

ACADEMIA

Innovative applications of MathWorks products across engineering disciplines in colleges, universities, and research institutions worldwide.

University of California at Davis

Competing to Design Fuel-Efficient Vehicles

The University of California at Davis (UCD) is competing with 16 other universities to design an advanced hybrid vehicle for Challenge X, a groundbreaking student engineering competition sponsored by General Motors Corporation and the US Department of Energy. The UCD team is using MathWorks tools for Model-Based Design to design and implement a control strategy that optimizes fuel economy and tailpipe emissions. They have developed vehicle models in Simulink® and used Real-Time Workshop® to automatically generate control software, which they will use to run real-time, hardware-in-the-loop

simulations on xPC TargetBox®. UCD will deploy the code on their microcontroller with the Embedded Target for Motorola® MPC555.

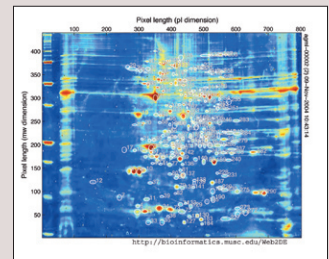
www.challengex.org



Medical University of South Carolina

Leveraging Research and Teaching in Computational Biology

Researchers at the Medical University of South Carolina (MUSC) use MathWorks tools to incorporate genomic and metabolic data into systems models and to teach graduate-level courses in biomolecular data analysis. They use MATLAB® and a technique for decoupling systems of differential equations to determine pathway structure from



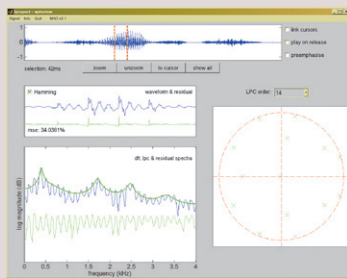
metabolic and time-series data. The Bioinformatics Toolbox helps them perform sequence alignment and normalize, visualize, and import microarrays. MathWorks tools helped MUSC win one of only 15 Bioinformatics Training grants from the National Library of Medicine and one of only 10 National Heart, Lung, and Blood Institute Proteomic Center awards. <http://bioinformatics.musc.edu/>

University of Sheffield

Learning How We Hear

Computer scientists in the Speech and Hearing Group at the University of Sheffield in the UK developed GUI-driven demonstrations that enable students to use signal processing to understand speech and the auditory system. They include MATLAB sound and signal processing functions, and show students how to compute common time- and frequency-domain parameters, simulate sound transformation in the inner ear, and explore more advanced auditory phenomena such as auditory streaming and temporal induction. Using these demonstrations as a primer, students go on to use MATLAB in coursework and projects.

www.dcs.shef.ac.uk/~martin/MAD/docs/mad.htm



Jawaharlal Nehru Technological University

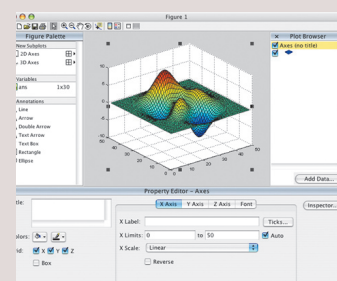
Standardizing on Engineering Software

Students and faculty at Jawaharlal Nehru Technological University College of Engineering in Hyderabad, India, use MathWorks products throughout the curriculum, a result of the college's adoption of MATLAB and Simulink across all engineering departments. Each year, 300 students use the software for courses

and projects in electrical and electronics engineering, mechanical engineering, electronics and communication engineering, computer science, and other areas. They use the Neural Network Toolbox, the Signal Processing Toolbox, as well as other MathWorks tools in classroom

and research activities.

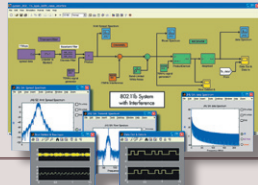
www.jntu.ac.in/academics/hyderabad.htm



The Johns Hopkins University

Teaching Wireless Technology through Theory and Simulation

At the Johns Hopkins University, graduate students learn wireless technology theory by modeling wireless communications systems with Simulink. As the primary simulation environment for the “Introduction to Wireless Technology” course, Simulink enables students to perform spectrum analysis with fast Fourier transforms. After modeling the modulator, demodulator, and wireless transceiver, they design a detailed binary phase-shift keying model to simulate a portion of the direct sequence spread spectrum for the IEEE 802.11 standard. Students finish the course with an 802.11 model that incorporates spreading and despreading, modulation and demodulation, and channel modeling. www.jhu.edu



Purdue University

Teaching Engineering and Collaboration Skills to First-Year Students

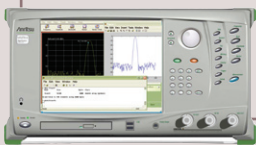
Each year, more than 1,600 first-year students at Purdue University use MATLAB in an innovative program that develops team-building and collaboration skills as they solve a range of engineering problems. In the classroom, students learn core engineering concepts and MATLAB commands for implementing them. In the lab, they work as teams to apply what they've learned to real problems. For example, they use MATLAB and the Image Processing Toolbox to quantify the size of aluminum crystals from micrographs and determine the nanoscale roughness of fabricated gold surfaces. Purdue has adopted MathWorks tools across computer, electrical, mechanical, aerospace, and chemical engineering departments. www.purdue.edu



Carleton University

Preventing Unauthorized Access to Wireless Networks

Researchers at Carleton University in Ottawa, Canada, are using MATLAB with Anritsu's Signature High Performance Signal Analyzer to “fingerprint” WiFi transceivers. They capture WiFi RF signals with the signal analyzer and immediately plot and analyze the data in the time and frequency domains with MATLAB and the Signal Processing Toolbox. Using tools developed in MATLAB, they extract a set of transceiverprints (transceiver “fingerprints”) from amplitude, frequency, and phase components of the signal, from which they generate a set of profiles. Finally, they use the Neural Network Toolbox to match new WiFi transceiverprints generated from signal analyzer data to these profiles to prevent unauthorized network access. www.scs.carleton.ca/~jhall2



University of Missouri-Rolla

Developing an Automatic Facial Recognition System

Researchers at the University of Missouri-Rolla developed an automatic facial expression recognition (FER) system based on Gabor-wavelet transforms and learning vector quantization networks. They used the Image Processing Toolbox to extract attributes from facial images as feature vectors and evaluated the responses from Gabor filters at reference points on the face.



Using MATLAB, they analyzed the resultant high-dimensional feature vectors and divided the image/vector set into classes of expression, such as

anger, distress, and sadness. They detected further facial feature points with a particle swarm optimization method developed with the Neural Network Toolbox. The FER system achieved 90% accuracy with the Japanese Female Facial Expression database developed by M. Lyons of the ATR Media Information Lab (Japan). www.umar.edu

Hanyang University

Training Future Automotive Engineers in ECU Development

The Automotive Control and Electronics Laboratory of Hanyang University in Korea uses MathWorks tools for Model-Based Design to teach nearly 500 aspiring automotive engineers each year to design powertrain, chassis, and frame-related electronic control units. Simulink and SimDriveline enable them to model and simulate the main components of the engine and transmission and to design control algorithms. They use Real-Time Workshop Embedded Coder to automatically generate production-ready code, which they validate by running hardware-in-the-loop simulations with xPC Target before deploying the code onto target processors. www.ancelab.org



RESOURCES

- ▶ **The MathWorks in Academia**
www.mathworks.com/res/academia
- ▶ **User Stories**
www.mathworks.com/res/user_stories