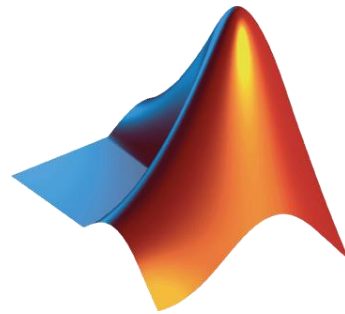


Introduction to MATLAB & Simulink



Nadia Bedjaoui
Ingénieure pédagogique
nadia.bedjaoui@mathworks.fr



Agenda

- What's MATLAB/Simulink ?
- Who use MATLAB/Simulink ?
- How do I get access to MathWorks products ?
- How to get started with MathWorks products ?

MathWorks core softwares



% Compute Kalman Gain:

```
W = P*M'*inv(M*P*M'+ R);
```

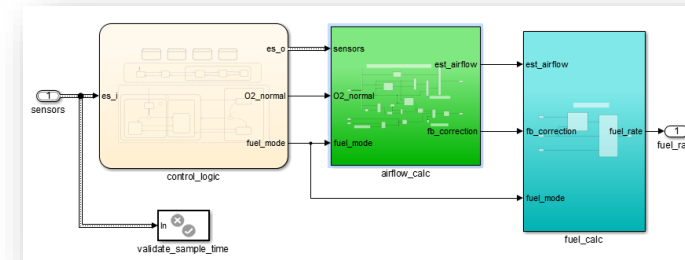
% Update estimate

```
xhat = xhat + W*residual;
```

% Update Covariance Matrix

```
P = (eye(4)-W*M)*P*(eye(4)-W*M)' +  
W*R*W';
```

**High level programming
language for technical Computing**



**Graphical environment for
modeling, simulation and design of
dynamical multi-domain systems**

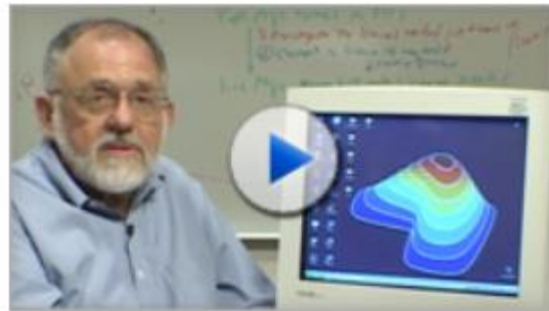


What does MATLAB mean?

- 1) MATrix LABoratory
- 2) MAThematics LABoratory

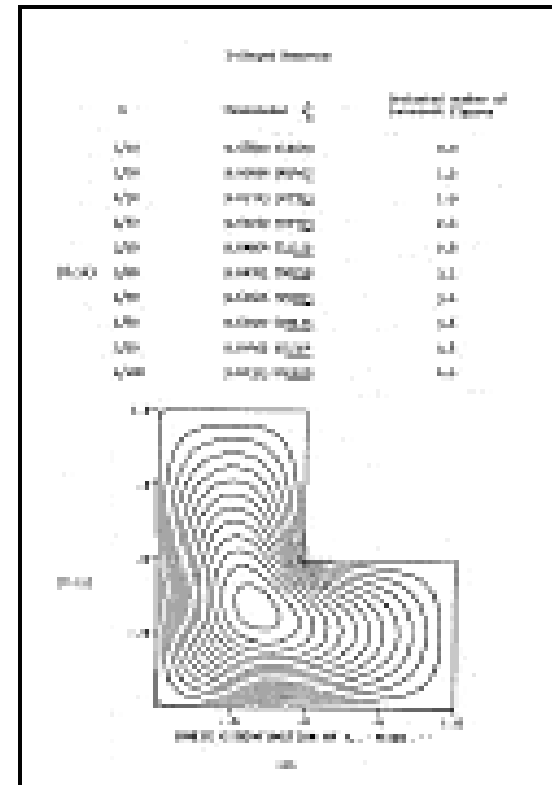
MATLAB: Origins (End of 70's)

- **Cleve Moler**, Senior-Lecturer at Stanford



Origins of MATLAB 8:25

- **For his research:**
Developed **Fortran** libraries
for Matrix Computation



L-shaped membrane

MATLAB: Birth

- **Cleve Moler**, Teacher of Numerical Analysis



- **For his teaching:** Developed higher level language for Matrix Computation:
MATLAB (Matrix Laboratory)
- **Objective:** accelerate his students learning.

Evolution of MATLAB

- **1984** Creation of **MathWorks** with **Jack Little**



Accelerating the pace of engineering and science

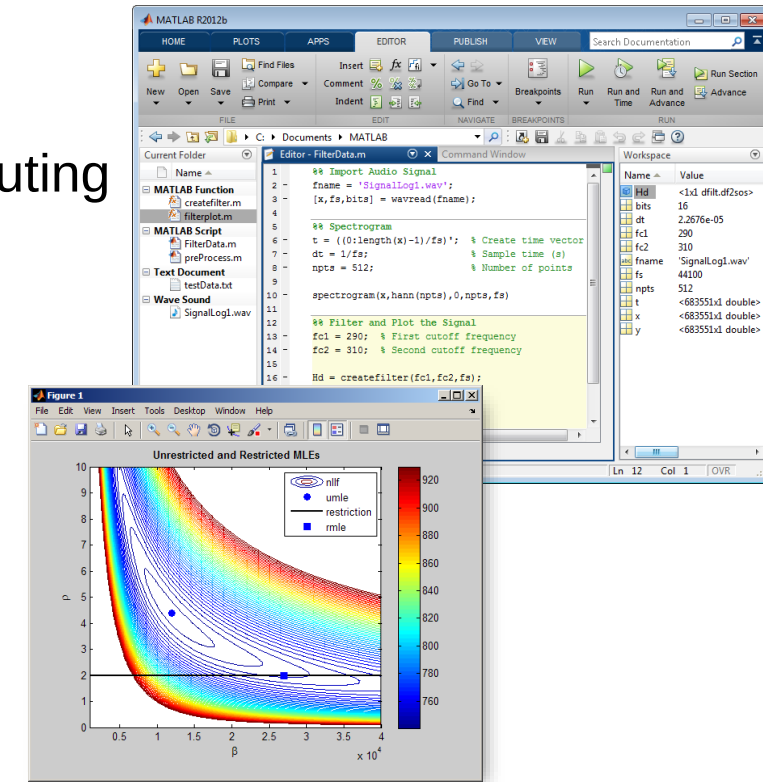


Jack
Little

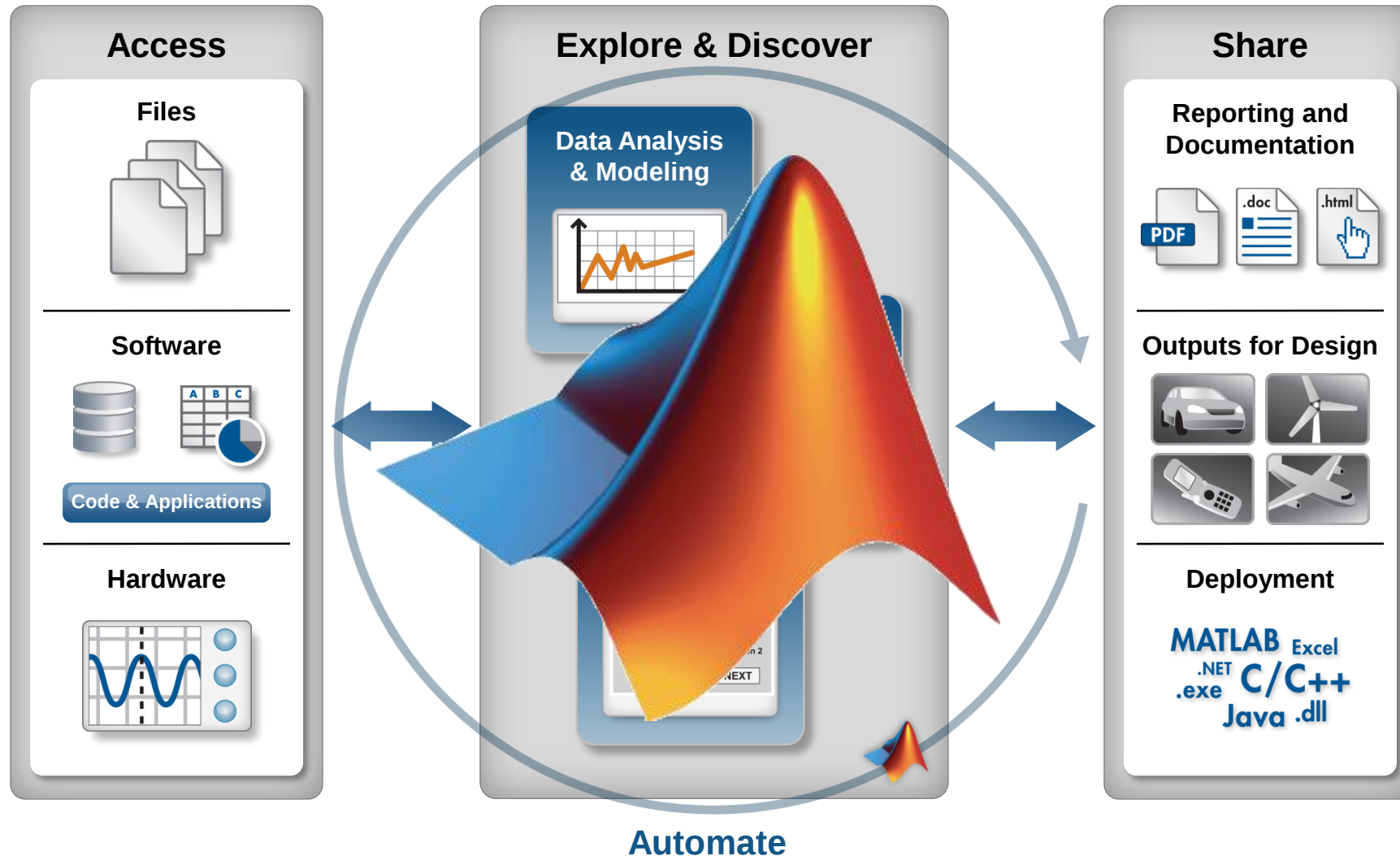
- MATLAB becomes **The Language of Scientific and Technical Computing**
- **Mission:** Accelerate the pace of Engineering and science

What's MATLAB ?

