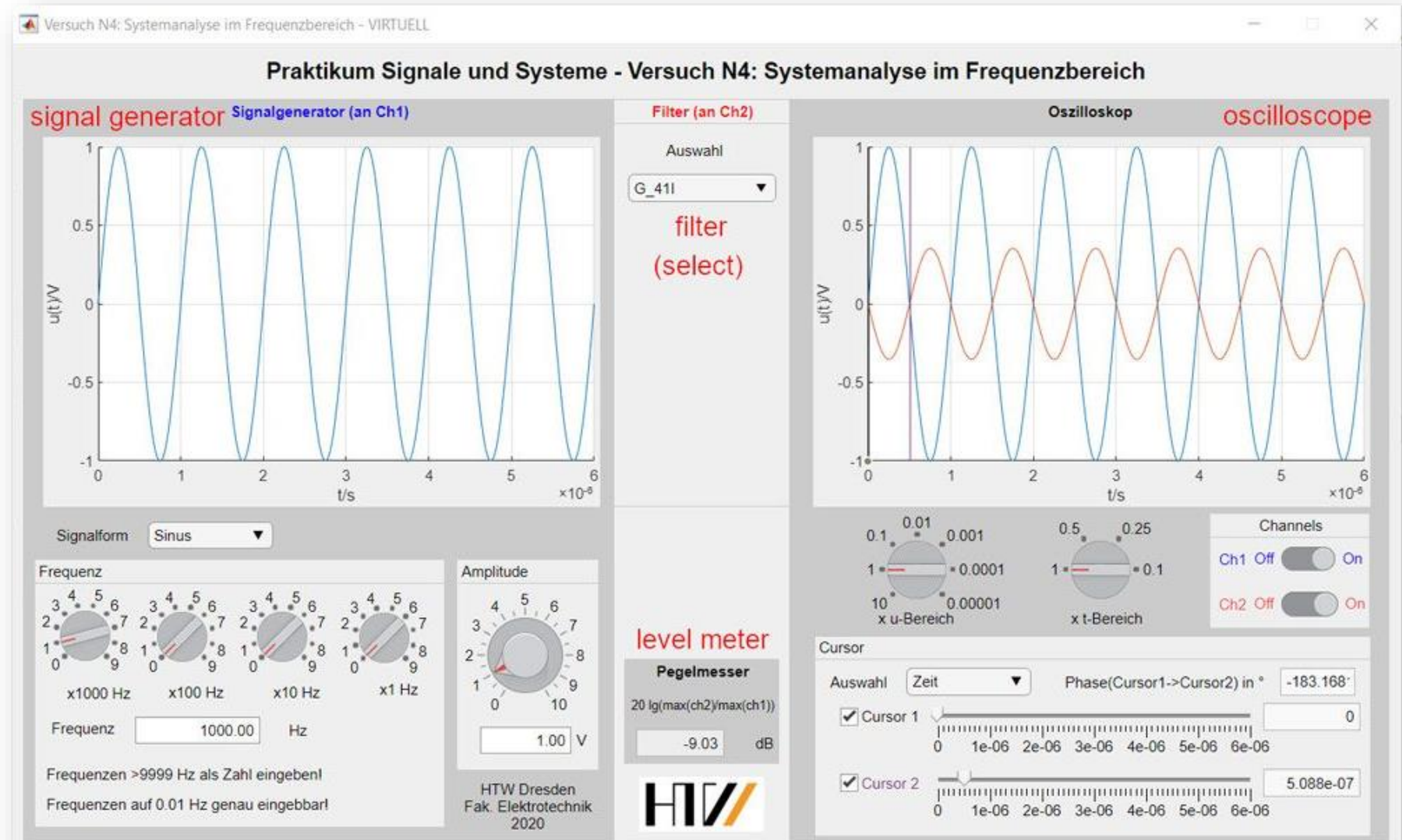
Hardware



# MATLAB Apps



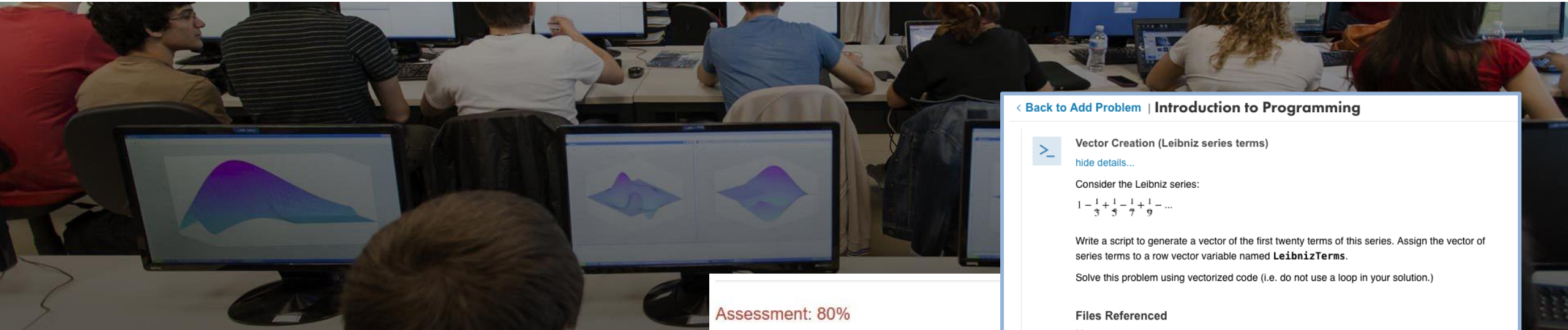
# Example: Virtualizing Electrical Engineering Teaching Apps



Prof. Dr. Matthias Henker  
 Prof. Dr. Kristina Kelber

HTW Dresden

# Autograding MATLAB code with MATLAB Grader



Create interactive course assignments



Automatically grade student work and provide feedback



Run your assignments in any learning environment

Assessment: 80%

✓ Is cross-sectional area correct?

✓ Is the Modulus of Elasticity correct?

✓ Is yield strength calculated correctly?

✓ Is ultimate strength correct?

✗ Is fracture strength correct?  
Variable fracture has an incorrect value.

Verify that:

- strain data starts at 0 mm/mm, and stress starts at 0 Pa. Correct the raw data if necessary.
- fracture is assigned a stress value with units of Pa

Total: 80% (100%)

< Back to Add Problem | Introduction to Programming

> Vector Creation (Leibniz series terms)

[hide details...](#)

Consider the Leibniz series:

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \dots$$

Write a script to generate a vector of the first twenty terms of this series. Assign the vector of series terms to a row vector variable named **LeibnizTerms**.

Solve this problem using vectorized code (i.e. do not use a loop in your solution.)

Files Referenced

None

Problem Type

Script

Code

Reference Solution [Learner Template](#)

```
1 k = 0:19;
2 LeibnizTerms = (-1).^k ./ (2 * k + 1);
```

# Assessment Content

< Back to Add Problem | Introduction to Programming Close x

111 problems:

- > Introduction
- > Matrices and Operators
- > Input/Output
