

Stak'em®

A Rocket Science Educational Kit for K-12 and Beyond

A LaSPACE LURA Project 2025-2026



Susannah Donoghue
Computer Science (Sophomore)



Dr. Dhan Fortela
Chemical Engineering



Dr. Ashley Mikolajczyk
Chemical Engineering

University of Louisiana at Lafayette



Short Talk Contents

- About Me
- Why: Motivation of the Project Idea
- What: *Stak'em*[®] - Interactive Rocket Kit
- How: Methods and Current Progress
- What's Next?
- Acknowledgments

About Me

- Name: Susannah Donoghue
- Hometown: Mandeville, LA
- Major: Computer Science
- Undergrad Program Duration: 2024-2028
- Extra-curricular: Violinist in orchestra, Cajun Advanced Picosatellite Experiment, Zydeco Ensemble

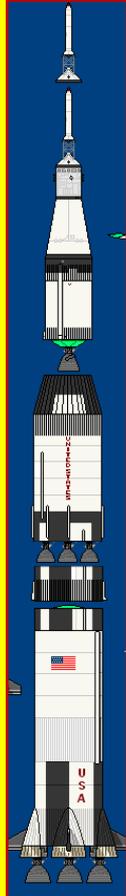


Why: Motivation of the Project Idea

Rocket Science



Saturn V
Rocket



Stages of
Saturn V
Rocket

Stage
3

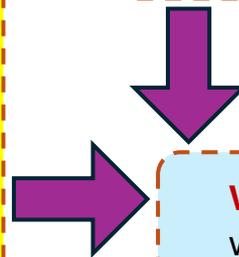
Stage
2

Stage
1

Leisure/Educational



Dr. Fortela
At ARCA Science Day



We asked: What if K-12 students can interact with rocket assembly and testing while learning rocket science?

We introduce: Stak'em®

Why: Motivation of the Project Idea



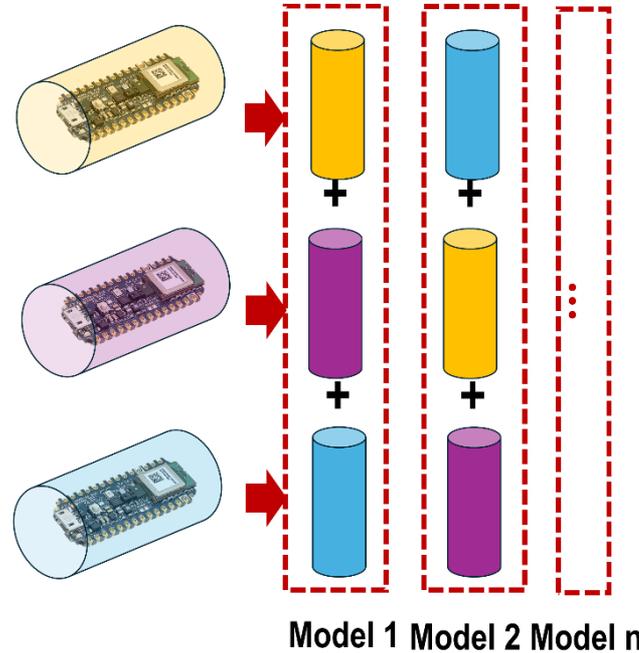
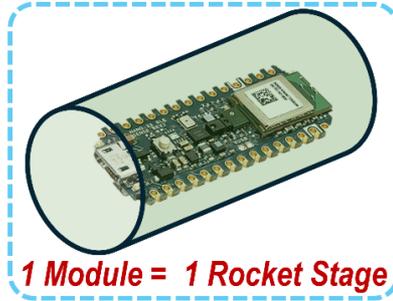
What: *Stak'em*[®] - Interactive Rocket Kit



An educational science kit for K-12

Kit Rocket Modules:

- Stackable (hence “Stak'em®”)
- Arduino-based sensing in a module
- Color-coded (and letter coded) for module-specific configuration that simulate “per stage” configuration of rocket stages
- Wireless connection from Arduino (via Bluetooth) for networking with a computer or mobile device
- Runs with an App to “score” rocket (1) assembly correctness and (2) launch height



The plastic casing of each module has snap-fit feature to stack them together.

