

MATLAB for Guidance Navigation and Control Applications in Aerospace Engineering



ODTÜ
METU

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Course description and learning objectives

AE404 Aerospace Engineering Project

- ❑ METU senior year aerospace engineering course
- ❑ Offered in both fall and spring semesters.
- ❑ Students have the option to finish the project within a semester or continue for one year.
- ❑ Weekly meetings with the students.
- ❑ Students can work individually or in groups.

Help students gain “hands on research experience” through conducting a design/research project in Aerospace Engineering.

In addition, the students will prepare a final project report and present it in front of an audience. The students taking the course are expected to

- gain hands-on comprehensive design experience of an aerospace vehicle or a specific part of the vehicle,
- apply their knowledge acquired in aerospace engineering program in the design of an aerospace system and/or research work,
- apply various theoretical/experimental/numerical analysis methods which are widely used in aerospace design work,

develop their communication and presentation skills and get acquainted with a team work environment.

Reason for adoption MATLAB and Simulink Tool



Hands-on experience

- All students do not have access to the actual sensors
- Hands-on experience is necessary to have a sense of what is happening in practice



Complex problems

- Some concepts are easier to teach via visualization and students' own practice
- Within limited timeframe of the lecture (or project) it can be difficult to model everything on your own



Getting ready for industry

- Getting acquainted with real industry problems is necessary for especially 4th grade students
- Up-to-date challenges which can be done on a PC and can be easily modified for real application, if needed

How MATLAB and Simulink were used in the course

MATLAB
Mobile for
Collecting
Sensor Data



Connect to MATLAB Mobile

Connect to a MATLAB® session running on MathWorks Cloud.



Acquire Sensor Data

Acquire data from device sensors – like the accelerometer and GPS – and analyze the data in MATLAB.



Capture Images and Video

Take pictures and record videos and for further processing and analysis.

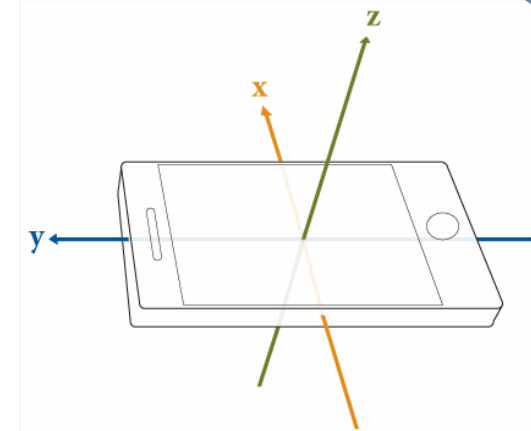


Learn and Teach

Learn and teach math, engineering, and other subjects right from your mobile device.

An example is estimating the phone orientation using sensor fusion

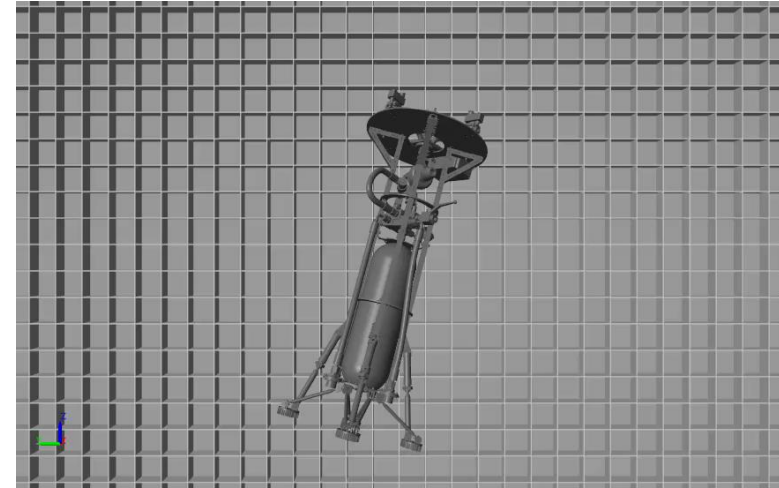
<https://www.mathworks.com/help/nav/ug/estimate-phone-orientation-using-sensor-fusion.html>



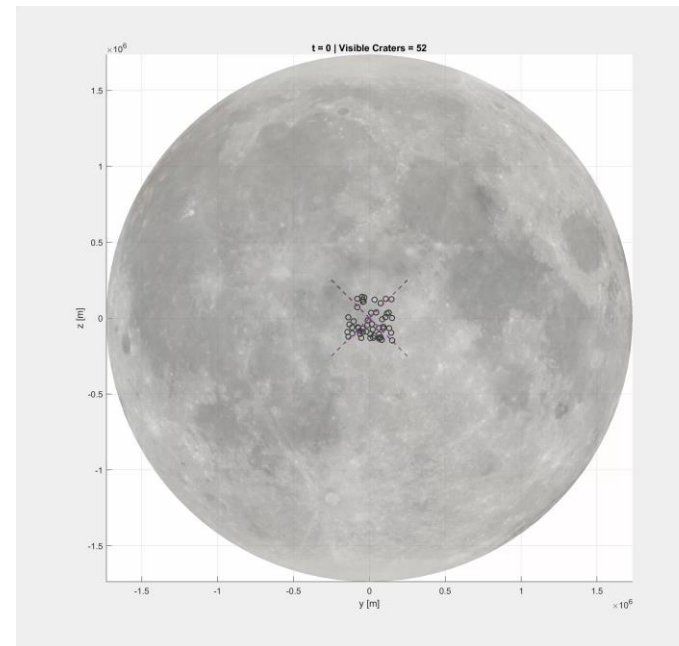
How MATLAB and Simulink were used in the course