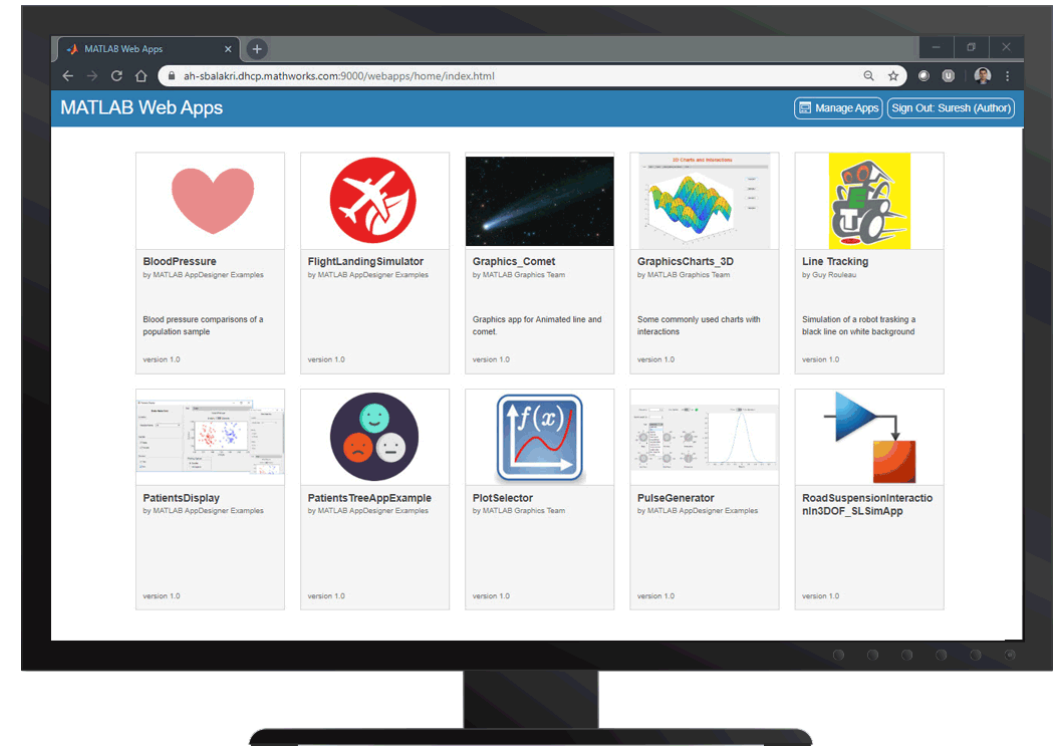
- High-level language & Interactive environment for technical computing
- Built-in functions, 100 toolboxes, different domains & applications



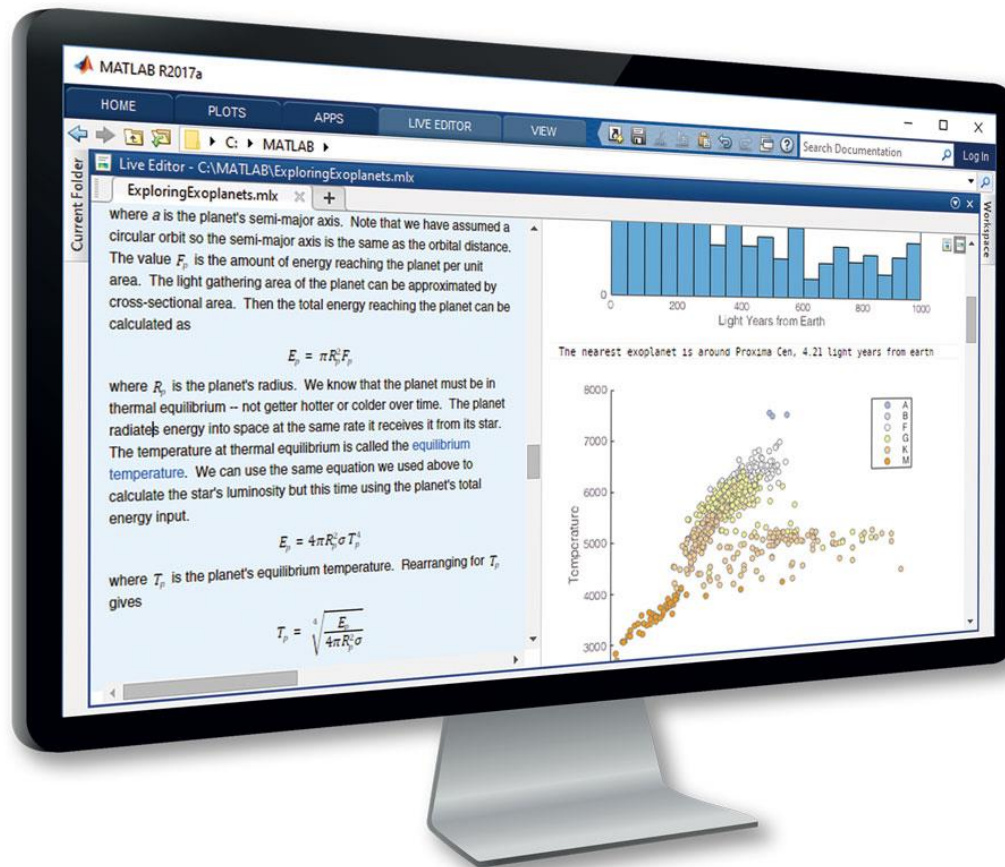
Technical Computing with MATLAB



Highlights on MATLAB Live scripts & MATLAB Apps



MATLAB Live Editor



MATLAB Live Editor :

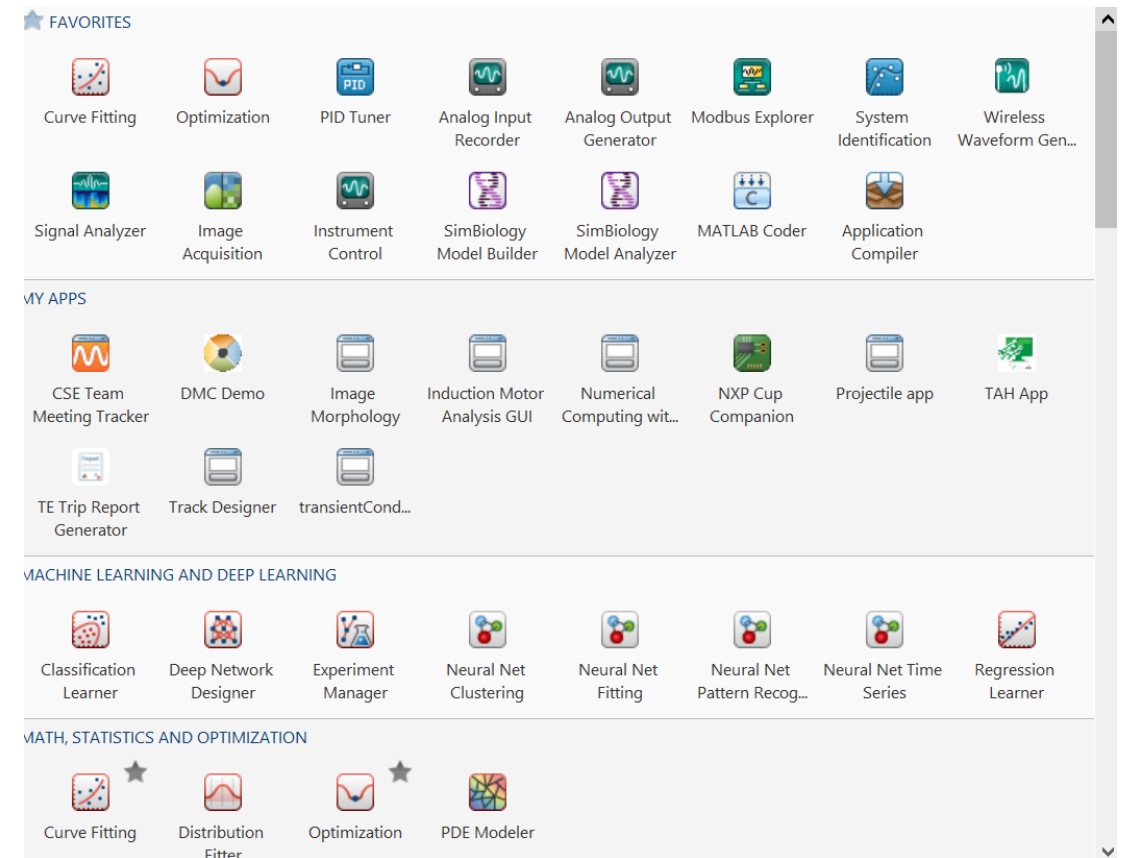
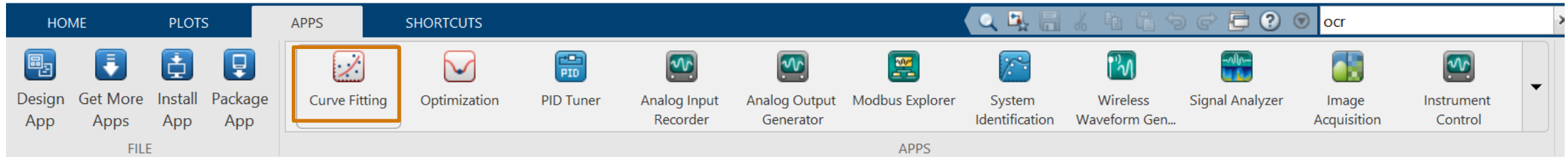
Créez des documents attractifs en associant du texte explicatif, des équations mathématiques, du code et des résultats

