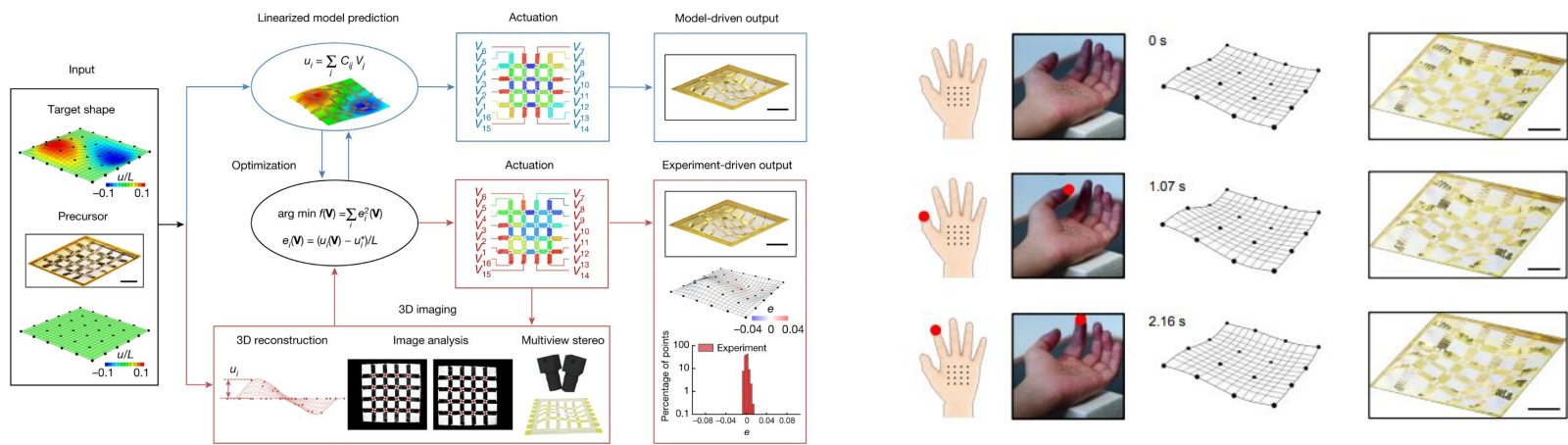




Robotics Portfolio

I am **Yuxin (Kyle) Pan**

This portfolio presents a selection of the projects that I delivered in the domain of robotics and mechatronics.



1

Self-Evolving Robotic Surface

As a recipient of **National Science Foundation Graduate Fellowship** on artificial intelligence (AI) for materials science research at *Duke University*, I worked on a robotic morphing surface with evolving inverse design.

Published on **Nature***

* Bai Yun, Heling Wang, Yeguang Xue, **Yuxin Pan**, Jin-Tae Kim, Xinchen Ni, Tzu-Li Liu et al.

"A dynamically reprogrammable metasurface with self-evolving shape morphing."

Nature 609, 701–708 (2022)

2

AUV Autopilot Development

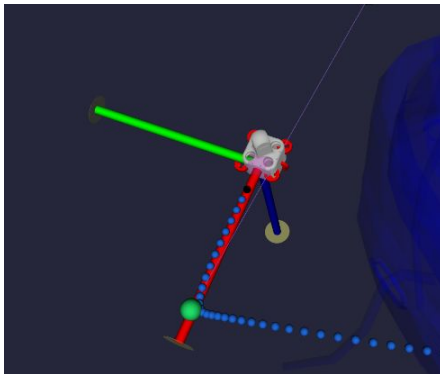
Enable autonomy for a revolutionary micro underwater vehicle (AUV).

At **Advanced Navigation** Pty Ltd, Australia.



