

# DroneMOM

*Drone Model Output Machine*

**Taylor Nelms**

*taylornelms15@gmail.com*

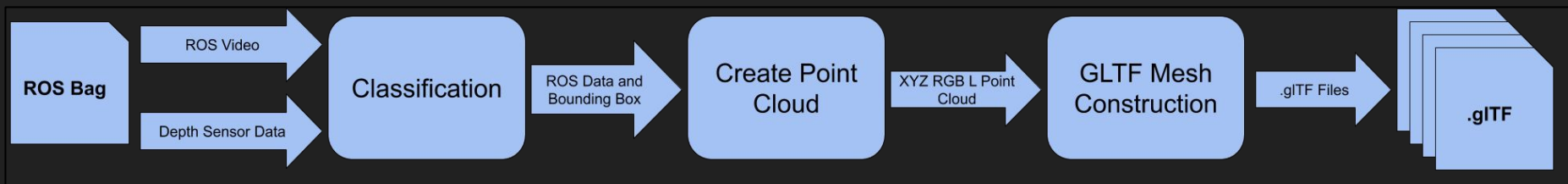
**John Marcao**

*jmarcao@seas.upenn.edu*

**Eric Micallef**

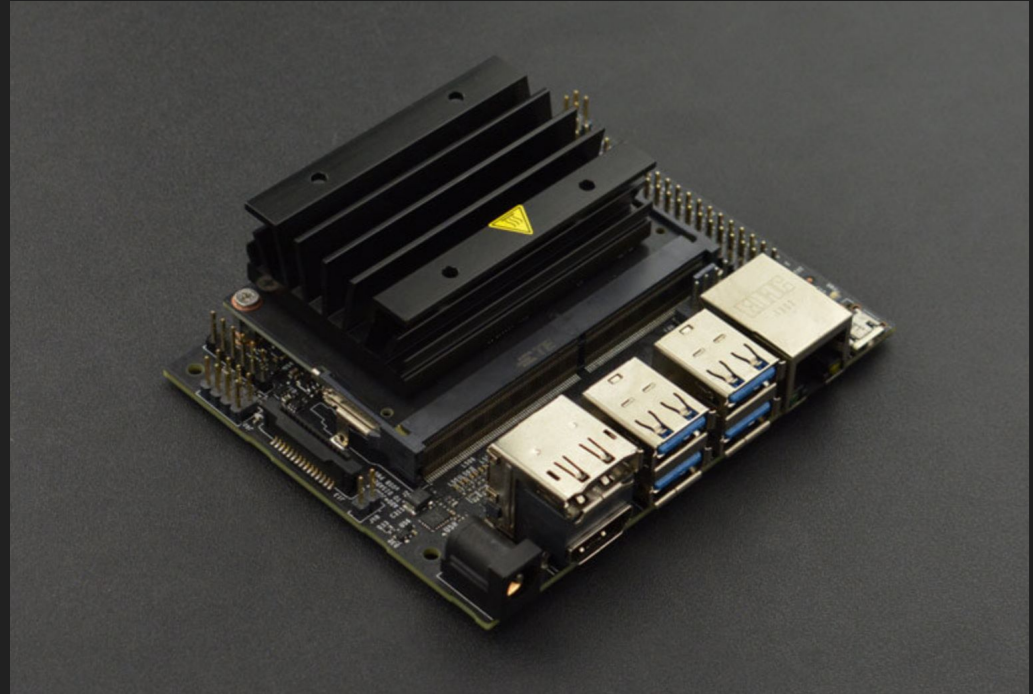
*emicallef@gmail.com*

# System Design



# Jetson Nano

- System On Chip with Nvidia GPU
- Limited RAM + Storage
- Limited Processing Capabilities
- Used for Aerial Platforms
- Robot Operating System (ROS) provides system infrastructure



# Classification

- Utilized Mobilenet as architecture
- Accelerated classification with TensorRT
- Implemented cuda algorithms with shared memory
- Bounding Boxes show what is classified in the frame
- ~50ms per inference
- Used ROS to implement a complex system



# What is TensorRT?

- Think of it like DXR
- Build a tensorRT engine ( like CPU side of DXR )
- Run inference on GPU based on this accelerated engine.

