*Think about: Today I want to get ____ out of this event, and right now I'm feeling ____.*

ENGINEERING STUDENT SUCCESS CENTER

# Intro to MATLAB

PRESENTER:

GUILLERMO ANAYA

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# overview

THE IMPORTANCE OF PROGRAMMING

WHAT IS MATLAB

WHY SHOULD YOU USE MATLAB?

MY MATLAB EXPERIENCES

OTHER MATLAB APPLICATIONS

QUESTIONS

# The importance of programming

Solve this system of linear equations

$$x + y + z = 2 \qquad (1)$$
$$2x + 3y + z = 3 \qquad (2)$$
$$x - y - 2z = -6 \qquad (3)$$

By substitution

from (1)

$$x = 2 - y - z \quad (a)$$

From (2)

$$z = 3 - 2x - 3y \quad (b)$$

# Part 2

(a) and (b) together yield

$$z = 3 - 2(2 - y - z) - 3y$$

$$z = y + 1 \quad (c)$$

Plugging (c) into (3)

$$x - y - 2(y + 1) = -6$$

.

.

.

$$x = 3y - 4 \quad (c)$$

# Part 3

Plugging (c) and (d) into (1)

$$(3y - 4) + y + (y + 1) = 2$$

$$\vdots$$

$$y = 1 \quad (e)$$

Using (e) we can solve (c) and (d)

$$x = 3(1) - 4 = -1$$

$$z = (1) + 1 = 2$$

Thus

$x=-1, y=1, z=2$

# Solving with MATLAB

$$x + y + z = 2$$
$$2x + 3y + z = 3$$
$$x - y - 2z = -6$$

Set the following variables for MATLAB

$$A = [1 \quad 1 \quad 1; \ 2 \quad 3 \quad 1; \ 1 \quad -1 \quad -2]$$
$$B = [2; \quad 3; \quad -6]$$

In the command window:

$$xyz = inv(A) * B$$

$$xyz = \begin{bmatrix} -1 \\ 1 \\ 2 \end{bmatrix}$$

x=-1, y=1, z=2

# The importance of programming

Now try to solve this one

$$
\begin{aligned}
2a + 5b + 10c + 20d + 30e + 16f &= 3 \\
12a + 15b + 4c + 13d + 2e + f &= 20 \\
32a + 50b + 67c + 200d + 19e + 20f &= 1 \\
14a + 41b + 18c + 25d + 3e + 3f &= 100 \\
a + 90b + 13c + 35d + 16e + 17f &= 21 \\
3a + 9b + 2c + 17d + 8e + 106f &= 32
\end{aligned}
$$

# Importance of Programming

## Reasons Why We Use Programming

- Automating Processes
- Collecting Data
- Analyzing Information
- Data Management
- Solve Complex Problems
- Sharing Knowledge

# Importance of Programming

Feasibility

Want something done fast, right, and easy

Automation

Have the program do the work for you

Marketability

MATLAB is a tool and a skill

# What is MATLAB?

“**MATLAB** is a programming platform designed specifically for engineers and scientists.” – Mathworks

**MATLAB is short for MAT**rix **LAB**oratory

Higher level language and object oriented

Ideal for its user-friendly interface for plotting and numerical computations

Contains a plethora of “toolboxes” designed for specified fields such as optimization and partial differential equations

MATLAB is highly convenient.

Easy to code.

Extremely user-friendly.

Process large amounts of data.

Large support.

# My MATLAB Experiences

- Homework for classes like
  - Calculus I, II, III, vector analysis, lineal algebra, thermodynamics, Dynamics, etc.
- Creating applications to calculate fatigue and failing stress of materials
- Data Analysis (multiple formats)
- Particle Image Velocimetry (PIV)
- Performing calculations to validate simulations
- Keep track of documents on a server
- Image analysis and manipulation
- Ordinary Differential Equation
- Numerical Methods
- Orbital Mechanics (analyzing orbits, space attitude for satellites)
- Active solar tracker for Concentrated Solar Energy (CSP)