Partagez vos scripts avec vos camarades via MATLAB Online et MATLAB Drive

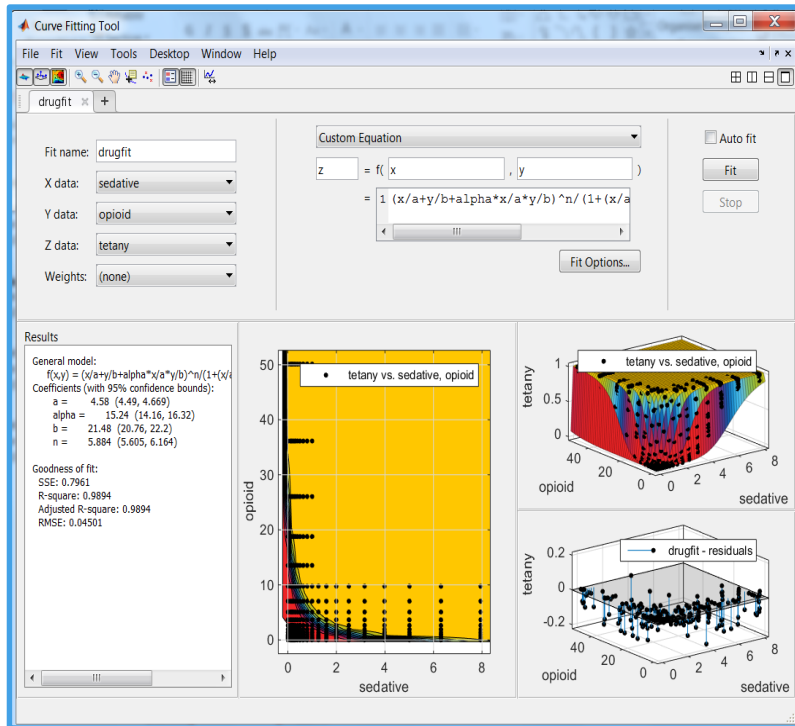
Centralisez votre travail (code, résultats et texte formaté) en un seul et même document exécutable

Utilisez des apps MATLAB disponibles

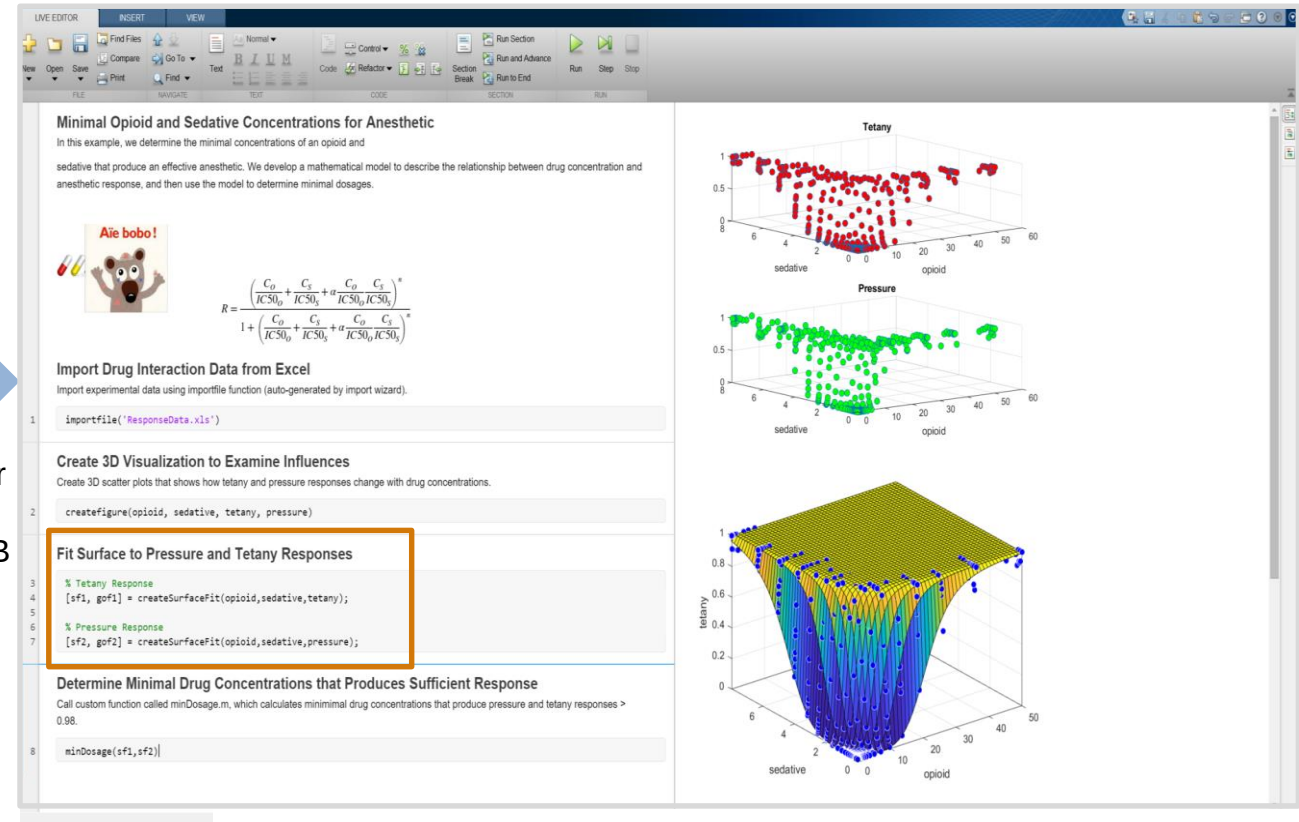
MATLAB R2020b



Générez le code MATLAB pour l'inclure dans votre Live script



Générer
le code
MATLAB



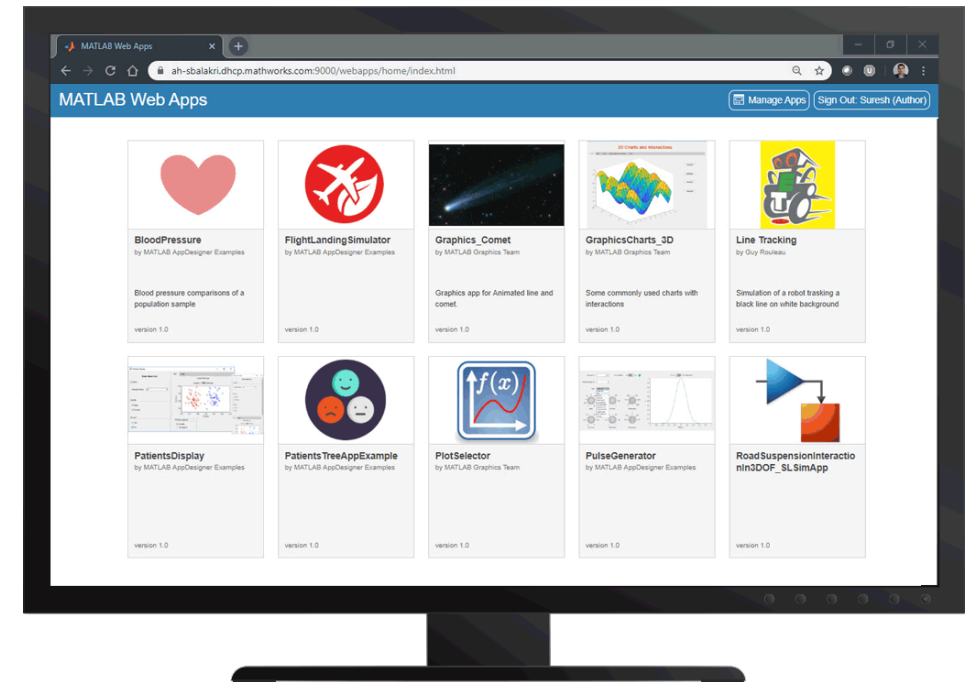
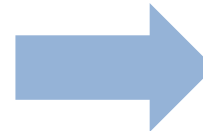
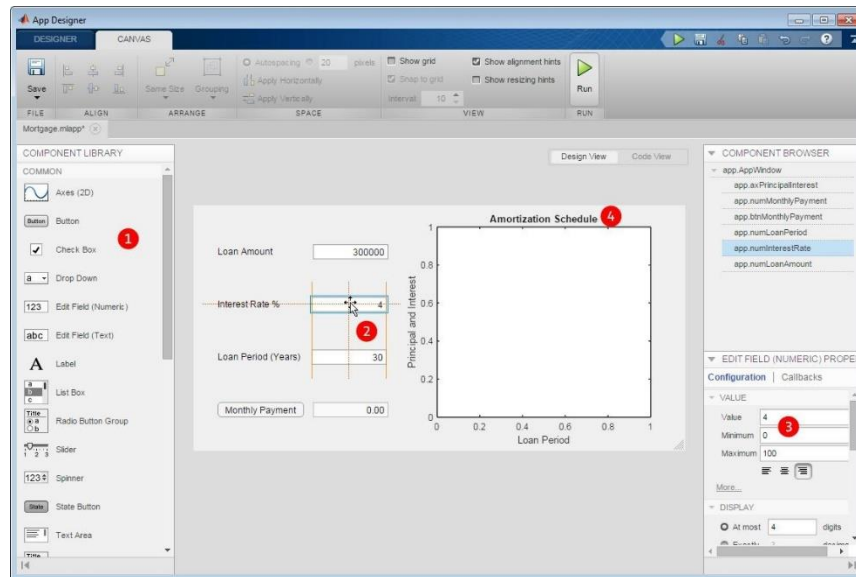
Faire toute la démarche sur l'app