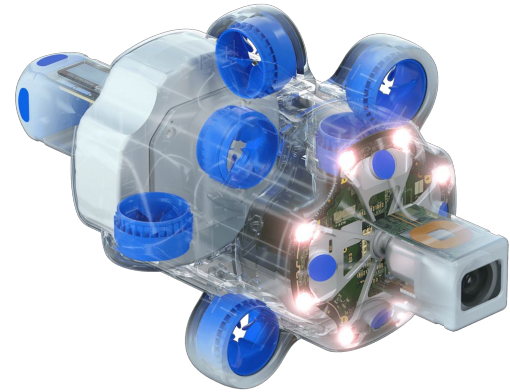
AUV Autopilot

- Kinematics and dynamics **modeling** of the autonomous underwater vehicle Hydrus
- Autopilot **control** scheme design with linear and optimal controller for vehicle stabilization and autonomous navigation, achieved average 2° tracking error



AUV Embedded System

- Conducted embedded programming of **real-time autopilot** module in C++ and FreeRTOS on Xilinx, with integration of IMU, brushless thrusters, and USBL acoustic positioning
- Performed ROS/Gazebo hardware-in-the-loop **simulation** with 3D kinematics and hydrodynamics



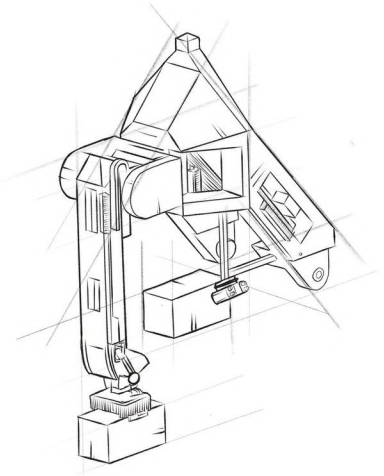
Embedded sensor integration

3

Bricklaying Robot

State estimation/sensor fusion and numerical control programming for world's first fully-automated bricklaying robot.

At **FastBrick Robotics**, Australia.



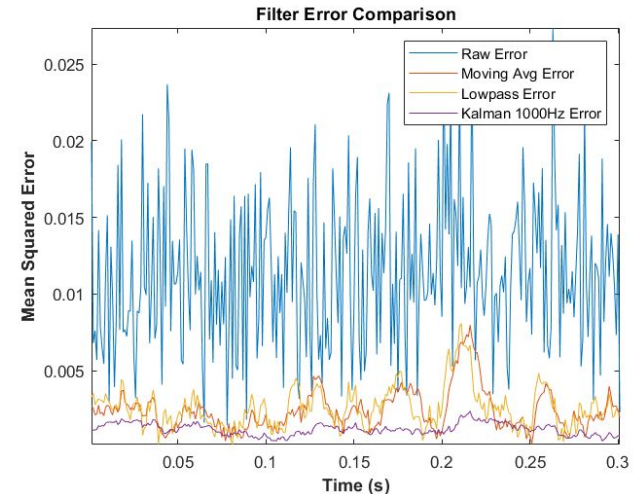


Robotics Engineering

- Developed and commissioned the world's first **autonomous robotic bricklayer** with the focus on layhead electromechanical control
- Designed and implemented **sensor fusion** (LIDAR, encoder, IMU) framework based on Kalman filter that achieved 0.002% positional error
- An open-source version of the multi-sensor Kalman filter fusion can be found here: [GitHub](#)



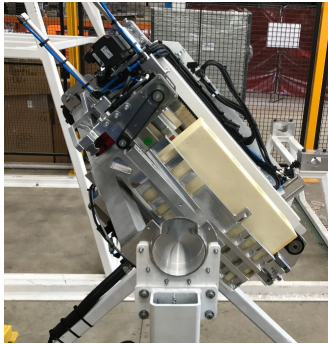
Dynamic Stabilization
of robotic layhead





Control System Engineering

- Programmed and commissioned the **computer numerical control** on layhead module with 0% downtime
- Optimized hydraulic system dynamics for **real-time** robotic boom control in Beckhoff TwinCAT automation



Layhead module

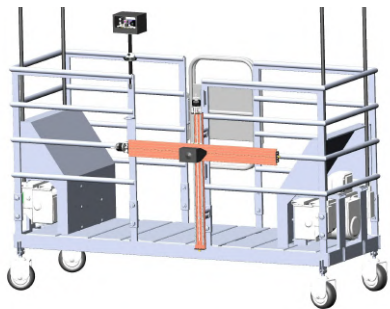


Robot commissioning



In-house testing

- Executed advanced kinematic modeling and **simulation** for the robotic manipulator in V-REP
- Participated in Hadrian-X milestone as engineering operator



4

Deep Learning Based Multi-sensor Building Diagnostics Device

Designed and deployed a building diagnostics device.