# Orbital Mechanics

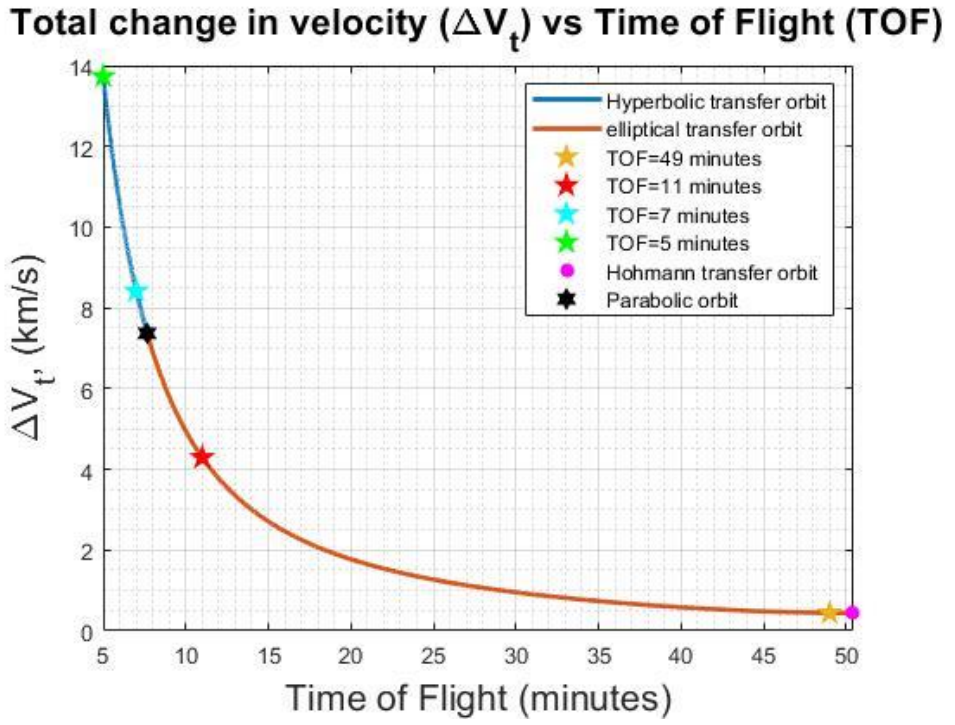
1. An Earth-orbiting satellite is in a 375-km parking orbit. The mission orbit is a 1225-km orbit in the same plane. For each of the orbit transfers below, the initial $\Delta v$ puts the satellite on a transfer orbit or trajectory at perigee. The second $\Delta v$ transfers the satellite from the transfer orbit to the mission orbit. For each of the orbit transfers, determine the transfer orbit (or trajectory) semimajor axis and eccentricity, and the individual and total $\Delta v$'s. Your answers should be in km and km/s.

   a. Time of flight is 49 minutes.

   b. Time of flight is 11 minutes.

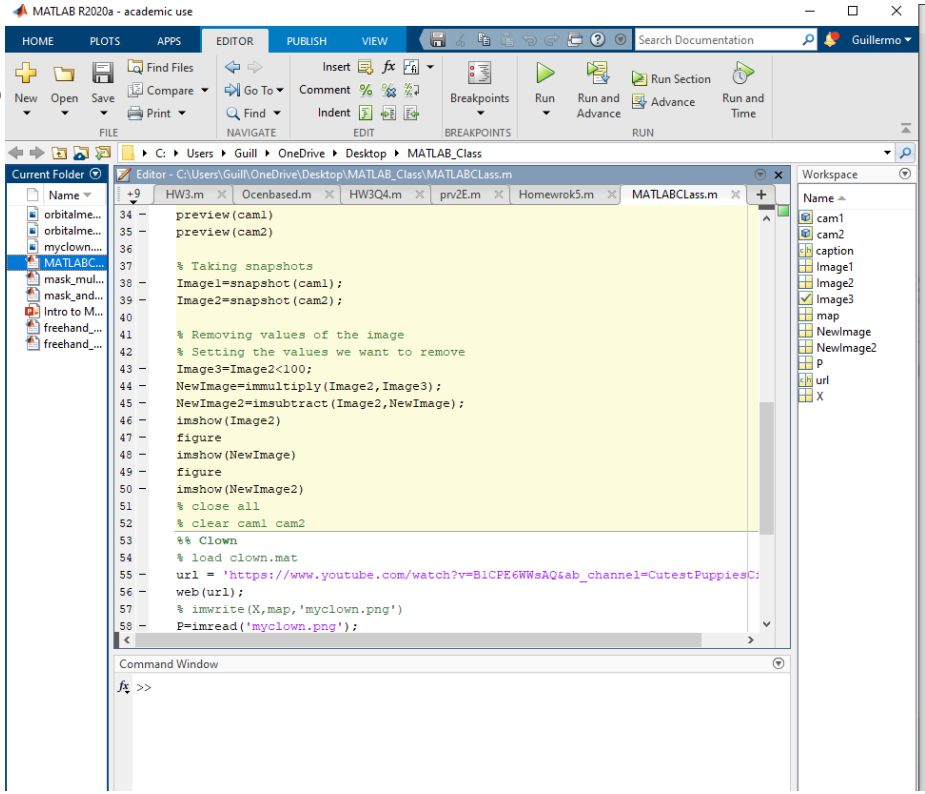
   c. Time of flight is 7 minutes.

