

Neuerungen bei MATLAB/Simulink

MATLAB Seminar – HTL Leonding

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MathWorks, Academia Group

JKU Linz, Institut für Signalverarbeitung

Graz University of Technology Develops AI to Identify Drowsy Drivers

Challenge

Determine driver drowsiness from the heart's electrical activity

Solution

Apply deep learning to find subtle patterns in ECG data from rested and fatigued drivers. Create wavelet scalograms with Wavelet Toolbox to transform ECG signals into time-frequency representations. Feed the resulting images into a convolutional neural network using MATLAB and Deep Learning Toolbox.

Key Outcomes

- The deep learning neural network achieved 77% and 79% accuracy when detecting drowsiness, outperforming current state-of-the-art machine learning methods
- The neural network identifies differences between alert and moderately drowsy drivers, paving the way for car functionality that alerts a driver that they are drowsy before they are aware of it



A study participant with monitoring equipment in a Mini Cooper. (Image Credit: Eichberger et al., TU Graz)

“[MATLAB and Deep Learning Toolbox were] very user-friendly. I could add different types of layers and easily make my own neural net.” — Sadegh Arefnezhad, Graz University of Technology

INSTRUCTION

Interaktives Programmieren mit dem Live Editor

The screenshot shows the MATLAB Live Editor interface. The document titled "Exploring Exoplanets" is displayed. It features two images of exoplanets, a table of exoplanet data, and a section titled "Calculating a Planet's Temperature". The table contains the following data:

Name	Distance	Radius	Mass	Orbital Period	Discovery	Discovery Date	Discovery Method	Discovery Team	Discovery Location
51 Pegasi b	42.4 light years	1.06 Jupiter radii	0.47 Jupiter masses	4.23 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi b	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi c	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi d	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi e	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi f	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi g	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi h	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi i	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi j	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi k	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi l	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi m	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi n	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi o	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi p	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi q	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi r	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi s	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi t	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi u	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi v	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi w	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi x	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi y	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva
52 Pegasi z	42.3 light years	1.25 Jupiter radii	0.95 Jupiter masses	6.08 days	1996	1996	Radial velocity	Georges Kouroupis	Geneva

Features

- Lehren Sie mit interaktiven Dokumenten
- Beschleunigen von explorativem Programmieren
- Erstellen Sie eine interaktive Erzählung um Konzepte
- Veröffentlichen einheitlicher Berichte

ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP

Live-Demo:

Interaktivität in (Live) Skripten: Vorher („.m“) – Nachher („.mlx“)

`cosMovAvgFilter.m`

`cosMovAvgFilter_Interactive.mlx`

INSTRUCTION

MATLAB Apps

MACHINE LEARNING AND DEEP LEARNING

- Classification Learner
- Deep Network Designer
- Neural Net Clustering
- Neural Net Fitting
- Neural Net Pattern Reco...
- Neural Net Time Series
- Regression Learner

IMAGE PROCESSING AND COMPUTER VISION

- Camera Calibrator
- Color Thresholder
- DICOM Browser
- Image Acquisition
- Image Batch Processor
- Image Browser
- Image Labeler
- Registration Estimator
- Stereo Camera Calibrator
- Video Labeler
- Video Viewer
- Volume Viewer

MATH, STATISTICS AND OPTIMIZATION

- Curve Fitting
- Distribution Fitter
- Optimization
- PDE Modeler

CONTROL SYSTEM DESIGN AND ANALYSIS

- Control System Designer
- Control System Tuner
- Diagnostic Feature Desi...
- Fuzzy Logic Designer
- Linear System Analyzer
- Model Reducer
- MPC Designer

Classification Learner - Scatter Plot

CLASSIFICATION LEARNER | VIEW

Import Data | Feature Selection | Boosted Trees | Bagged Trees | Subspace Discriminant | Subspace KNN | Train | Advanced | Scatter Plot | Confusion Matrix | ROC Curve | Export Model

FILE | FEATURES | CLASSIFIER | TRAINING | PLOTS | EXPORT

Data Browser

Model	Accuracy
SVM	
Linear SVM	86.4%
SVM	
BoxConstraint = 3	87.1%
KNN	
Fine KNN	94.9%
KNN	
NumNeighbors = 2	90.7%
KNN	
NumNeighbors = 1	94.1%
KNN	
NumNeighbors = 2	91.7%
Ensemble	
NumLearners = 100	95.9%