MATLAB Toolboxes
for Modelling
Complex Problems
and Visual
Examples

- ❑ Students can use the build-in functions to save time.
- ❑ They can study the examples at their own pace and gain experience.
- ❑ They can easily output the results visually.



Rocket vertical landing example, Sadettin Galip Sezer, 2024



Crater navigation for a moon lander, Atakan Süslü & Betül Rana Kuran, 2022

How MATLAB and Simulink were used in the course

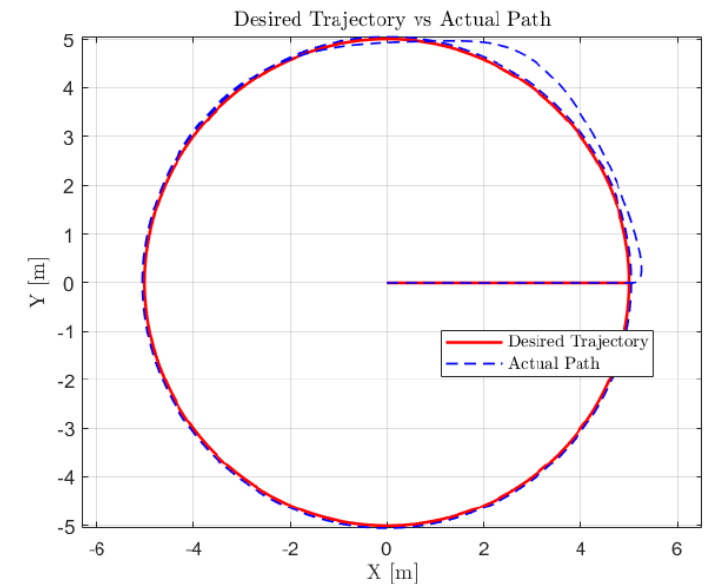
MATLAB and
Simulink Challenge
Projects for
Graduation

<https://github.com/mathworks/MATLAB-Simulink-Challenge-Project-Hub>

**Satellite Collision Avoidance,
Oğuzhan Alperen Ergün & Elif
Berra Çınar, 2024**



Drone Control, Furkan Aker, 2024



- ❑ Industry related up-to-date project examples.
- ❑ Students have extra motivation of getting recognized after successful completion.
- ❑ A PC is sufficient and if the hardware is available can be easily modified for testing in real life.

Benefits / added value of using MATLAB and Simulink

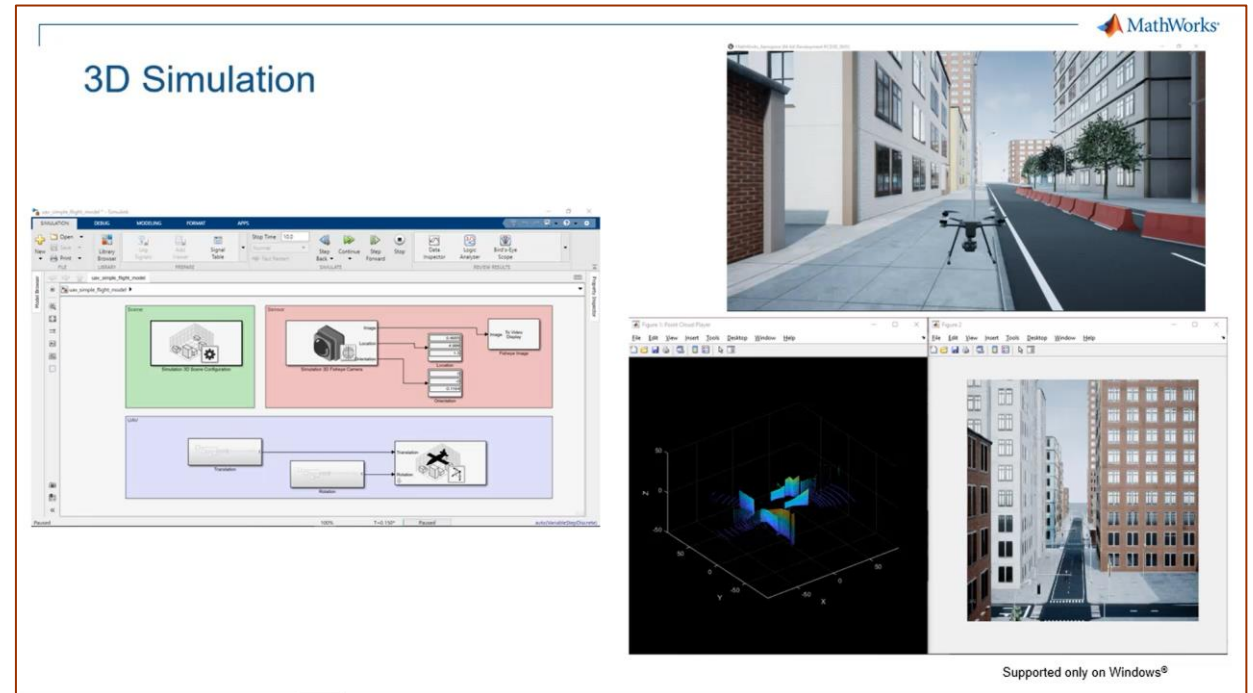
- ❑ Obtaining data from easily accessible devices, foremost the smart phones.
- ❑ Easy software – hardware integration.
- ❑ Easy integration with other tools (e.g. Unreal Engine)
- ❑ Students can work in their own pace.
- ❑ Ease in simulation and visualization.
- ❑ Wide range of toolboxes & examples.



