Chapter 1. MATLAB/Simulink as a Technical Computing Language
• 1.1 Introduction
• 1.2 History of MATLAB Creation and Development
• 1.3 Capabilities and Resources
• 1.4 Aerospace Application Tools
• 1.5 Overview of MathWorks Products
• 1.6 Installing Mathworks Products
• 1.7 MATLAB Online
Fast Facts

- Founded in 1984
- Software installations at over 80,000 business, government, and university sites
- Customers in over 180 countries
- There are more than:
  - 2 million users of MATLAB worldwide
  - 4 million files downloaded from File Exchange on MATLAB Central in 2016
  - 225,000 contributors worldwide to MATLAB Central apps
  - 500 third-party solutions that build on MATLAB and Simulink
  - Over 2,000 MATLAB based books in 25 languages
MATLAB News & Notes - December 2004

The Origins of MATLAB

Jack Little left his job at the consulting company and bought a new COMPAQ portable computer at Sears. The machine had only 256 KB of memory and no hard disc; Jack had to swap 5 1/4-inch floppies to compile programs. Jack and Steve took a year and a half to rewrite MATLAB in C, adding new features they had envisioned. Steve wrote the parser/interpreter, and Jack wrote the math libraries, including translations to C of about a dozen routines from LINPACK and MATLAB. Jack also wrote the first Control System Toolbox. Some of their original code is still used in MATLAB today.

In 1984, Jack, Steve, and I founded The MathWorks. The first mailing address was a rented A-frame cabin where Jack lived in the hills above Stanford University in Portola Valley, California.
Latest Release Highlights

- **R2012b** – new Desktop features (Toolstrip interface that replaced menus and toolbars, Apps gallery presenting apps from the MATLAB product family, redesigned Help system), command line suggestions; new Simulink Editor, smart signal routing and simulation tools
- **R2013b** – new types of data (**table** data container, **categorical** array)
- **R2014a** – new way to display Command History window (pop-up window rather than static window)
- **R2014b** – new graphics system, new types of data (**datetime**, **duration**, and **calendarDuration**), suggested corrections for syntax errors in the Command Window, packaging a sharing tool, big data analysis tools (**datastore** and others)
- **R2016a** – Live Editor to create and run live scripts with embedded output), suggested corrections for syntax errors in the Command Window, App Designer
- **R2016b** – new types of data (**timetable** data container, **timeseries** objects, **string** array), working with missing data (**fillmissing**) and big data (**tall**)
- **R2017a** – MATLAB Online to use MATLAB through the web browser, working with outliers (**filloutliers** and others)
- **R2017b** – MATLAB Drive providing a common free cloud-based storage of 250Mb), plotting in geographic coordinates, **wordcloud** function, contextual hints for function arguments in Live Editor
- **R2018a** – improved graphic (**axes**, **legend**)
- **R2019a** – new tabular data reading functions (**readmatrix** and others), **parallelplot**, graphics export, Reinforcement Learning Toolbox
- **R2019b** – Simulink Toolstrip and other tools, Git integration with MATLAB, map-based data visualization, Live Editor Tasks, function argument validation, Navigation, Robotics System and ROS Toolboxes
Toolboxes and Blocksets
## Aerospace Toolbox

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axes Transformations</td>
<td>Transforms axes of coordinate systems to different types</td>
</tr>
<tr>
<td>Flight Parameters</td>
<td>Computes various flight parameters, including ideal airspeed correction, Mach number, and dynamic pressure</td>
</tr>
<tr>
<td>Quaternion Math</td>
<td>Assures common mathematical and matrix operations on a quaternion</td>
</tr>
<tr>
<td>Unit Conversion</td>
<td>Converts common measurement units from one system to another, and enables time calculations, including Julian dates, decimal year, and leap year</td>
</tr>
<tr>
<td>Environment</td>
<td>Simulates various aspects of aircraft environment, such as atmosphere conditions, gravity, magnetic fields, and wind</td>
</tr>
<tr>
<td>Gas Dynamics</td>
<td>Provides various gas dynamics tables</td>
</tr>
<tr>
<td>Trajectory and Attitude ...</td>
<td>Allows constructing FlightGear animation objects to be used in virtual reality animations</td>
</tr>
</tbody>
</table>
Mathworks for Academia

Teach and Learn with Mathworks
The tools used at more than 5000 universities worldwide.

Students
Use the tools of technical inspiration -- in the classroom and throughout the industry. With MATLAB and Simulink, students can:
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- Communicate their work

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Research Highlights
- Get MATLAB and Simulink for Academic Research
- 7 Reasons to Use MATLAB

Educators
Add MATLAB and Simulink to the classroom, as 5000 universities already have, and you inspire critical thinking and innovation. You also prepare students for careers in industry, where the tools are used.