Current model: Type: Ensemble, Preset: < Custom >, Data Transformation: None, Status: Trained

Scatter Plot

Variable on X axis: avg_body_gyro_x_test

Variable on Y axis: stdv_total_acc_y_test

Legend

Correctly classified

- Walking
- ClimbingStairs
- Sitting

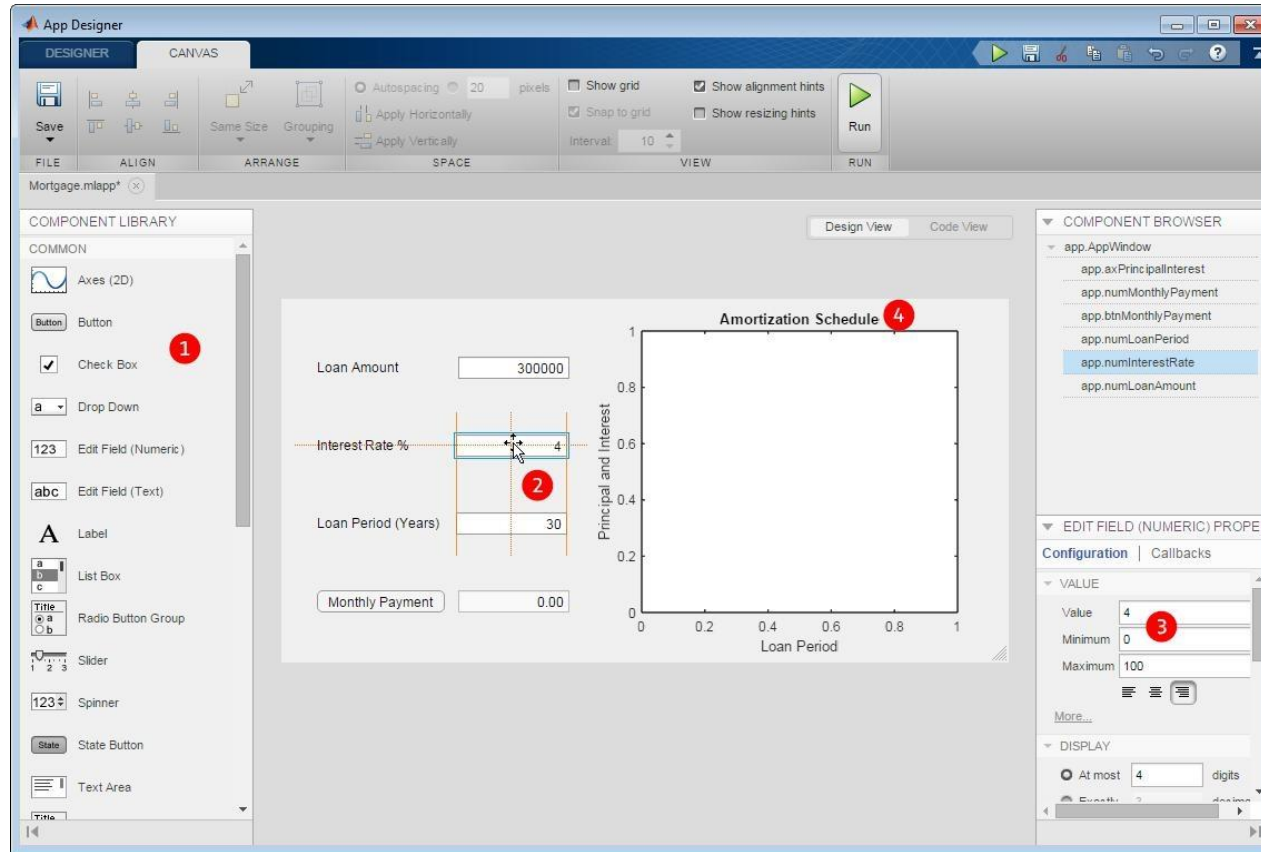
Misclassified - true class is:

- Walking
- ClimbingStairs
- Sitting

Scatter Plot of humanAct

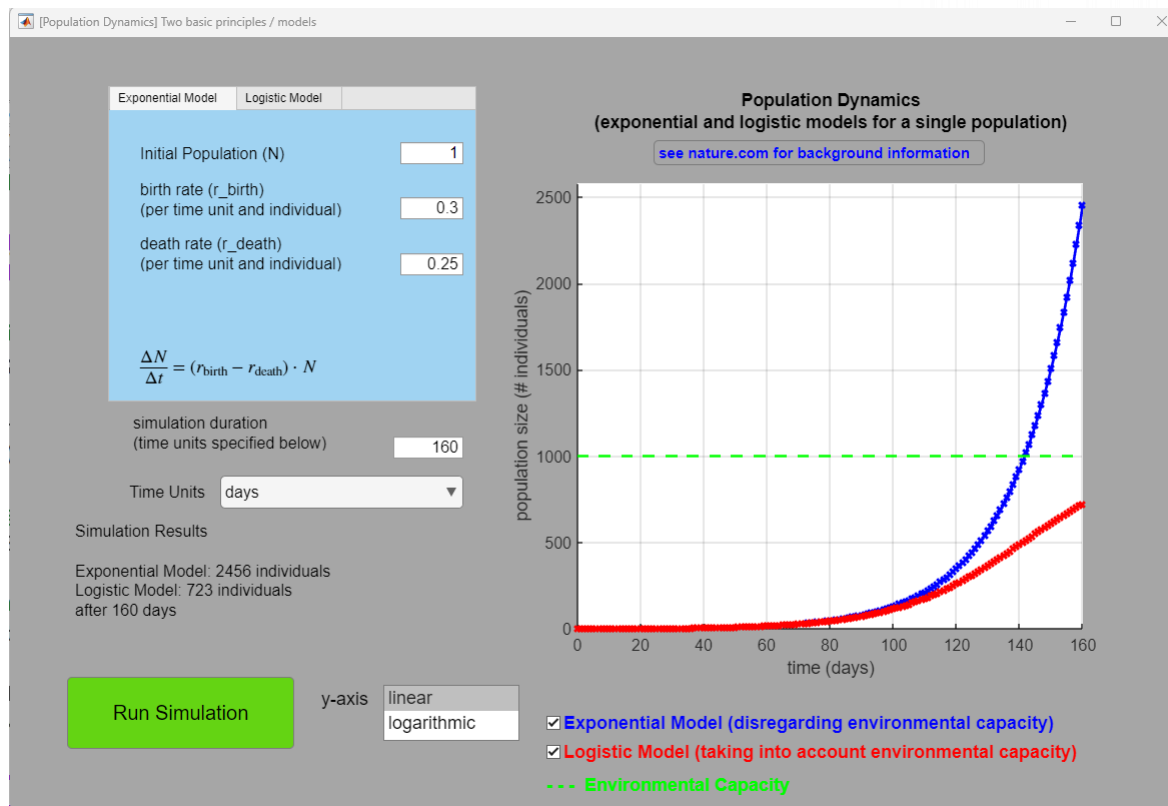
INSTRUCTION

MATLAB App Designer



INSTRUCTION

Demo: MATLAB Apps & eigene MATLAB Apps – Beispiel: Populationsdynamik*



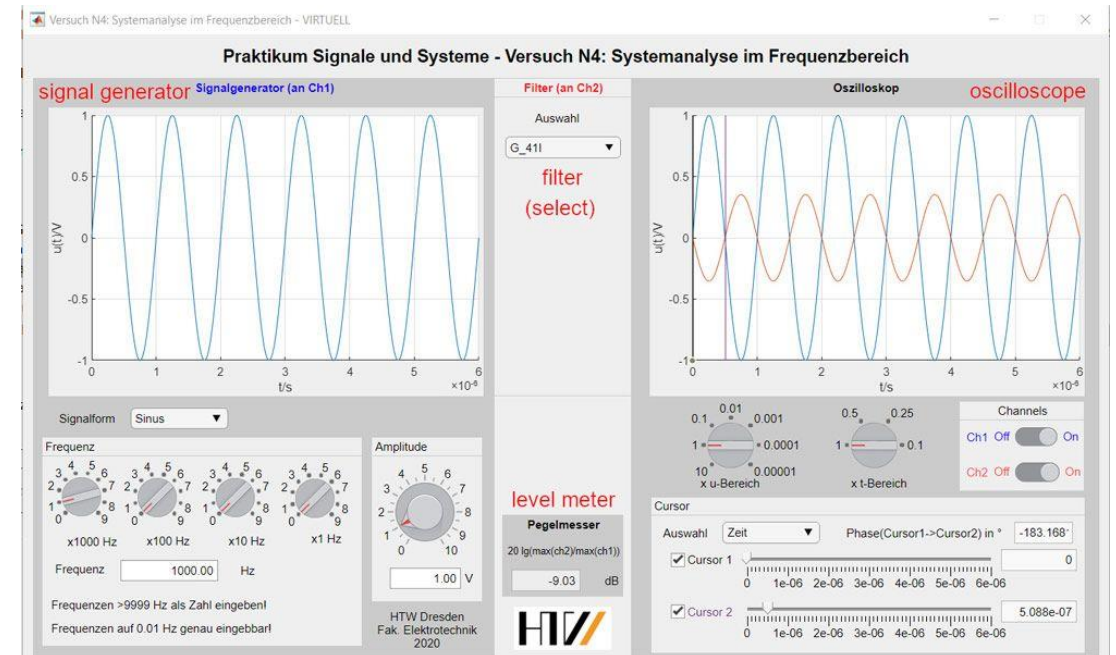