**Moon Surface Simulation, Dide Begüm
Gözel 2024**

Results obtained and personal considerations

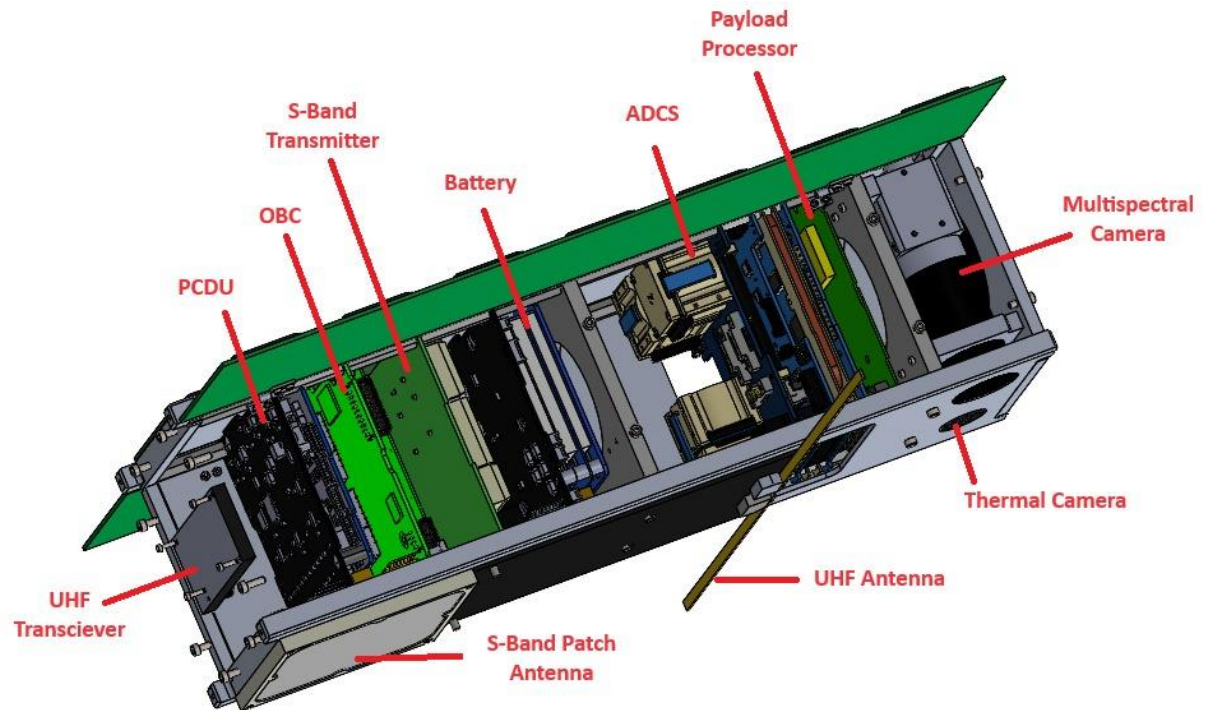
- ❑ Students are satisfied with the outputs.
- ❑ Excellent results within a limited time frame.
- ❑ An opportunity to get acquainted with the industry.
- ❑ Working simultaneously for competitions (Teknofest, VTOL)



Drone Simulation

Future plans

- ❑ Acquiring basic hardware to be used for projects.
- ❑ Using old but intact UAVs for implementation.
- ❑ Integration with physical flight simulator.
- ❑ Trying simulink for Model-Based Systems Engineering for Space-Based Applications in our CubeSat project.



METUCube

Thank You

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