Intégrer le code MATLAB dans le Live script

Créez et partagez des applications MATLAB

Créez votre App via
App Designer

Partagez votre App via
MATLAB Web App Server



MathWorks core softwares



% Compute Kalman Gain:

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```

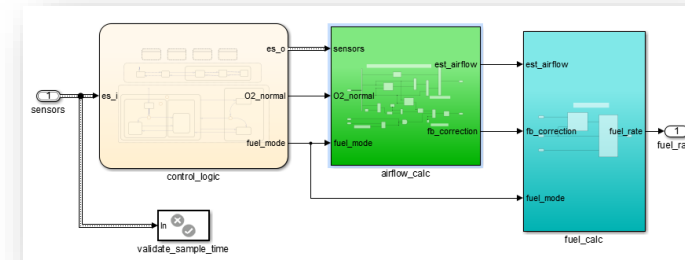
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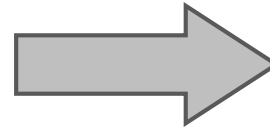
**High level programming
language for technical Computing**



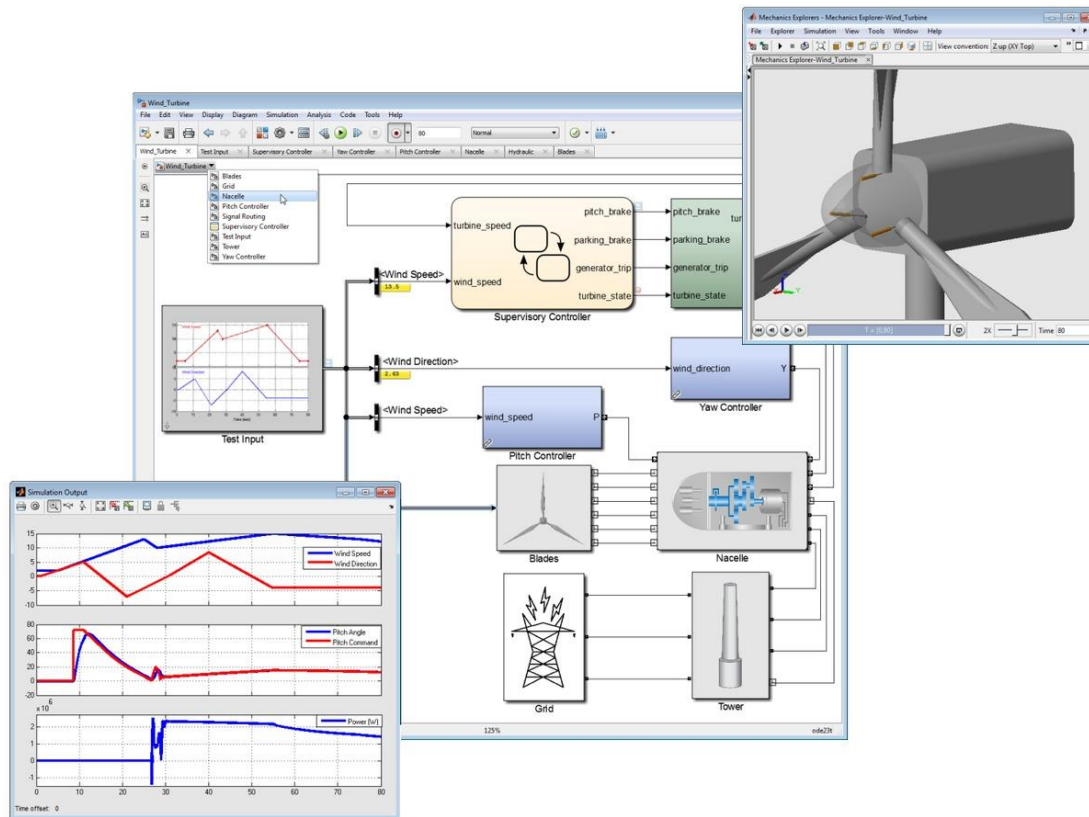
**Graphical environment for
modeling, simulation and design of
dynamical multi-domain systems**

Model-Based Design with Simulink

1. Modeling and simulation
(Physical system, embedded algorithms)



2. Generating code and targeting hardware



```

53 Turbine_Logic_B.parking_brake = 1.0;
54 Turbine_Logic_B.generator_trip = 1.0;
55 Turbine_Logic_B.pitch_brake = 1.0;
56 Turbine_Logic_B.turbine_state = 0.0;
57 } else {
58 switch (Turbine_Logic.DWork.is_c1_Turbine_Logic) {
59 case Turbine_Logic.IN_Brake:
60 /* During 'Brake' */
61 if (0.0 <= Turbine_Logic.park_speed) {
62 /* Transition: '<S1>20' */
63 Turbine_Logic.DWork.is_c1_Turbine_Logic = Turbine
64
65 /* Entry Park: '<S1>7' */
66 Turbine_Logic_B.parking_brake = 1.0;
67

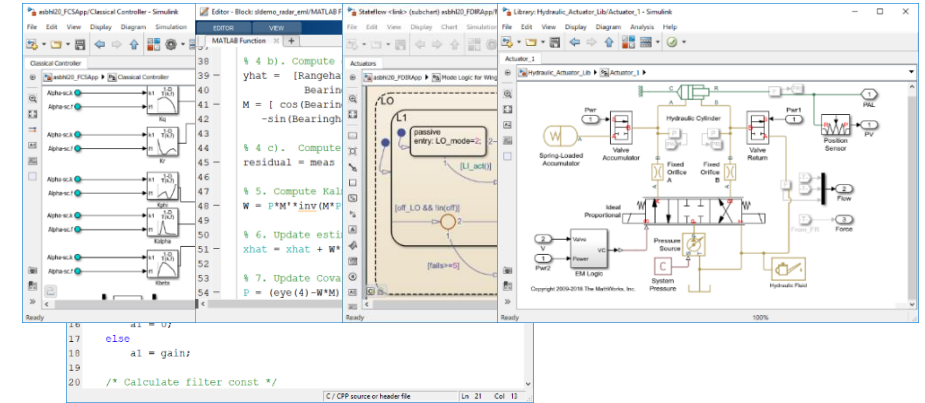
```

FPGA (VHDL, Verilog)



What's Simulink

- Simulink® is one environment for Model-Based Design of multidomain embedded systems
- Different multidomain physical modeling approaches
- Automatic Code Generation for a variety of targeted hardware
- Engineers and scientists use it to take their ideas from concept to production.