*Datengenerierung auch möglich in Simulink-Modellen, die im Hintergrund laufen

INSTRUCTION

Interaktive Apps für ein eindrückliches Lernerlebnis

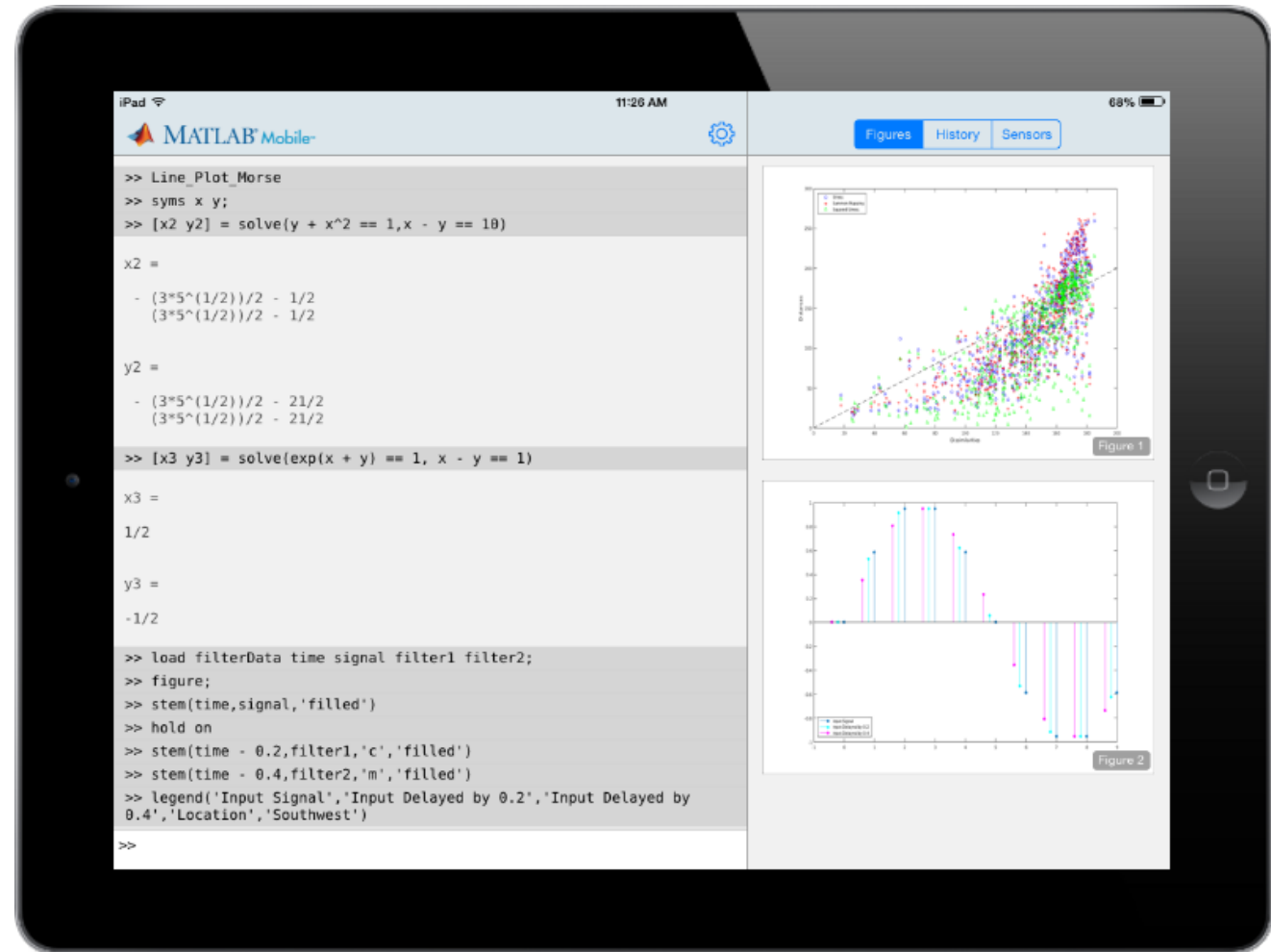
HTW Dresden Virtualizing Electrical Engineering Teaching Labs