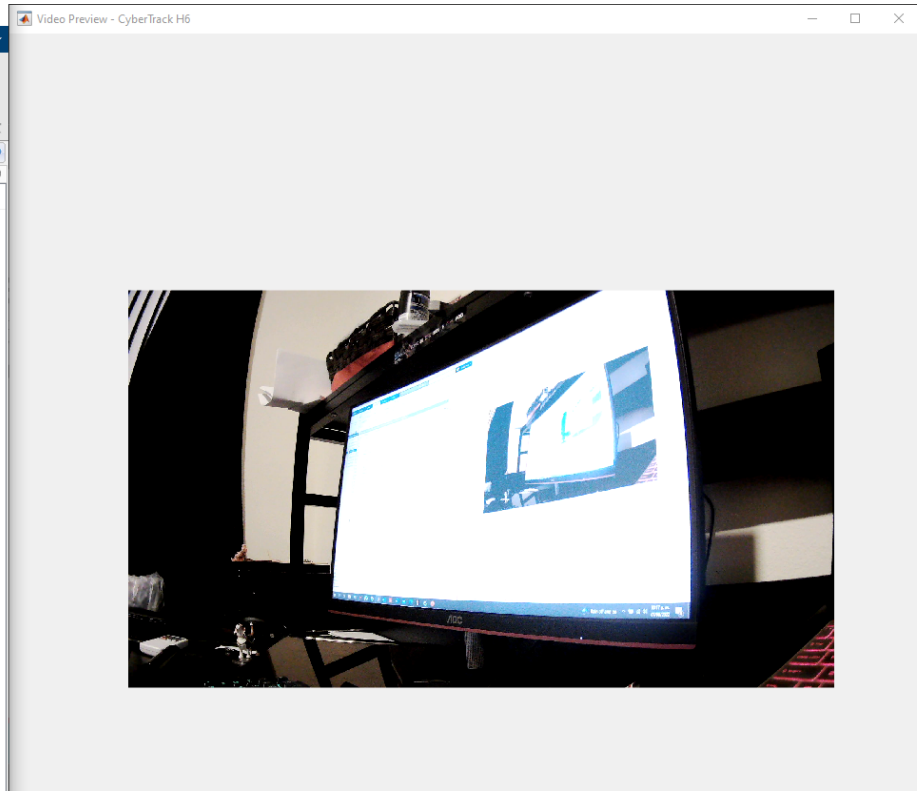
   d. Time of flight is 5 minutes.



# Image Processing

- Obtaining measurements from images
- Opening multiple cameras at the same time
- Taking snapshots
- Enhancing images
- And more…



# MATLAB & Excel

- xlsread to read an excel document into MATLAB
  - Options to read: Sheet, range, headers…
- Xlswrite to write values from MATLAB
  - Options to write: Sheet, range, headers…