## TensorRT Optimizations and Performance



### Weight & Activation Precision Calibration

Maximizes throughput by quantizing models to INT8 while preserving accuracy



### Layer & Tensor Fusion

Optimizes use of GPU memory and bandwidth by fusing nodes in a kernel



### Kernel Auto-Tuning

Selects best data layers and algorithms based on target GPU platform



### Dynamic Tensor Memory

Minimizes memory footprint and re-uses memory for tensors efficiently

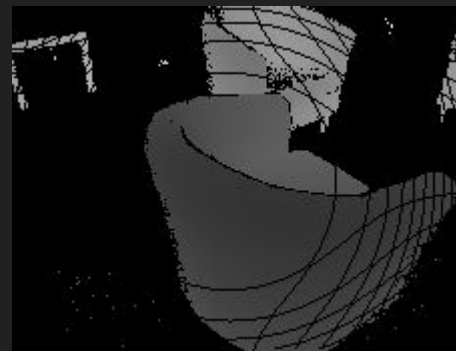


### Multi-Stream Execution

Scalable design to process multiple input streams in parallel

# Point Cloud Generation

- Input: color image, depth image



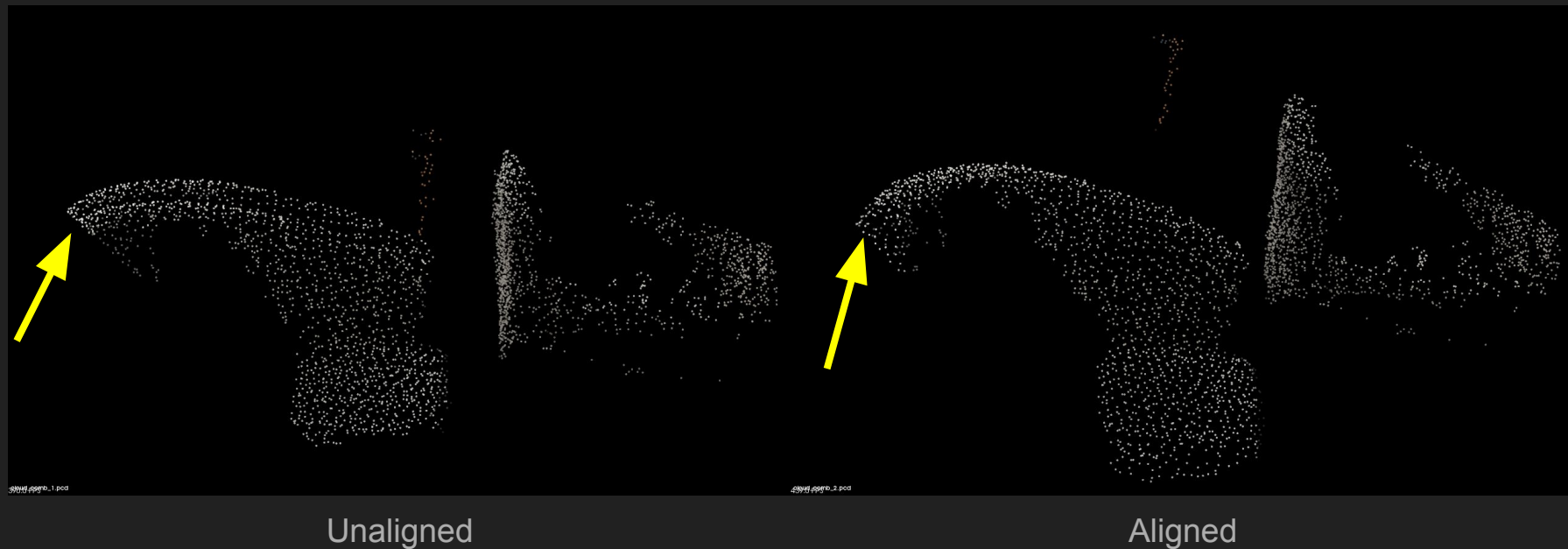
# Point Cloud Generation

- Align depth and color images, project into 3d space



# Point Cloud Generation

- Align and register frames for subsequent point clouds

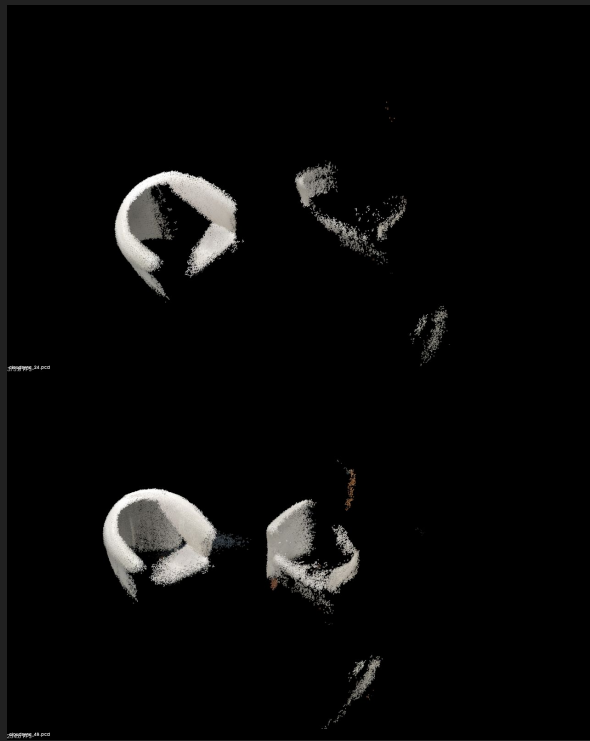




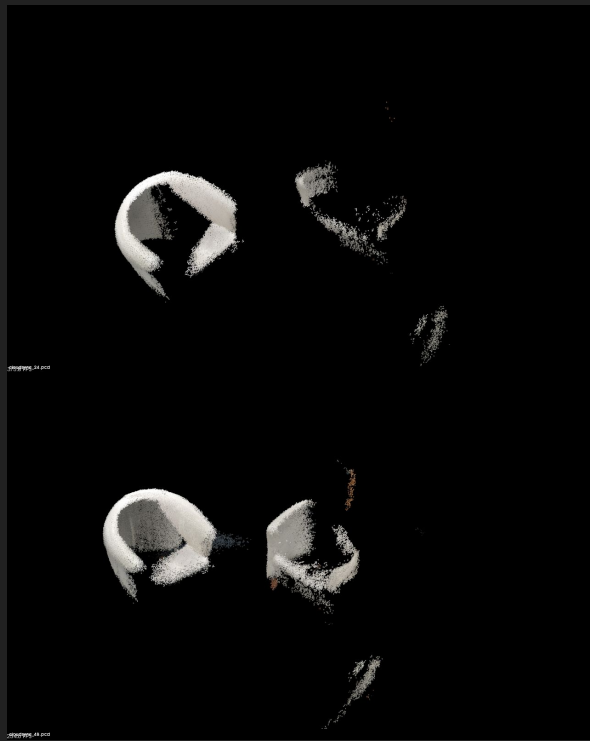
# Point Cloud Generation

- Accumulate subsequent frames to create overall point cloud

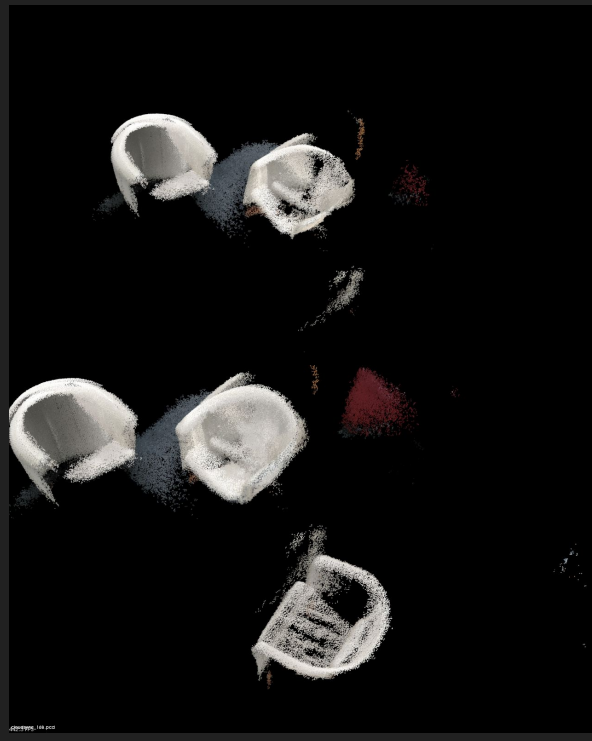
24 Frames



48 Frames



120 Frames

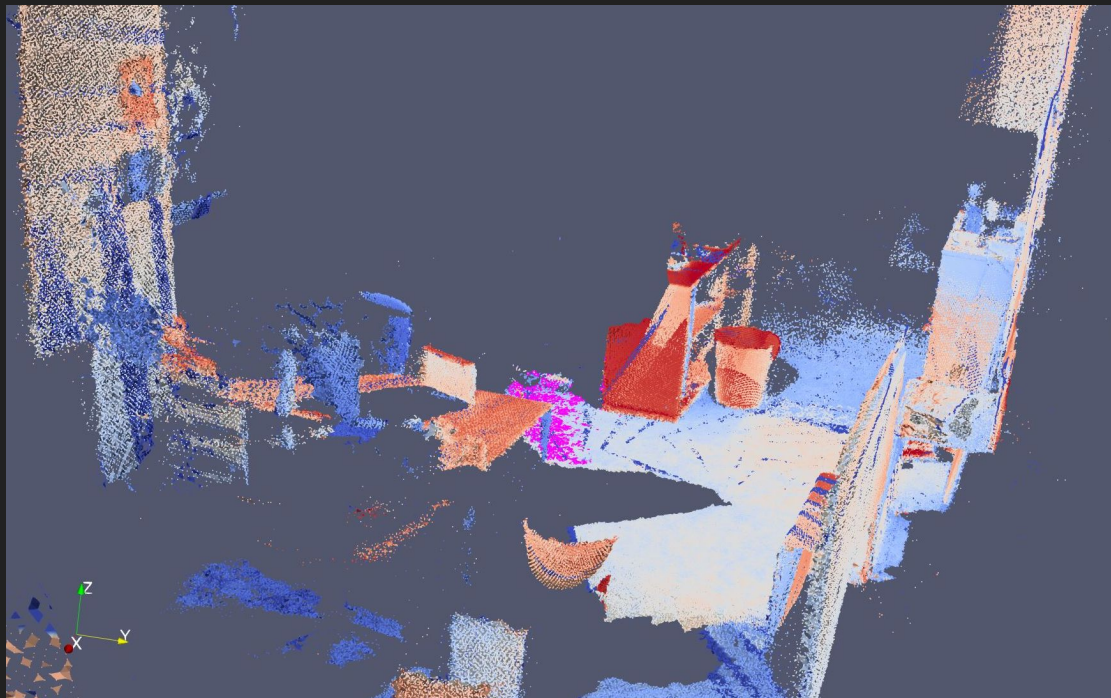


168 Frames



# GLTF Mesh Construction

- Convert a Point Cloud into a GLTF Mesh
- Challenges
  - Noise in the Point Cloud
  - Too many points
  - Incomplete data



# GLTF Mesh Construction

1. Downsample using a Uniform Voxel grid
2. Remove Statistical Outliers
3. Smoothing through Moving Least Squares
4. Point Normal Estimation
5. Greedy Triangulation Mesh Construction



Mesh using a small frame count

# Output Mesh after 5GB of data

Not quite right...

- Coordinate system not preserved
- GLTF Vertex Winding Order



# Special Thanks + Credits

Dewang + Vaibhav (Shadow Team Point cloud and ML help)

Tim Kaldeway (TensorRT advice+resources)

Andrew Feng

# DroneMOM



**Taylor Nelms**

<https://www.linkedin.com/in/taylor-k-7b2110191/>

**John Marcao**

<https://www.linkedin.com/in/jmarcao/>

**Eric Micallef**

<https://www.linkedin.com/in/eric-micallef-99291714b/>