- Virtuelle Laborgeräte (als Apps): die Studierende können zuhause das im Labor erlebte Revue passieren lassen ([Artikel](#))
- Graphische Benutzeroberflächen zur einfachen Bedienung, darunter MATLAB Code und/oder Simulink Modelle
- Die [interaktiven Apps \(vgl. rechts\) auf File Exchange](#)



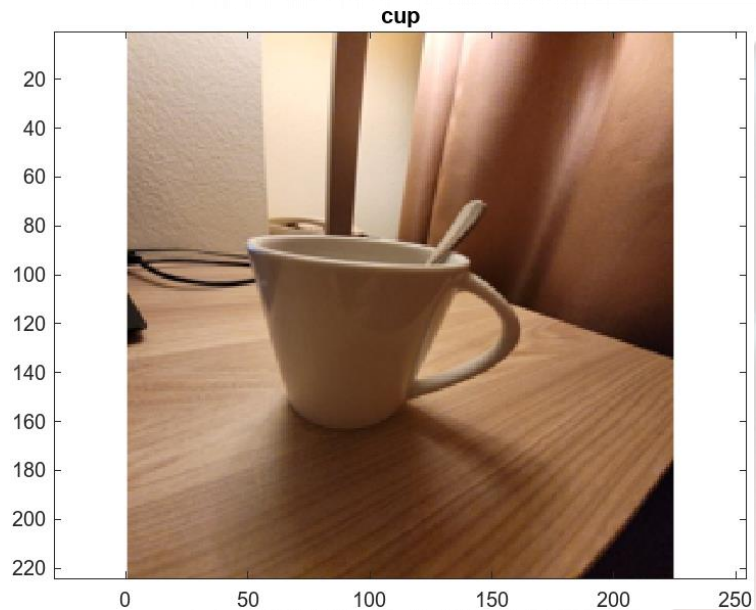
INSTRUCTION

MATLAB Mobile



INSTRUCTION

MATLAB Mobile: Live Demo – Klassifizierung von Photos von der Handykamera



Files:

`ClassifyCameraImage.m` (Handy)

`ClassifyCameraImage_desktop.mlx` (Desktop)

`camnet.m` (benötigte Funktion)

Erstellen von Handy- und Web Apps

Handy-Apps

- Es gibt die Möglichkeit zur [C-Codegen und Integration in Apps](#)
- Zugeschnittene Lösungen für
 - [Android](#)
 - [iOS](#)