Arduino



STM
Electronics



Raspberry Pi



Android/iOS
Devices

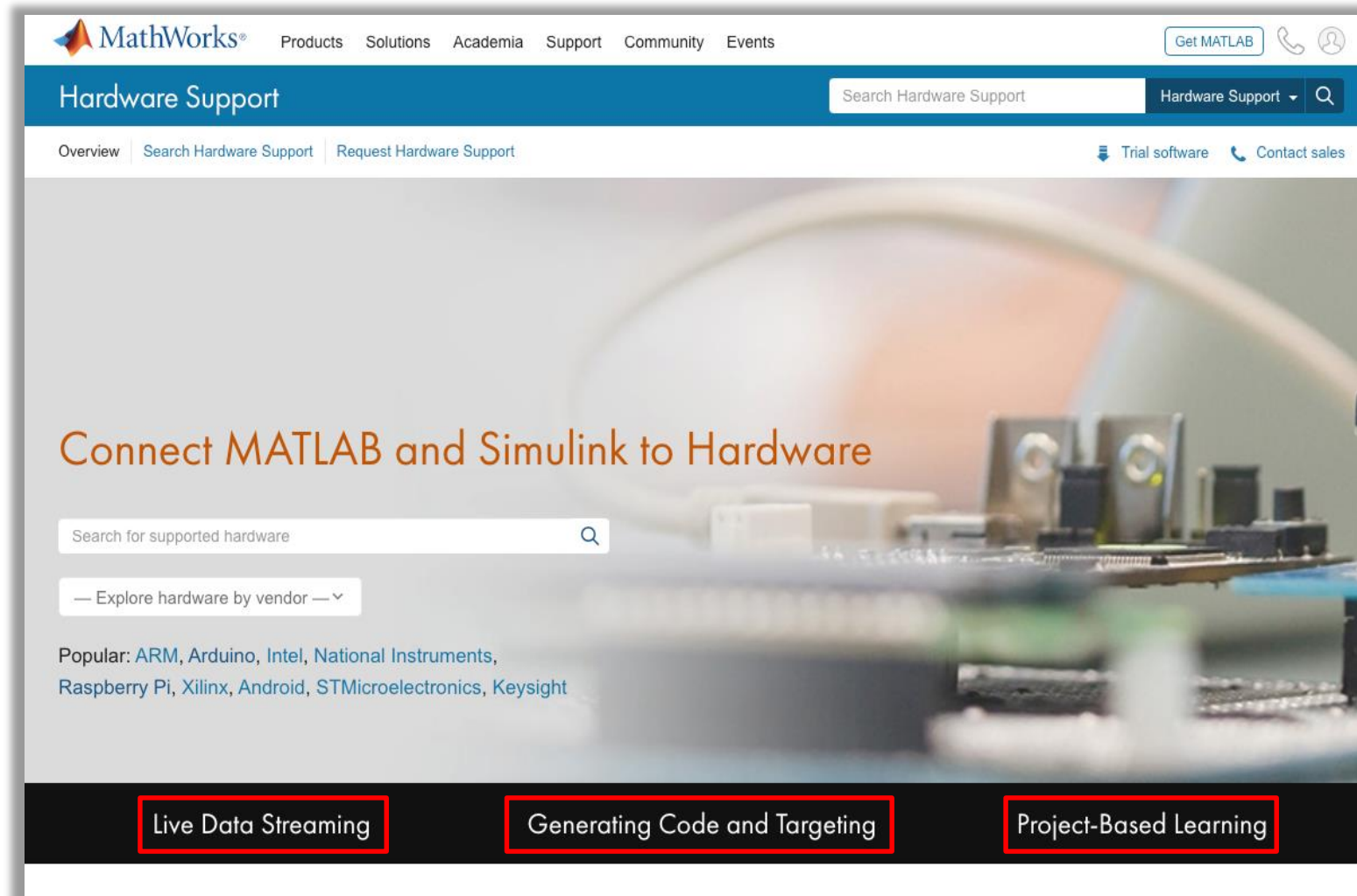


FPGA



Zynq SDR

Find your hardware



MathWorks® Products Solutions Academia Support Community Events

Get MATLAB

Hardware Support

Search Hardware Support Hardware Support

Overview Search Hardware Support Request Hardware Support

Trial software Contact sales

Connect MATLAB and Simulink to Hardware

Search for supported hardware

— Explore hardware by vendor —

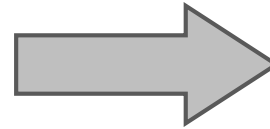
Popular: ARM, Arduino, Intel, National Instruments, Raspberry Pi, Xilinx, Android, STMicroelectronics, Keysight

Live Data Streaming Generating Code and Targeting Project-Based Learning

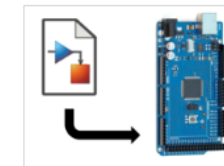
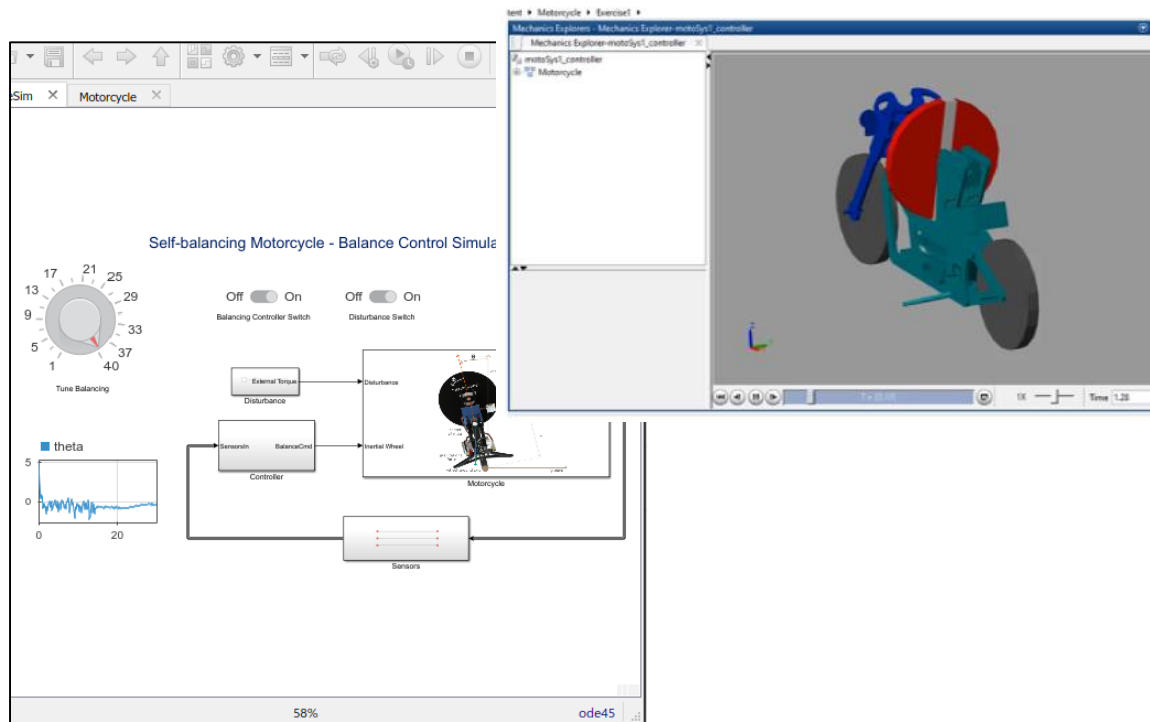
www.mathworks.com/hardware

Simulink supports Model-Based Design workflow

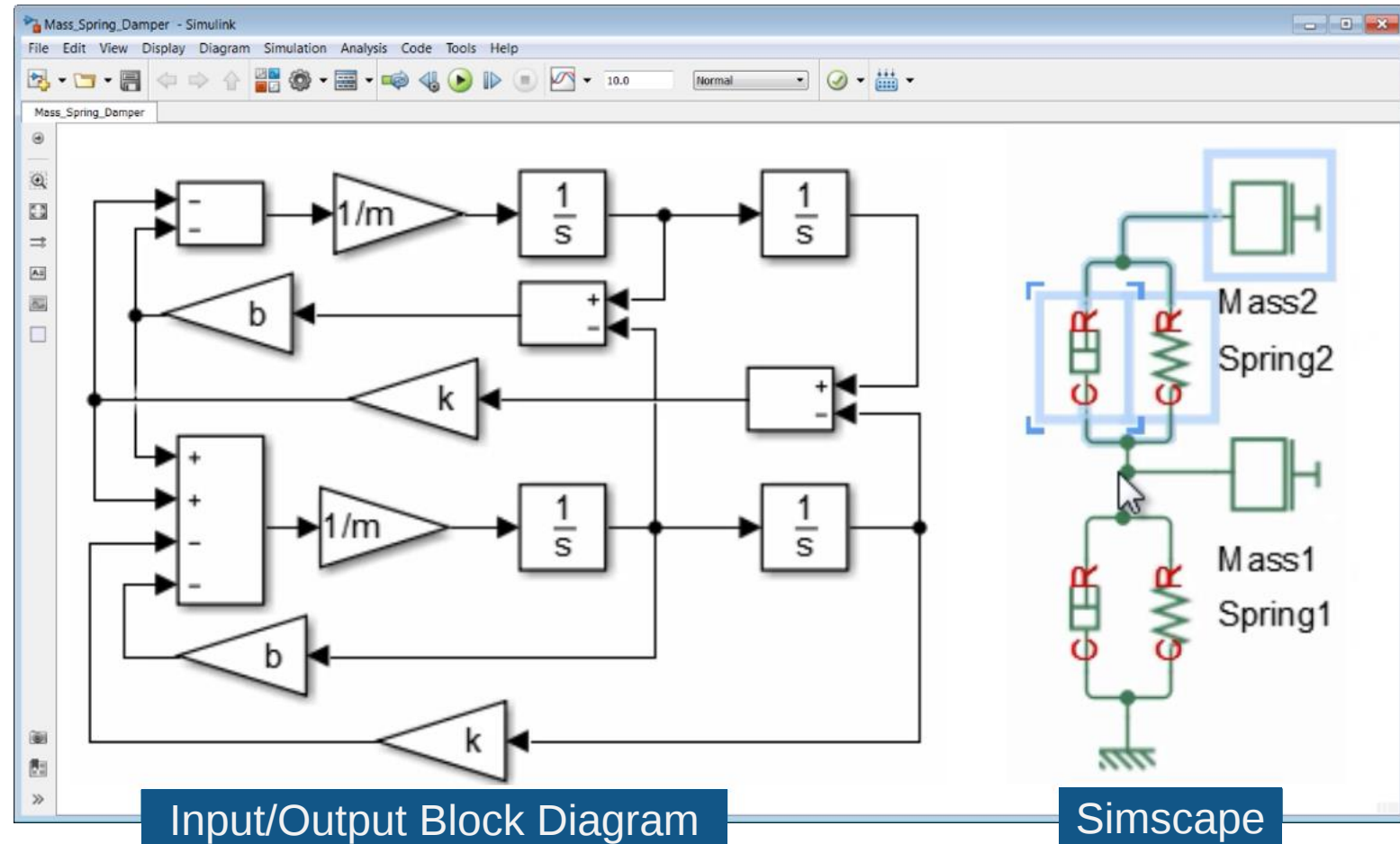
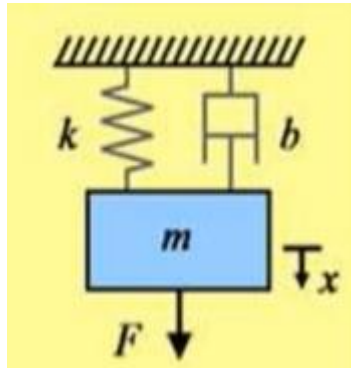
1. Modeling and simulation
(Physical system, embedded algorithms)