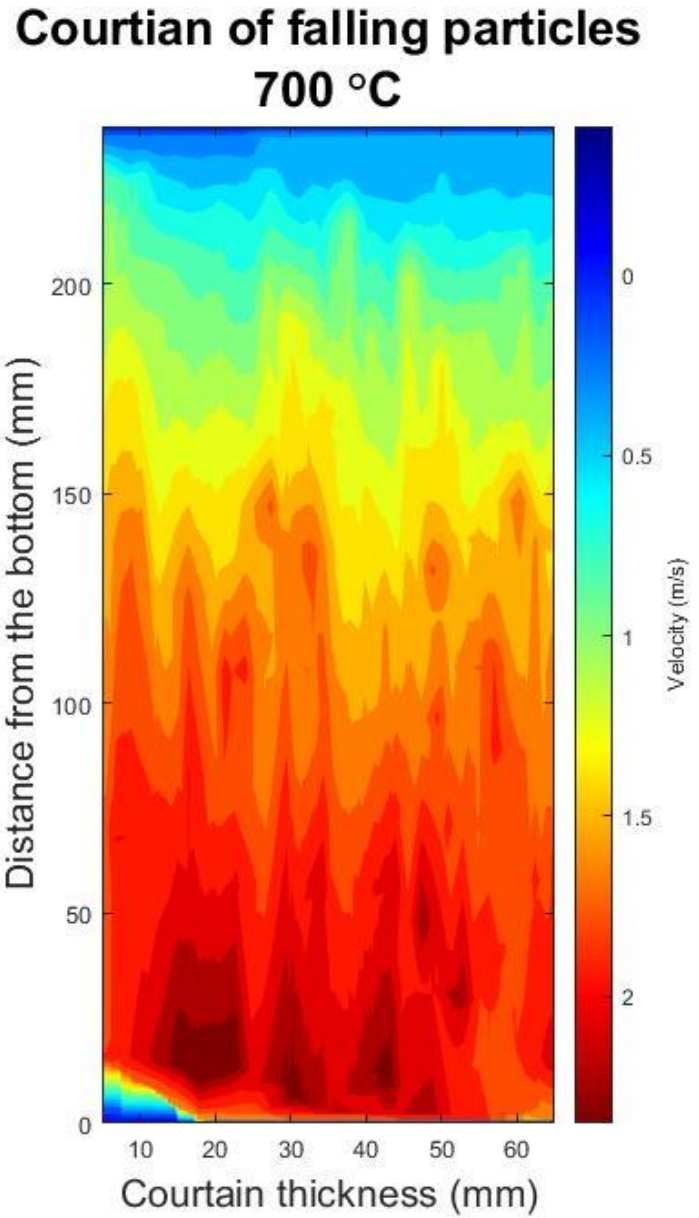
- Helps to organize your data
- More people is familiar with excel than MATLAB

# .DAT Files

- Some Data Acquisition instruments will export the data on a .DAT file
- With MATLAB you can go from this…
- To this

File Edit F

```
TITLE = "B
VARIABLES
ZONE T="Fr
-455.82699
-455.14050
-454.45402
-453.76753
-453.08105
-452.39456
-451.70807
-451.02159
-450.33510
-449.64862
-448.96213
-448.27564
-447.58916
-446.90267
-446.21619
-445.52970
-444.84321
-444.15673
-443.47024
-442.78376
-442.09727
-441.41078
-440.72430
-440.03781
```



Add-On Explorer

Contribute | Manage Add-Ons

R2022a now available

Clear Filters × Search for add-ons

Flight Instruments - Flight Data Playback

Piper PA-24 Comanche Flight Data Display

AIRSPEED KNOTS

ALT 100 FEET

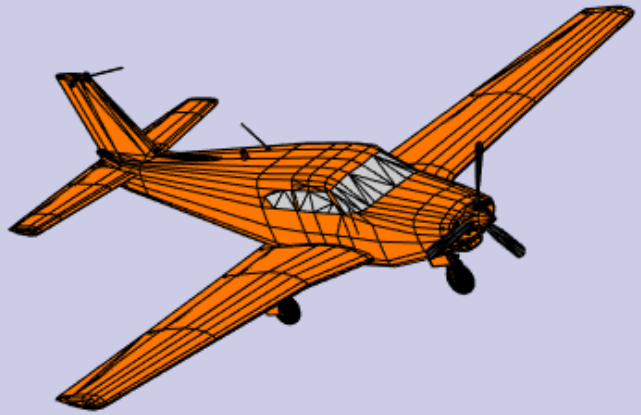
VERTICAL SPEED 1000FT PER MIN

TURN COORDINATOR

NO PITCH INFORMATION

Time: 8.1 sec

Aero.Animation



| | |
|---|---|
| Signal Processing | 113 |
| Image Processing and Computer Vision | 54 |
| Control Systems | 49 |
| Test & Measurement | 21 |
| RF and Mixed Signal | 11 |

**GUI**

Easy to use, GUI based tool to analyze, validate, postprocess, visualize and simulate (micro) PIV

74.4K Downloads

Toolbox containing files and app from Numerical Computing with MATLAB

63.9K Downloads

**Simulation Toolbox**

FEATool Multiphysics - Physics Simulation Made Easy

19.7K Downloads

CFDTool - An Easy to Use Computational Fluid Dynamics (CFD) Toolbox

9.6K Downloads

App Designer Start Page

MATLAB App Designer

Ready to transition your GUIDE apps to App Designer? Open Migration Tool

Open...