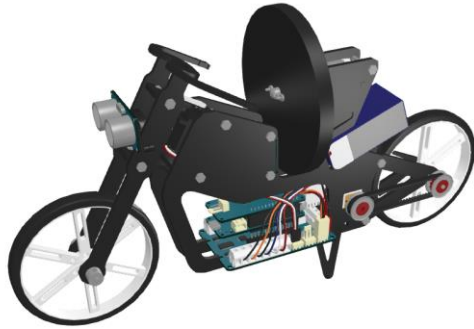
Web Apps

- [Allgemeine Information](#) in der Dokumentation



INSTRUCTION

Project-based learning with low-cost hardware



Self-balancing robots using
Arduino



Edge Detection using
Raspberry Pi

"I really enjoyed, 'Edge AI with Raspberry Pi using MATLAB' to deploy face detection and age prediction algorithms on a Raspberry Pi. I have no experience in hardware, but I completed the tutorial and now have a strong curiosity!"

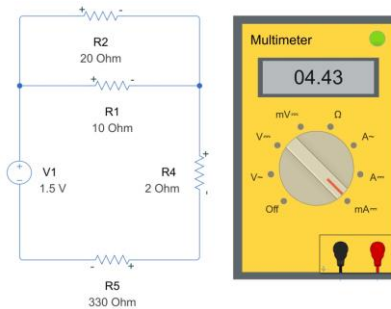
-Katie Amrine, PhD
Decision Scientist, Facebook

INSTRUCTION

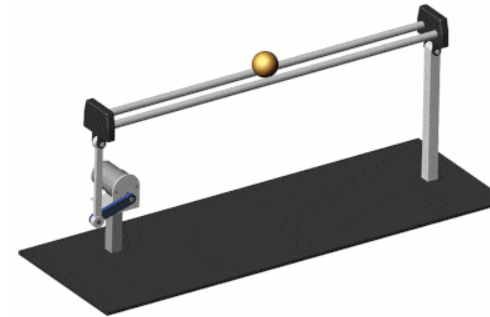
Modulare Lehrmaterialien

■ Beispiele:

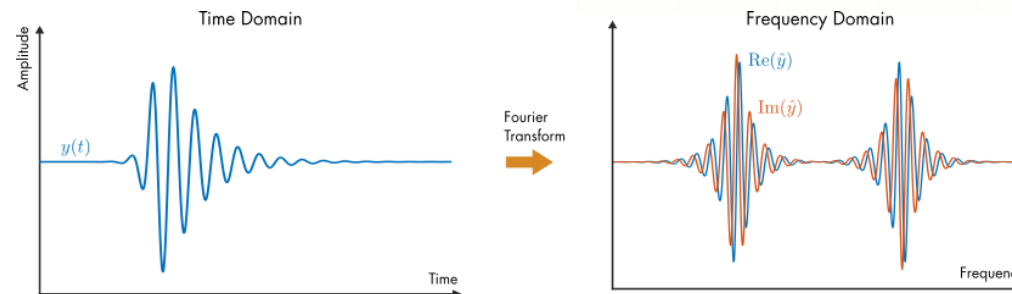
– [DC Circuit Analysis](#)



– [Virtual hardware and labs for controls](#)



– [Fourieranalyse](#)



INSTRUCTION

Kurse zum Selbststudium

FREE COURSES (2-3 hours)

- MATLAB Onramp
- Simulink Onramp
- Stateflow Onramp
- Machine Learning Onramp
- Deep Learning Onramp

