**Introduction | Who We Are**

Eric Swenson  
*Team Lead*

Andrew Tran  
*Team Scribe*

Alex Thielk  
*Team Firebase Bender*

Ángel Ortega  
*Team Expert*

Gustavo Cornejo  
*Team Guüs*

**ArGus:**

- Aerocube-WebApp
- Aerocube
- Aerocube-ImP
- Aerocube-MaL

Your Fire Nation
CubeSat Swarms for Attitude Control

Mission Goal
To demonstrate that a swarm of satellites is capable of collecting multi-point science data and transferring the data to the ground.
Problem

- High maintenance
  - Astronauts are required to service satellites
  - Manned-missions are not reachable from a shuttle for monitoring
  - Communication Signals from Earth are unreliable
- Deployed satellites require monitoring
- Tradeoffs: Power dissipation vs. Performance
- Processing Power
Motivation

- **Satellites Are Expensive**
  - The CubeSat is a low-cost solution for space missions

- **Deep Neural Networks and CUDA**
  - Algorithms can now run on a low-cost 50x87mm NVIDIA embedded computer
  - Allows for GPU-accelerated parallel processing
  - High-performance, low-power tradeoff

- **Computer Vision**
  - Computer Vision for estimating pose and identifying entities
  - Computational power with GPUs, parallel programming, and ML models
Technologies

Web Application
- React.js
  Ecosystem & Views
- Redux
  Async Event Lifecycle
- Reselect
  Efficient Data Hooks
- Immutable.js
  Application State
- Firebase
  DB & Bucket Storage
- Webpack
  Bundling & Building
- Enzyme, Karma, Mocha, & Chai
  Testing

Infrastrucure
- Flask
  Event Source
- Events and Signals
  Custom Event System
- TCP
  Communication
- Controller
  Center of the world
- NVIDIA Jetson TX1
  High-Performance “CubeSat”

Image Processing
- OpenCV
  Image Manipulation
- Aruco
  Fiducial Marker Creation, Detection
- NVIDIA CUDA
  GPU-Accelerated Image Processing
Solution Design

Web App

Event Handler

Controller

CubeSat System (Ye Olde Blackbox)

Image Processing (ImP)

Machine Learning (MaL)

DB (Google Firebase)

External Communication

Internal Storage

MarkerInfo

OK

Image

Event

ResultEvent

MarkerInfo

ResultEvent

MarkerInfo

Event Handler

On Jetson Controller

Event Handler Extern. Comm. Internal Storage
Roadmap

Current Status
- Receive image
- Identify fiducial marker(s)
- Store results in database

Future steps
- Using pose from fiducial markers find pose of AeroCubes
- Complete Dashboard UI
- CUDA-accelerated programming
- Garbage collection of similar images and redundant data
- Making software architecture independent for future space deployment missions
- Feedback to the camera
Prototype Demo

Main Use Case:

1. Send image
2. Process image
3. Receive ID’s in firebase
Questions?
Satellite 
Attitude Control 
& Image 
Acquisition 

On June 30 2003, a CubeSat space deployment mission (AAU CubeSat), for the purpose of creating an attitude control system and acquiring images of the Earth, was launched by the Aalborg University in Denmark.¹