- > Flow Control
- > Functions
- ▼ Graphing

What does Copy do?



Projectile trajectory (plot of multiple data series)

Consider the motion of an object modeled with ideal projectile motion  
[show details...](#)

Copy



Ideal Gas (function to plot multiple data series)

The pressure, volume, temperature, and mass of an ideal gas are related by  
[show details...](#)

Copy



Plot a decaying cosine wave (basic plot of mathematical function)

Damped oscillations are commonly used to describe physical systems such  
[show details...](#)

Copy

< Back to Add Problem | Numerical Methods

How to call the function (when the learner clicks 'Run')

```
1 fun = @(x) 4*x.^3;
2 a = 8; b = 1; n = 11;
3 Q = quadSimp(fun,a,b,n)
4
```

Assessment

> Test 1

Check for a correct result using the test case provided (Pretest)

MATLAB Code

> Test 2

Check for a correct result using randomized inputs

MATLAB Code

> Test 3 Check that a loop is not used

MATLAB Code

< Back to Add Problem | System Dynamics and Control Close x

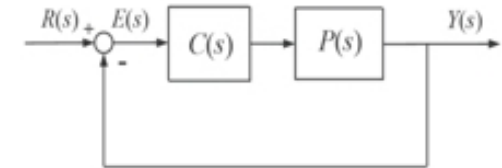


Design of a Lead Compensator using Frequency Response

[hide details...](#)

Copy

In this problem you will employ a frequency response approach to design a lead compensator for the standard unity-feedback system below in order to achieve a prescribed phase margin and level of steady-state error.



Let the plant be given by  $P(s) = \frac{1}{s^2 + 4s + 5}$  and the controller have the form

$C(s) = \frac{K(s+z)}{s+p}$ , where  $z < p$ . Your task is to create a transfer function object C of a

lead compensator such that the following two requirements are met:

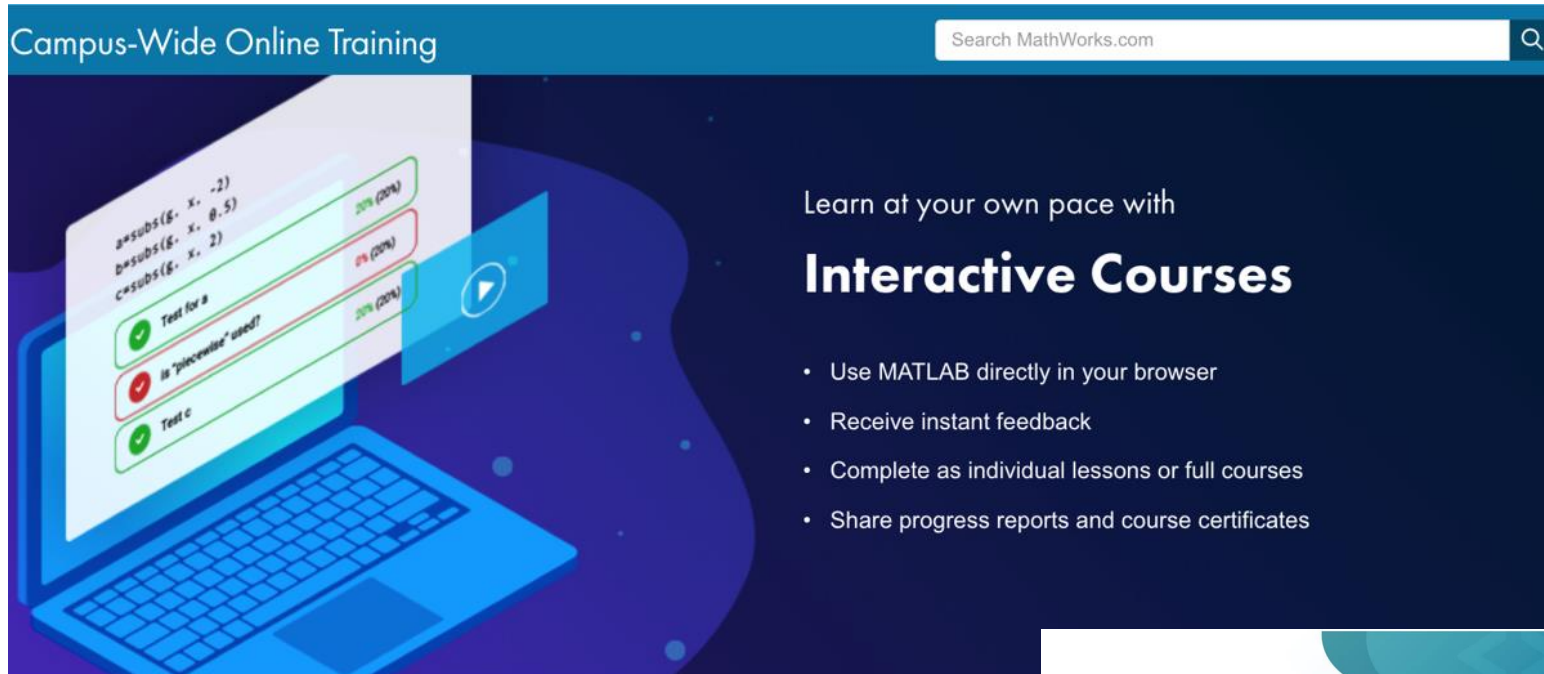
1. The steady-state error to a unit step reference is less than  $ess$ .
2. The phase margin is within  $\pm 0.1$  degrees of  $Pm$ .

The variables  $ess$  and  $Pm$  have been already defined for you in the solution template.

Example problems in common academic topics show how automated MATLAB assessment can work in your curriculum