2. Generating code and targeting hardware



Simulink vs Simscape



What's Simscape

Simscape

Electrical



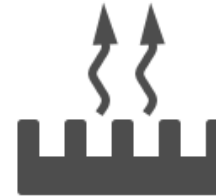
Mechanical



Magnetic



Thermal



Custom
equations
if $v > v_0$
 $i = (v - v_0) / R$
else
 $i = 0$

Hydraulic



Thermal
Liquid



Two-Phase
Fluid



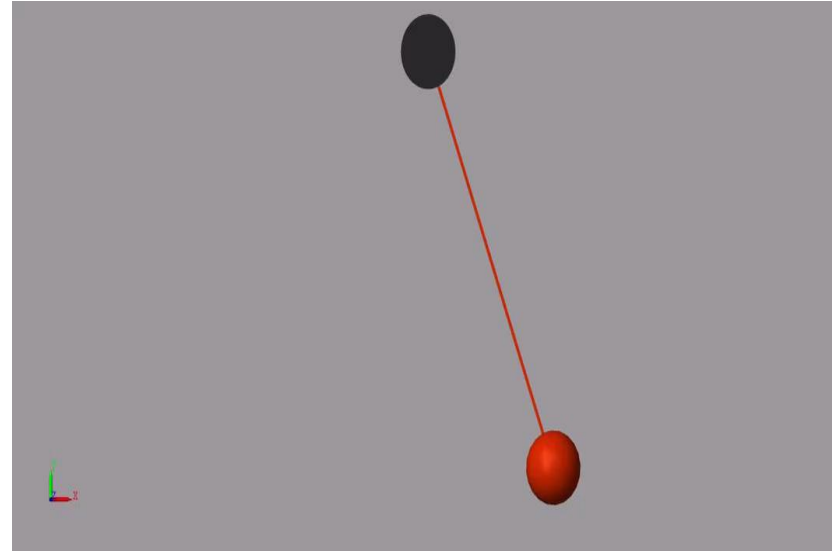
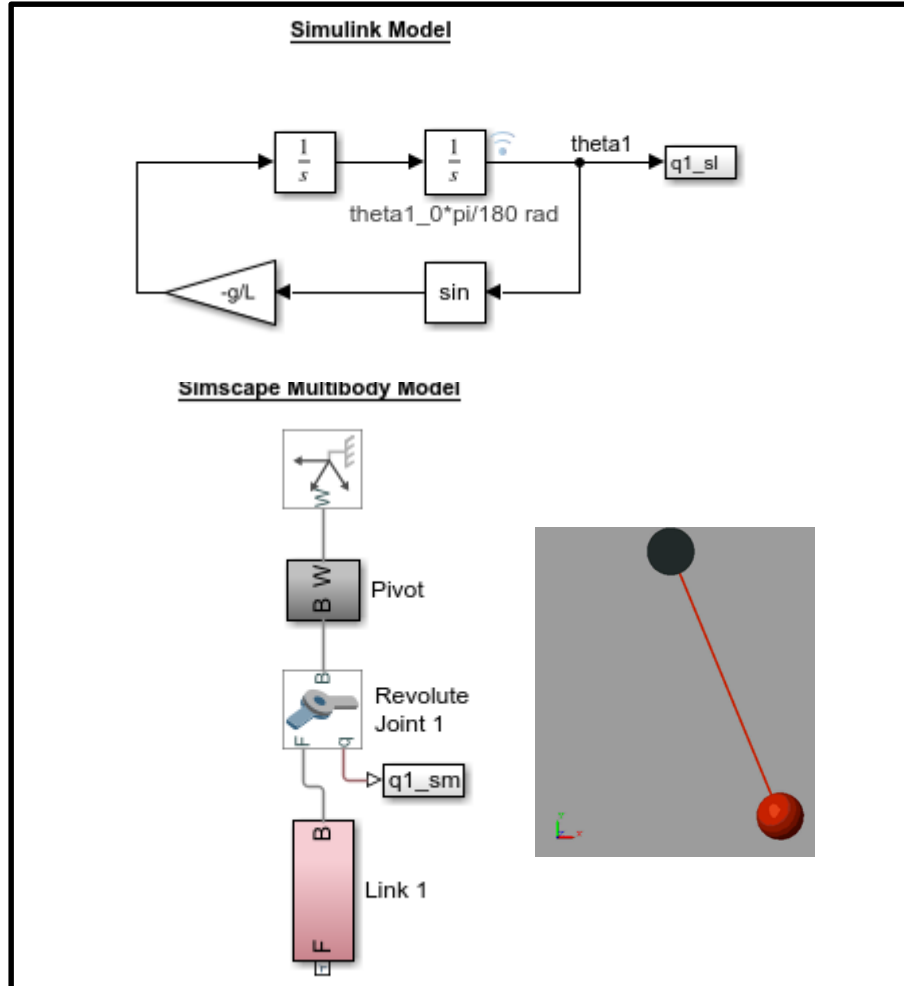
Gas