Recent Apps

FlightInstrumentsExample

Getting Started | GUIDE Migration Strategies | Displaying Graphics in App Designer | Release Notes

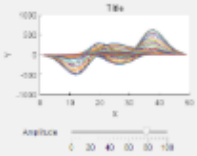
New

Blank App

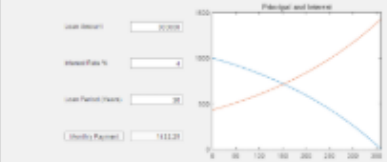
2-Panel App with Auto-Reflow

3-Panel App with Auto-Reflow

Examples: General

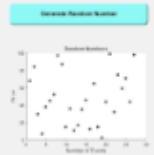


Interactive Tutorial

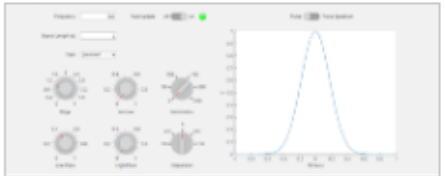


Respond to Numerical Input

Respond to User Selections



Embed HTML Content



Lay Out Controls in a Grid

# Fun things to do with MATLAB

- Make MATLAB talk
- Turn their computer off
- Open a website on their computer
- …

# Other MATLAB applications

THE UNIVERSITY OF NEW MEXICO

Engineering Student Success Center | CAPS

# Start Your Semester Off Right

## Join us for a *FREE*

## Pre-Semester Prep Workshop Series

These interactive workshops will review all foundational material leading up to the specified course so you are better equipped to hit the ground running.

### Synchronous in-person in the ESS suite & virtual via Zoom

| | | |
|---|---|---|
| †College Algebra Review (Pre-Calc/Trig Prep) | Monday, August 15, 2022 | 10 AM - 12 PM |
| †Pre-Calc/Trig Review (Calc 1 Prep) | Tuesday, August 16, 2022 | 10 AM - 12 PM |
| †Calc 1 Review (Calc 2 Prep) | Wednesday, August 17, 2022 | 10 AM - 12 PM |
| Calc 2 Review (Calc 3 Prep) | Thursday, August 18, 2022 | 10 AM - 12 PM |
| †Physics 1 Prep | Friday, August 19, 2022 | 10 AM - 12 PM |
| Chem 1 Prep | Friday, August 19, 2022 | 1 - 3 PM |

*†Attend these sessions & give feedback for access to a general knowledge exam.*

**RSVP is preferred but not required**

**ess.unm.edu/events > August**

@UNMESSCENTER

*or* **through our app - succESS**

Many are open to pre- and full majors and have no citizenship or GPA requirements.

https://goto.unm.edu/mentoring

## MENTORING

- **BE a mentor**
  ...to our incoming students in their transition into the University of New Mexico, the university setting, and Albuquerque.
- **HAVE a mentor***
  ...who is a STEM Professional working in the field to build your network and receive guidance and support.

**This program is open to UNM STEM Majors. Priority is given to Freshmen and Sophomores, but all levels are encouraged to apply.*

https://goto.unm.edu/internships

## INTERNSHIPS

Getting real-world experiences leads to your satisfaction with your undergraduate journey. Gain valuable hands-on experience while making professional connections.

*These programs are only open to School of Engineering Students.*

https://goto.unm.edu/research

## RESEARCH

- **EPICS @UNM**
  ...to give back to the community, earn credit, and gain research experience all at the same time!
- **Student Research Experience Program**
  ...to get hands-on research experience to understand how your courses fit in to real-world applications.

*These programs are only open to School of Engineering Students.*

ENGINEERING STUDENT SUCCESS CENTER

**For more information, or to apply, visit:**
**https://ess.unm.edu/programs/current-students**

# Semester Long Engagement Opportunities

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