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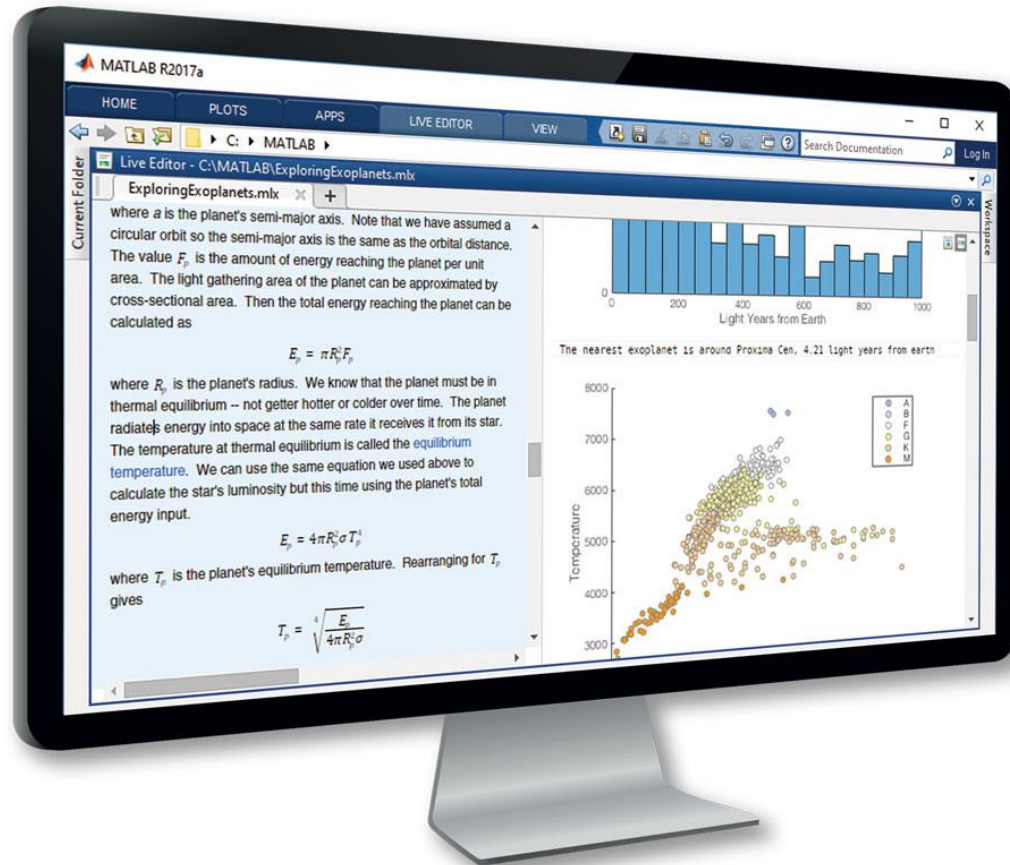
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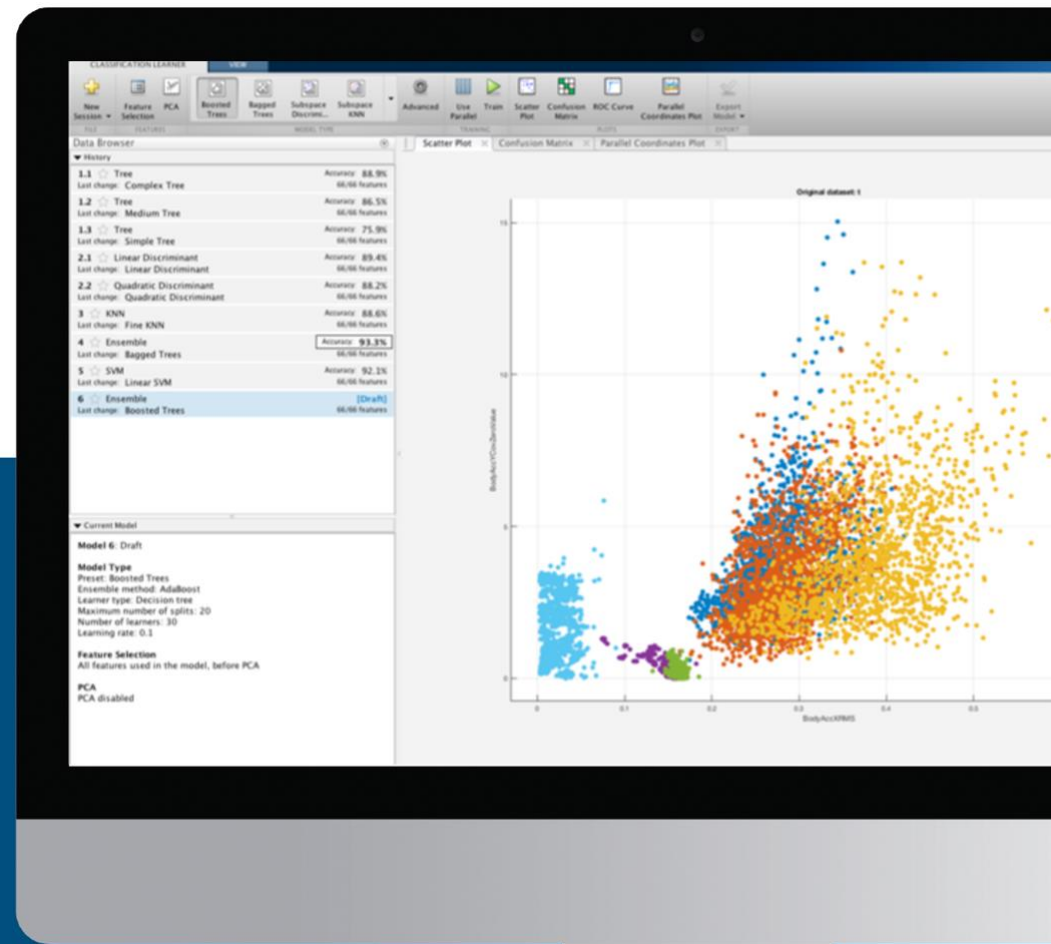
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