Scholarship Intern at **Arup Group**.
Sydney, Australia, 2018.

ARUP

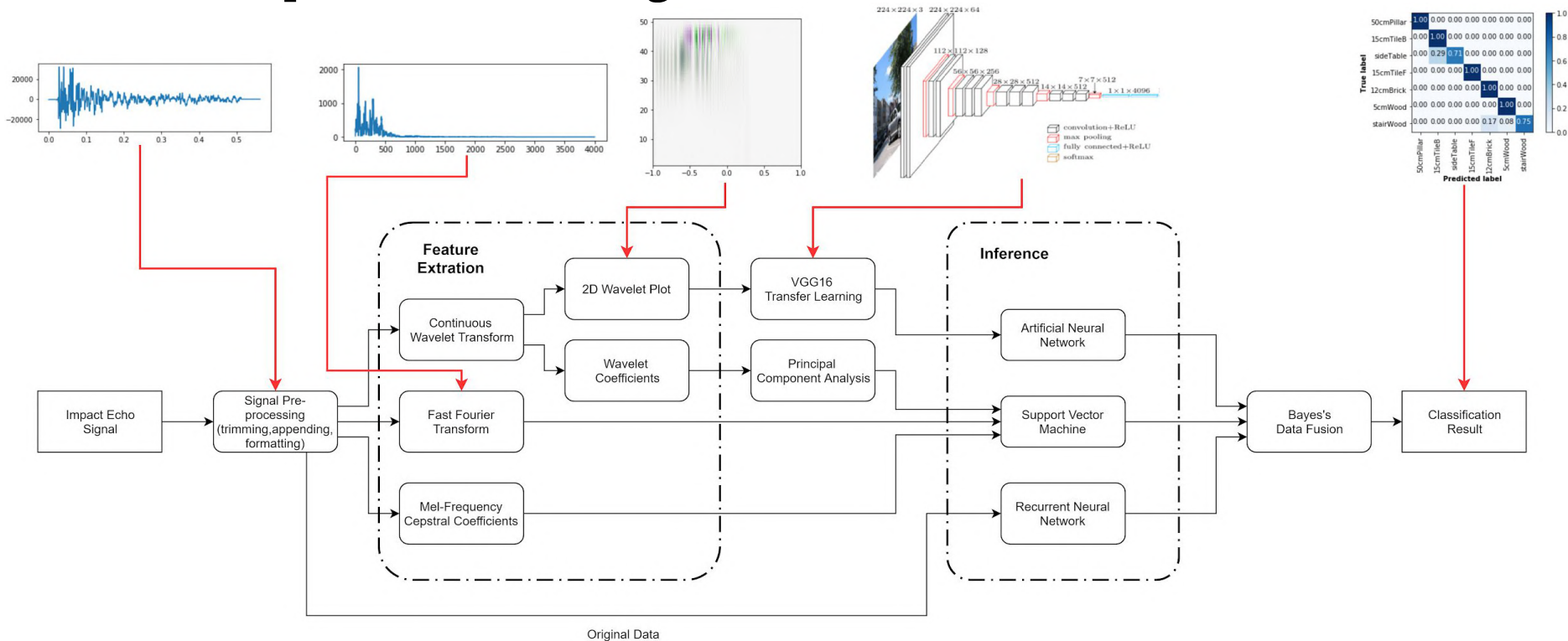


The **sensor suite** I developed including LIDAR, color/thermal camera, impact echo tester, and web interface



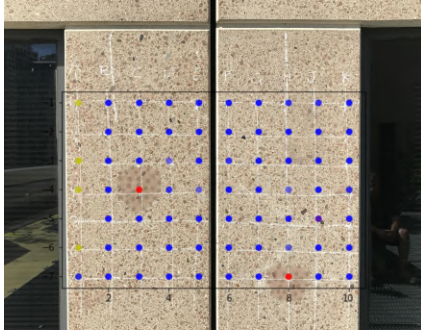
Signal Processing and Supervised Learning

- Incorporated **deep learning** data-driven model (RNN) with less than 0.4% false negative rate