Moist
Air

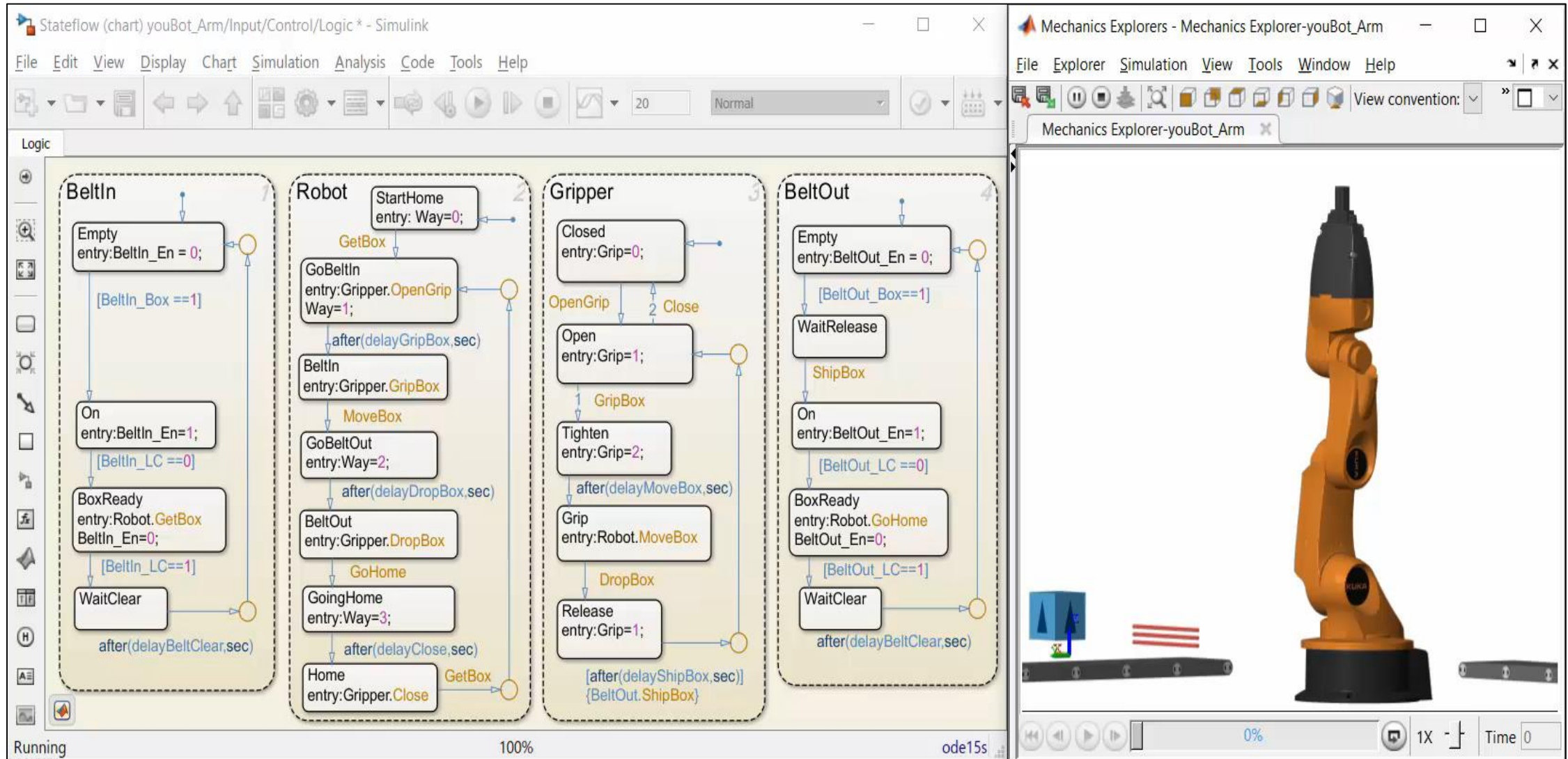


Simulink vs Simscape Multibody



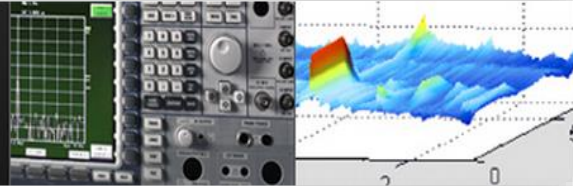
Create your own 3D models or Import CAD models with Simscape Multibody

Controls of Robot Arm

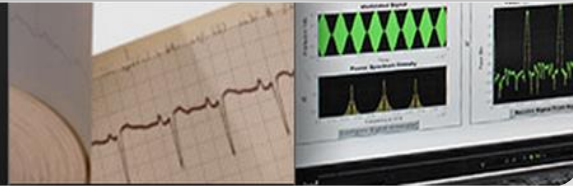


What MATLAB/Simulink does:

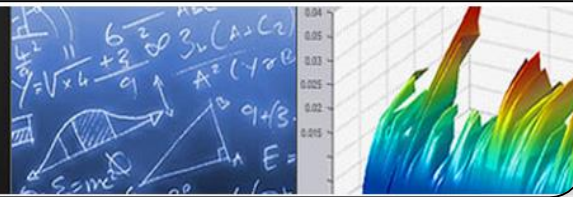
Acquisition des données



Analyse des données



Modélisation mathématique



Développement d'algorithmes



Calcul Parallèle



Conception et simulation de systèmes



Simulation des systèmes à événements discrets



Modélisation physique



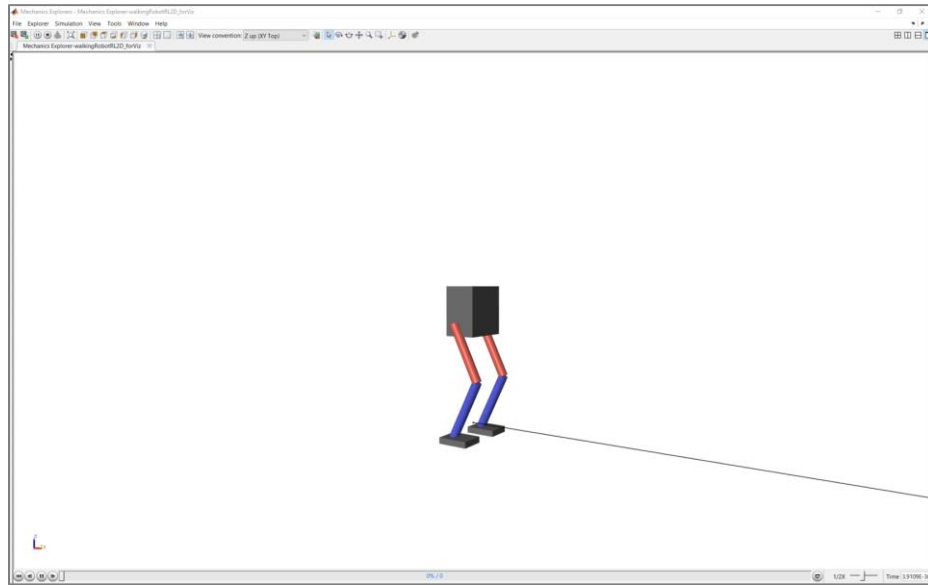
Prototypage rapide



Génération de code embarqué



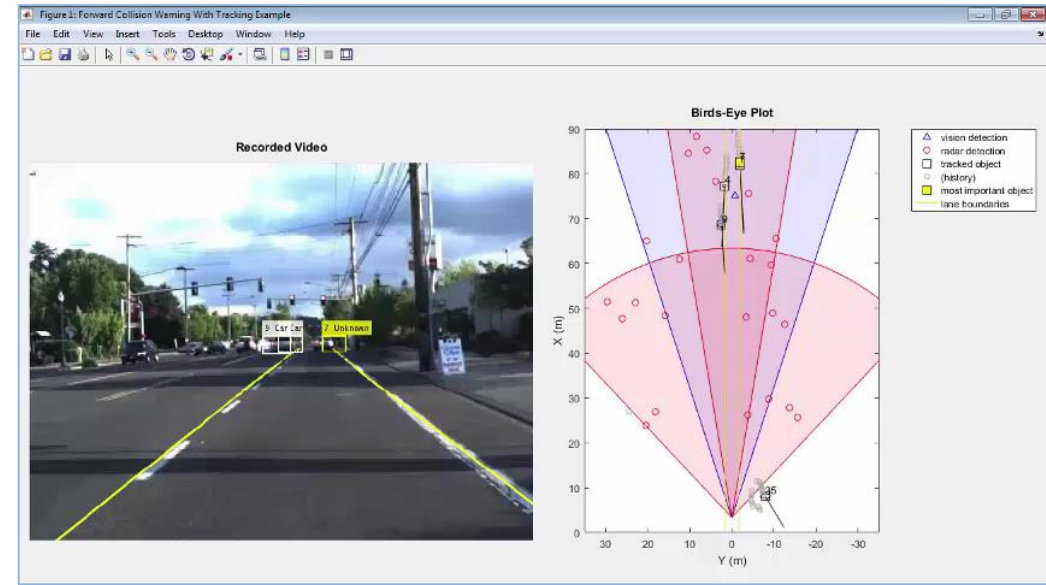
Machine Learning/Reinforcement learning



Deep Learning



Data visualization and sensor fusion



IOT





The image shows the top section of the ThingSpeak website. At the top is a blue navigation bar with the ThingSpeak logo on the left and links for Channels, Apps, Community, and Support in the center. On the right side of the bar are links for How to Buy, Log In (which is highlighted with an orange square), and Sign Up. Below the navigation bar is a large banner with a city skyline at night and a network diagram overlay. The banner contains the text 'Understand Your Things' and 'The open IoT platform with MATLAB analytics.' Below this text are two buttons: 'Get Started For Free' (green) and 'Learn More' (white with a black border). In the top right corner of the banner area, the text 'MathWorks account' is displayed in orange.

ThingSpeak™ Channels Apps Community Support ▾

How to Buy Log In Sign Up

MathWorks account

Understand Your Things

The open IoT platform with MATLAB analytics.

Get Started For Free Learn More



Send sensor data to the cloud.



Analyze

Analyze and visualize your data with MATLAB.



Act

Trigger a reaction.



What industries use
MATLAB/Simulink?

Our Customer Industries



Aerospace and Defense



Automotive



Biological Sciences



Biotech and Pharmaceutical



Communications



Electronics



Energy Production



Financial Services



Industrial Machinery



Medical Devices



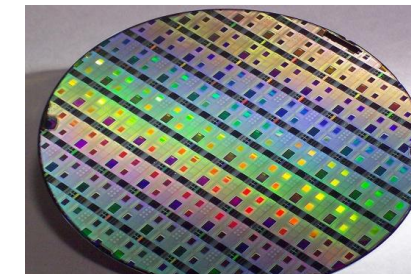
Metals, Materials, and Mining



Neuroscience



Railway Systems



Semiconductors



Software and Internet



Who are our customers?

Our Customers / Key Industries



AIRBUS

EATON
Powering Business Worldwide

Google



LOCKHEED MARTIN

DAIMLER

Honeywell

PHILIPS



ABB

NOVARTIS

Capgemini

**NATIONAL
GEOGRAPHIC**

amazon

Wolters Kluwer

BAE SYSTEMS



BOEING

Genentech



Museum of Science

Continental
The Future in Motion



BOSCH

Pfizer



MERRIMACK
PHARMACEUTICALS



FARADAY

Carnegie
wave energy



ROBECO

Gulfstream

KOREAN AIR

CalPERS

FUJITSU

EMBRAER



xerox

**Hydro
Québec**

mondi

Alcatel-Lucent



**NTT
docomo**



Cognizant

But also



SIEMENS



THALES





Where can I find what industries do with MATLAB/Simulink?