What: *Stak'em*[®] - Interactive Rocket Kit

General Procedure

Starts with a Challenge:

- No. of Players/Teams
Competing: 1-10 (or more)
- App will randomly assign rocket configuration for each module (color-coded & letter-coded)
 - Physical dim.-based: weight, height, diameter, etc.
 - Fuel Phase-based: solid fuel, liquid fuel
 - Module type-based: fuel module, crew module, etc.
- Objectives are: (1) stack the modules correctly, and (2) launch the rocket via a pressure-based system.

Make a Rocket:

- Plan
- Stack modules
- Set/fix rocket in a launch system
- Make sure the App is communicating with the rocket wirelessly

Launch the Rocket:

- Launch!
- Check score in the App

Mobile



Computer



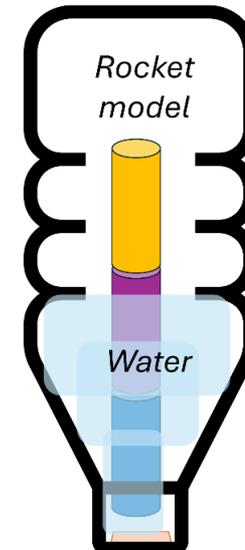
***Stak'em*[®] App**



**Score = [90% Assembly Rating]
+ [10% Launch Height Rating]**

Suggested Launch Setup

Plastic bottle



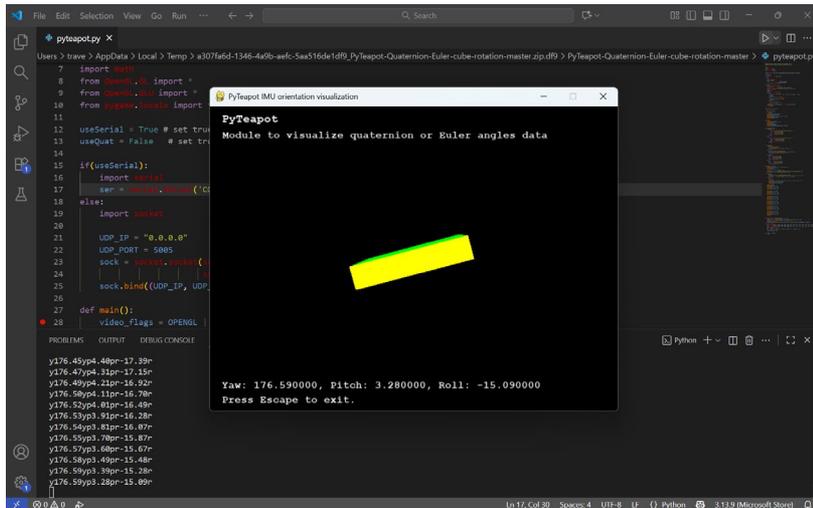
Air pressure system
(snap-tight lid
connection, hand
pump-driven, etc.)



Note: % in score items can be varied

How: Methods and Current Progress

- Using PyTeapot to get rudimentary position/orientation info
- Madgwick filter for yaw, pitch, and roll
- Snap mechanism for Arduino Nano container/physical rocket
- Next moves: relative position to other nanos, bluetooth capabilities