Mathworks for Academia

Autograder MATLAB Code
Create and grade assignments
MATLAB Online
Access MATLAB from your web browser without installing or installing software
Get started

Contact the American Institute of Aeronautics and Astronautics, Professional Development Programs, 12700 Sunrise Valley Drive, Suite 200, Reston, VA 20191-5807.
1. **MATLAB Student** version includes MATLAB only, with the option to purchase add-on products for a variety of courses and applications.
2. **MATLAB and Simulink Student Suite** includes full-featured versions of MATLAB and Simulink (the student version of Simulink enables you to create models that include over 300 blocks) along with the key functions from:
   - Control System Toolbox
   - Curve Fitting Toolbox
   - DSP System Toolbox
   - Image Processing Toolbox
   - Instrument Control Toolbox
   - Optimization Toolbox
   - Parallel Computing Toolbox
   - Signal Processing Toolbox
   - Statistics and Machine Learning Toolbox
   - Symbolic Math Toolbox

Runs on Windows, Mac and Linux
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Develop data-driven insights that lead to improved designs and decisions.

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Connect embedded devices to the Internet and gain insight from your data.

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- Tutorials

Get Help

- Documentation
- Examples
- Answers

Community

- File Exchange: Find and Share Code
- Blogs: Learn from Experts
- Cody: Play Coding Game
- ThingSpeak: Collect and Analyze IoT data
User Community

An open exchange for the MATLAB and Simulink user community

A place where you can get answers, challenge yourself and others, and share your knowledge. Tap into the knowledge and experience of over 100,000 community members and MathWorks employees.

Ask and Answer  Get & Share Code  Read and Learn  Play  Explore IoT Data

CONTRIBUTORS  ANSWERS PER DAY  DOWNLOADS PER DAY  SOLVERS PER DAY

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Mathworks Training

MATLAB and Simulink Events

MATLAB EXPO 2018
United States
November 6 | San Jose, California

Register
From GPS measurements to ENU measurements: sample code

This code was written in MATLAB

**Step 1: Convert GPS to ECEF**

```matlab
function [X,Y,Z] = l1h2xyzTest(lat,long,h)
% Convert lat, long, height in WGS84 to ECEF X,Y,Z
% lat and long given in decimal degrees.
lat = lat/180*pi; % converting to radians
long = long/180*pi; % converting to radians
a = 6378137.0; % earth semimajor axis in meters
f = 1/298.257223563; % reciprocal flattening
e2 = 2*f - f^2; % eccentricity squared

chi = sqrt(1-e2*(sin(lat)).^2);
X = (a./chi-h).*cos(lat).*cos(long);
Y = (a./chi-h).*cos(lat).*sin(long);
Z = (a*(1-e2)./chi + h).*sin(lat);
```

**Step 2: Convert ECEF to ENU**

```matlab
function [e,n,u] = xyz2enuTest(Xr,Yr,Zr,X,Y,Z)
% convert ECEF coordinates to local east, north, up

phi1P = atan2(Zr,sqrt(Xr^2 + Yr^2));
lambda = atan2(Yr,Xr);

e = -sin(lambda).* (X-Xr) + cos(lambda).* (Y-Yr);

n = -sin(phi1P).*cos(lambda).* (X-Xr) - sin(phi1P).*sin(lambda).* (Y-Yr) + cos(phi1P).* (Z-Zr);

u = cos(phi1P).*cos(lambda).* (X-Xr) + cos(phi1P).*sin(lambda).* (Y-Yr) + sin(phi1P).* (Z-Zr);
```
MATLAB/Simulink: What’s Next?

Event-Based Modeling
- Real-Time Simulation and Testing

Physical Modeling
- Verification, Validation, and Test
- Simulation Graphics and Reporting

Applications
- Control Systems
- Signal Processing and Communications
- Image Processing and Computer Vision
- Test and Measurement
- Computational Finance
- Computational Biology

Parallel Computing
- Code Generation

MATLAB®
- The Language of Technical Computing

Math, Statistics, and Optimization
- Application Deployment
- Database Access and Reporting

SIMULINK®
Simulation and Model-Based Design

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MATLAB Code Generation Tools

Integrate
algorithms with custom software

Prototype
algorithms on PCs

Accelerate
algorithm execution

Implement
algorithms on embedded processor

Prepare → Test → Generate → C/C++ → MEX

MATLAB Code Generation Report

Radar Tracking Using MATLAB Function Block

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Application Deployment Tools

MATLAB
- MATLAB Compiler
- MATLAB Compiler SDK

Deployment Tools
- Standalone Application
- Excel Add-in
- Hadoop
- C/C++
- Java
- .NET
- MATLAB Production Server

Tools
- Develop algorithms in MATLAB
- Package them as Excel add-ins

Flowchart:
1. Add main file
2. Package
3. Optionally

Diagram:
- User
- Group Members
- Suppliers
- Clients
- Collaborators
- Organization

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Simulink Coder & Simulink Real-Time

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Simulink Model V&V Tools

- Collaboration: modeling standards checks
- Track design changes: traceability analysis
- Structural verification: model coverage
- Formal verification:
  - test generation
  - static error detection
  - requirements proving
Access MATLAB Online with your Mathwork’s account at www.matlab.mathworks.com

Enjoy Cloud Storage and Synchronization

- **MATLAB Drive** gives you up to 5Gb (250Gb free) to store, access, and manage your files from anywhere with MATLAB Online
- **MATLAB Drive Connector** enables synchronizing your files between your computers and MATLAB Online, eliminating the need for manual upload or download then
Installing MathWorks Products


Between-release updates

The End of Chapter 1

Questions?