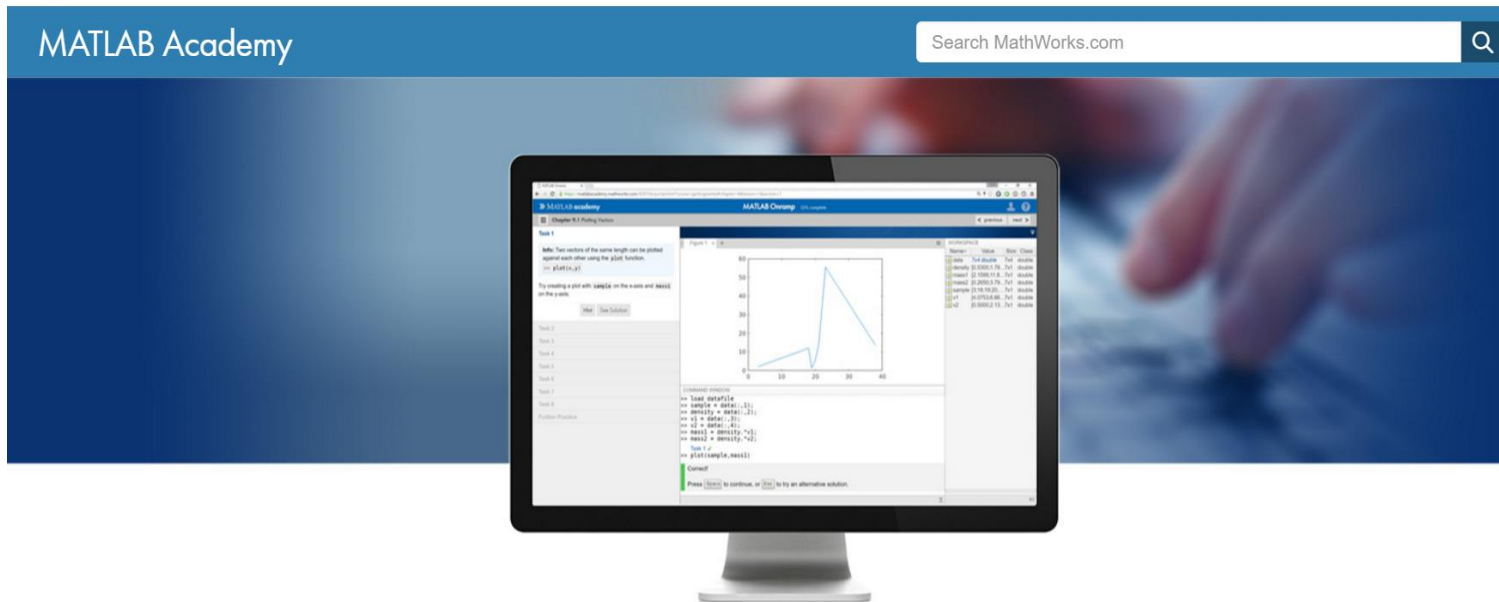
FOCUSED COURSES

FOUNDATIONAL COURSES (17-21 hours)

- MATLAB Fundamentals
- MATLAB Programming Techniques
- MATLAB for Financial Applications
- MATLAB for Data Processing and Viz
- Machine Learning with MATLAB
- Deep Learning with MATLAB

COMPUTATIONAL MATH COURSES (2-3 hours)

- Introduction to Linear Algebra
- Solving Ordinary Differential Equations
- Introduction to Statistical Methods
- Solving Non-Linear Equations
- Introduction to Symbolic Math



Learn MATLAB for Free

[Launch MATLAB Onramp now](#)

“The interactive MATLAB tutorials were perfect for engaging students and getting them up to speed quickly.”

–Dr. Yu-li Wang, Carnegie Mellon University

Online Trainings

Self-Paced Courses

Getting Started (16)

MATLAB (5)

Simulink (7)

AI, Machine Learning, and Deep Learning (6)

Math and Optimization (6)

Image and Signal Processing (6)

Explore over 50 virtual and in-person **classroom courses**

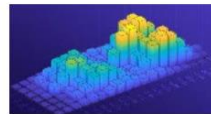
MATLAB



MATLAB Onramp

14 modules | 2 hours | Languages

Get started quickly with the basics of MATLAB.



MATLAB Fundamentals

0% 

18 modules | 16.5 hours | Languages

Learn core MATLAB functionality for data analysis, modeling, and programming.



MATLAB for Data Processing and Visualization

0% 

10 modules | 8 hours | Languages

Create custom visualizations and automate your data analysis tasks.



MATLAB Programming Techniques

0% 

10 modules | 16 hours | Languages

Improve the robustness, flexibility, and efficiency of your MATLAB code.



Object-Oriented Programming Onramp

100% 

4 modules | 2 hours | Languages

Learn the basics of using object-oriented programming in MATLAB to model real-world objects and manage software complexity.

Danke für die Aufmerksamkeit!



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