Real-world Validation

Identified 3 previously undiscovered defects, results verified by field engineer via destructive testing



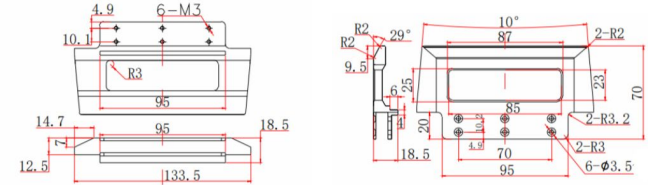
Impact-echo calibration field on commercial building



Field engineer acquiring data with my developed system

Mechanical Design

Prototyped in Solidworks with CAD and thermal simulation

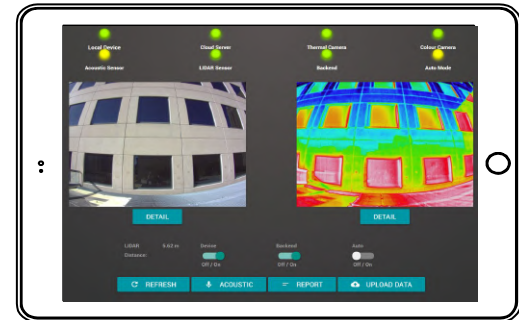


Full Stack Programming

Real-time cameras streaming, user feedback, and deep learning inference

Frontend with JS RESTful API, backend with Flask

Hosted on AWS cloud ([AWS Certificate](#))



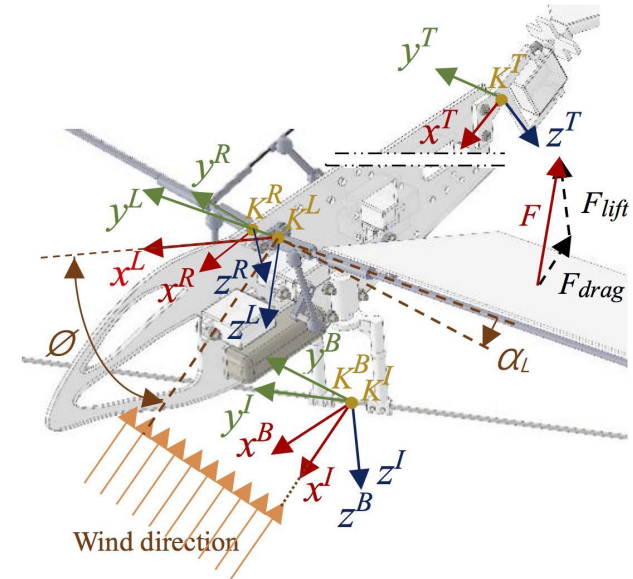
5

Bio-mimicking Robotic Seagull

Research at **Australia Centre for Field Robotics**.

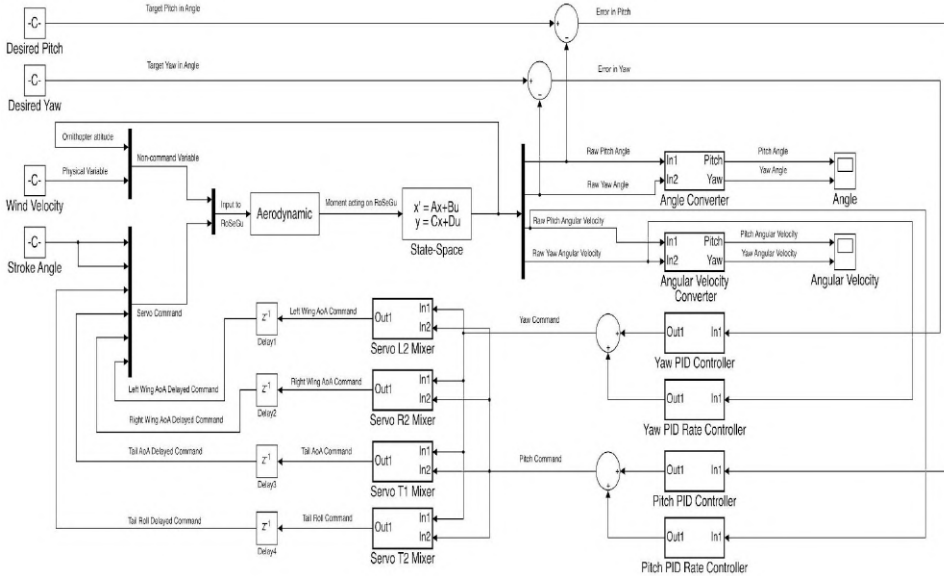
Scientific results published on
[*Australasian Conference on Robotics and Automation*](#)*