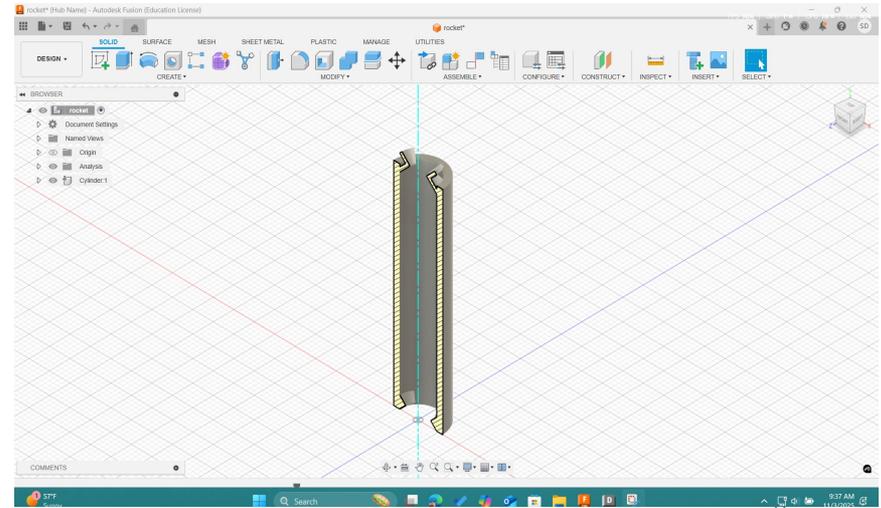


```
7 import sys
8 from queue import Queue
9 from queue import Empty
10 from pyserial import Serial
11
12 useSerial = True # set true
13 useQuat = False # set true
14
15 if (useSerial):
16     import serial
17     ser = serial.Serial('/dev/ttyUSB0')
18 else:
19     import socket
20
21 UDP_IP = "0.0.0.0"
22 UDP_PORT = 5600
23 sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
24 sock.bind((UDP_IP, UDP_PORT))
25
26
27 def main():
28     vlibo_flags = OPENGL
```

PyTeapot IMU orientation visualization

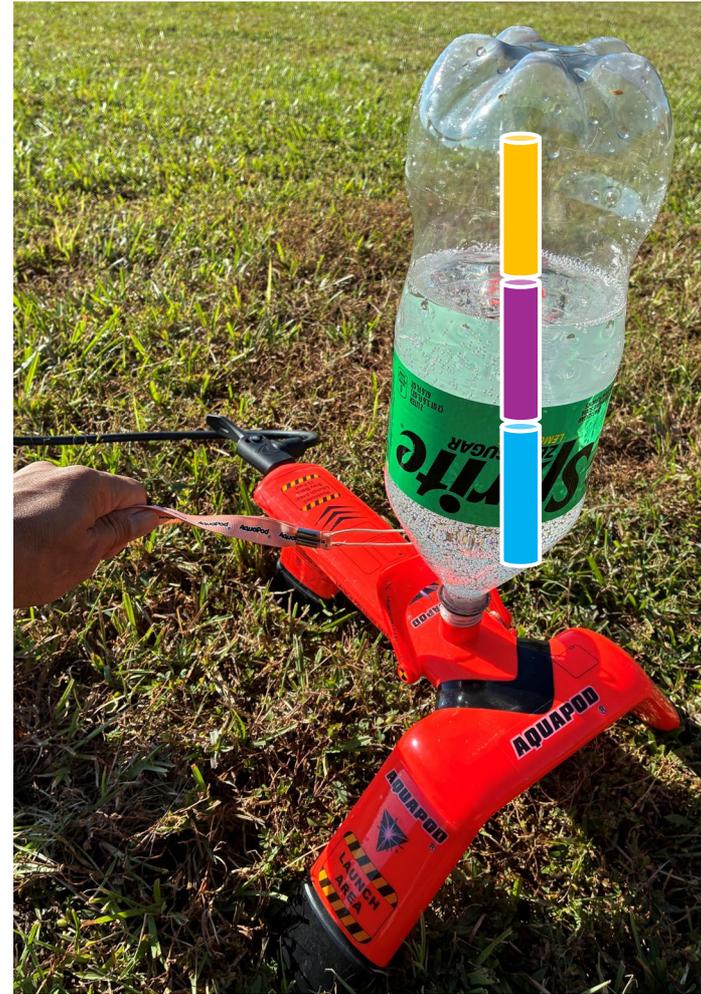
PyTeapot
Module to visualize quaternion or Euler angles data

Yaw: 176.590000, Pitch: 3.280000, Roll: -15.090000
Press Escape to exit.



What's Next?

- Integration of modules with the App.
- Prototype system's first successful demo.
- Trial runs by kids/students.



Acknowledgments



- We appreciate the support of LaSPACE through this LURA grant.
- Some of the foundational ideas and questions stemmed from the Principal Investigator's involvement in the annual Science Fair at Acadiana Renaissance Charter Academy (ARCA), a K–12 school in Youngsville, Louisiana.

Thank you!
Questions?