Témoignages d'utilisateurs

MATLAB EXPO

Vidéos et webinars

Rechercher des vidéos

Vidéos

Recherche

Rechercher par produit

MATLAB	63
Simulink	43
Aerospace Blockset	1
Aerospace Toolbox	1
Communications Toolbox	1
Control System Toolbox	7
Deep Learning Toolbox	3

FILTRES PAR

Témoignages des utilisateurs

Tout supprimer

Résultats 1 - 25 sur 74

La SNCF utilise des réseaux neuronaux pour la modélisation de la réponse dynamique d'un véhicule ferroviaire

Pour prendre en compte les réponses dynamiques des trains, la SNCF souhaite modéliser le comportement des véhicules en fonction des paramètres de la voie. La SNCF a envisagé d'explorer la modélisation...

Date: 30 janvier 2017

Corindus Develops Real-Time System for Telerobotic Coronary Intervention

Corindus used MATLAB and Simulink to develop the CorPath GRX platform for catheter control, and Simulink Real-Time to run the real-time application on Speedgoat targets, using Precision Time Protocol to...

Date: 21 Jul 2020

Corindus Vascular Robotics Platform Enables First In-Human Telerobotic Coronary Intervention

Corindus has developed a robotic platform that makes it possible for surgeons to perform PCI and other minimally-invasive cardiac interventions.

Recherche par Type de vidéo

Témoignages des utilisateurs

Recherche par Application

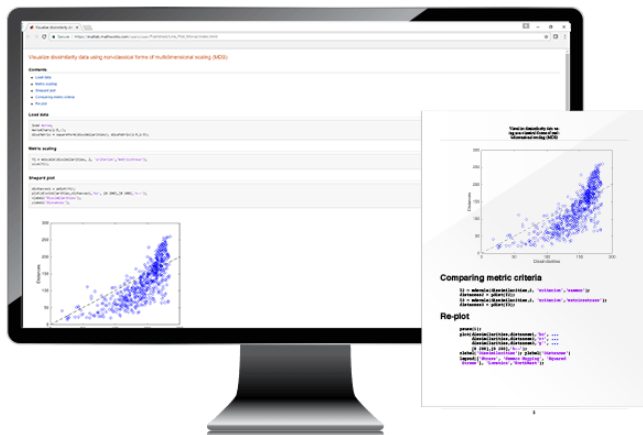
Analyse des données	6
Calcul scientifique	6
Deep Learning	1





How do I access to MathWorks tools?

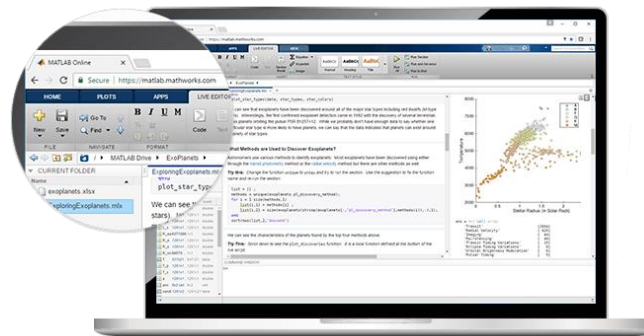
Campus-Wide License: Anytime, Anywhere Access for Faculty, Staff, Students, and Visitors



MATLAB for Desktops

Individual access on personal and university-owned machines

- Installation
- Access to **>100 products**



MATLAB Online

Access MATLAB with a web browser

- No installation
- **Limited products** (see [link](#))
- Uses the **latest version** of MATLAB



MATLAB Mobile

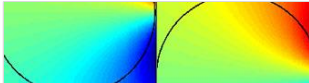
Access MATLAB on iOS/Android devices

- No installation
- Limited functionalities



How do I get trained on MATLAB and Simulink?

Self-paced Online Tutorials (free for Université de Lorraine)

 MATLAB Onramp	 Simulink Onramp	 Deep Learning Onramp	 Stateflow Onramp	 Machine Learning Onramp	 Image Processing Onramp	 Signal Processing Onramp
 Solving Nonlinear Equations with MATLAB	 Solving Ordinary Differential Equations with MATLAB	 Introduction to Linear Algebra with MATLAB	 Introduction to Statistical Methods with MATLAB	 Introduction to Symbolic Math with MATLAB	 Control Design Onramp with Simulink	
 MATLAB Fundamentals	 MATLAB Programming Techniques	 MATLAB for Financial Applications	 MATLAB for Data Processing and Visualization	 Machine Learning with MATLAB	 Deep Learning with MATLAB	

<https://matlabacademy.mathworks.com/>

Generate Certificate or report

MATLAB and Simulink Training



[Training Overview](#) |
 [Find a Course ▾](#) |
 [Get Certified](#) |
 [Training At Your Facility](#) |
 [More ▾](#)

[» My Courses](#)
[? Contact Training](#)

Getting Started

Launch

MATLAB Onramp

Get started quickly with the basics of MATLAB.

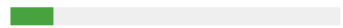
 [View/Share Certificate](#)

 [Settings](#)

Details

Simulink Onramp

Get started quickly with the basics of Simulink.

 13% Unlimited access

 [View/Share Certificate](#)

 [Settings](#)

Launch

Deep Learning Onramp

Get started quickly using deep learning methods to perform image recognition.

 [View/Share Certificate](#)

Details

Stateflow Onramp

Learn the basics of creating, editing, and simulating state machines in Stateflow.

Course Certificate

[View/print certificate](#)

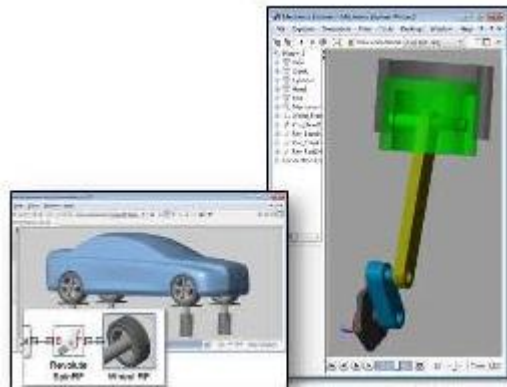
Share certificate:



 shareable link

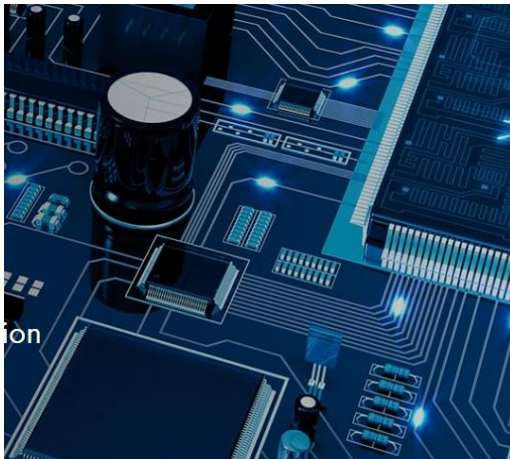
Other online free trainings (series of videos)

- Physical modeling



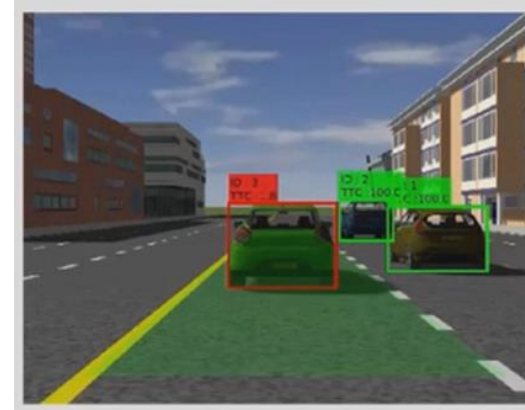
<https://www.mathworks.com/academia/student-competitions/physical-modeling-training.html>

- Code generation



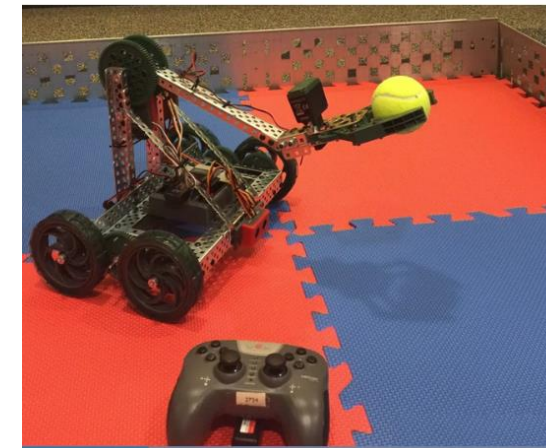
<https://fr.mathworks.com/videos/series/student-competition-code-generation-training.html>

Computer vision



<https://www.mathworks.com/academia/student-competitions/computer-vision-training.html>

Mobile robotics



<https://www.mathworks.com/academia/student-competitions/mobile-robotics-training.html>

Free download (Book & Models)

Modeling and Simulation of Multi-Physics Systems with MATLAB – Simulink (R2015b) for Students and Engineers

Second edition

Introduction to Model-Based-Design



- MATLAB
- Simulink
- Simscape
- SimMechanics
- SimHydraulics
- SimElectronics
- Stateflow



Ivan LIEBGOTT

This book is an introduction to modeling and simulation (8 chapters, more than 90 models and scripts)

Book & models : [Link](#)



Q&A