*Pan, Yuxin, and Ali Haydar Gökdoğan. "Quasi-Static Balance of a Bioinspired Robotic-Seagull Ornithopter Perching on a Wire." Australasian Conference on Robotics and Automation (2017)



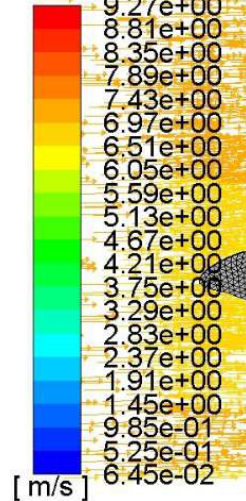


Seagull Perching Simulation



Dynamics and Control

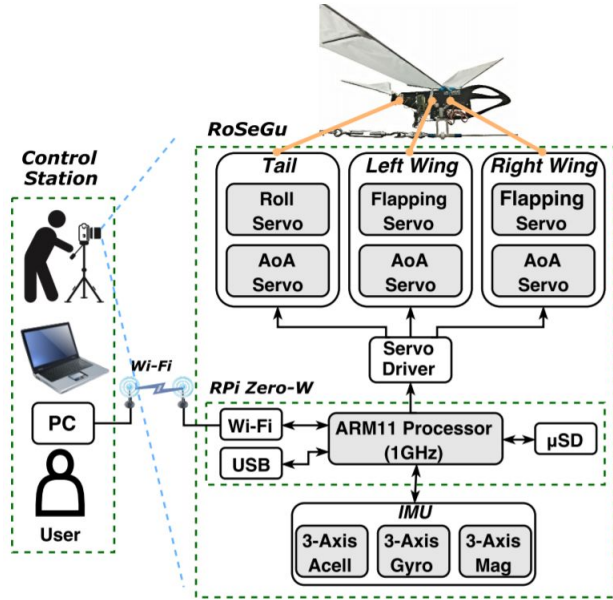
vector-2
Velocity Magnitude



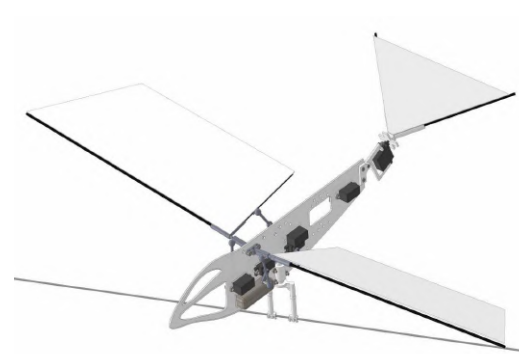
ANSYS Fluid Study



Prototyping of robotic seagull balancing



Hardware Architecture



Prototype

6

USV for Marine Science

Deployment of WAM-V and Kingfisher unmanned surface vessels (USV).

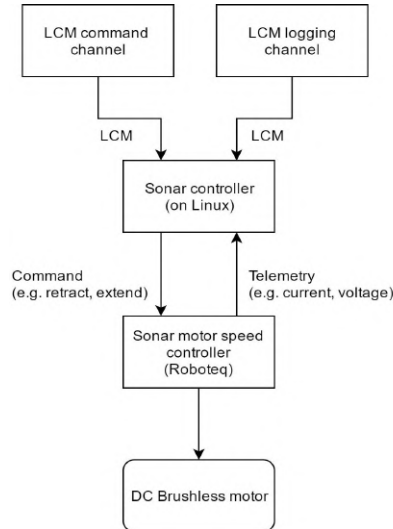
Supported by research scholarship at
Australian Centre for Robotics.





Vessel Control

- Developed the sonar control submodule on WAM-V via RS-232 interface
- Navigation and control real-time system programming in ROS



```
Press Ctrl-C to interrupt
Now checking log file paths under image in /tmp...
started rosbridge server http://localhost:4577/
ros_core version 1.12.11

LOGGING
*****
PARAMETERS
  /use_sim_time: false
  /use_sim_time: true

INFO
starting new master
process[Master]: started with pid [1189]
INFO: master_heartbeat_monitor[1189]: heartbeat
process[Master]: started with pid [1190]
[ctrlc] core server [running]

ussubowl@kingfisher~$ catkin_ws
[core] [11866091.46142]: left: 0.0s
[core] [11866091.52102]: [Ultrasonic_200_1186609082] recvLevel: Longitude: 13.1170925, [E]Latitude: 33.5337091, [E]Altitude: 11.8660910
[core] [11866091.52102]: [Ultrasonic_200_1186609102]: recvLevel: Longitude: 13.1170925, [E]Latitude: 33.5337091, [E]Altitude: 11.8660910
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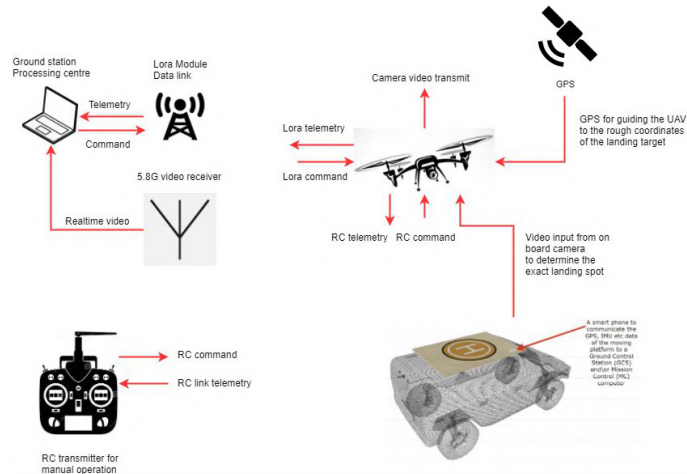


7

Autonomous Tracking UAV

Moving target tracking with autonomous quadcopter
At **Australia Centre for Robotics**

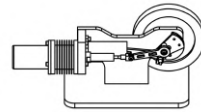
- Developed fully customized autonomous vehicle with integration of 2DOF tracking gimbal
- Deployed high-level path planner for auto-landing
- Created robust computer vision based landing pad target tracking pipeline
- Achieved tracking error within 10% of glide slope



8

Heat Engine

Mechanical Design and Manufacturing

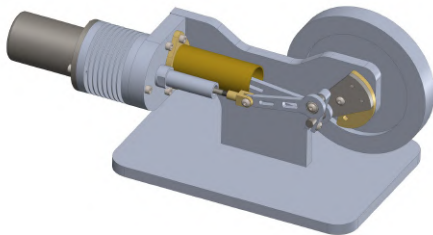


A heat engine designed in Solidworks and machined from raw aluminium stock

At *University of Pennsylvania*, United States

CAD Design

Designed and modeled the heat engine from scratch in Solidworks



Manufacturing

Manufactured the engine from raw stock at university lab utilizing mill, lathe, and drill



Validation

Test speed reached **1100RPM**





9

Outreach

Robotic Material Workshop

- Lead organizer of a full-day workshop for high school students from underrepresented minorities
- Drew sponsorship from Step Up to STEM and Duke Material Initiative totalling \$3000



Robotic Material
WORKSHOP

GET SIGNED UP NOW!!!

.....
.....
.....

NI LAB TOUR
MARCH 4
3:00 AM - 4:00 PM (EST/EDT)

LEARN ABOUT:

- ROBOTIC MATERIALS
- HUMAN-CENTERED MATERIALS INTELLIGENCE

JOIN US FOR:

- OPTICS DEMONSTRATION
- LAB TOURS
- WORKSHOPS

FOR MORE INFO
<https://sites.duke.edu/robotic-materials-workshop/>

Diagram labels: Laser source, Reflected beams, Incident beam, Receiving screen, Camera



Thanks

You can find me on:

[Personal Website](#), [GitHub](#) , [LinkedIn](#), [Youtube](#)