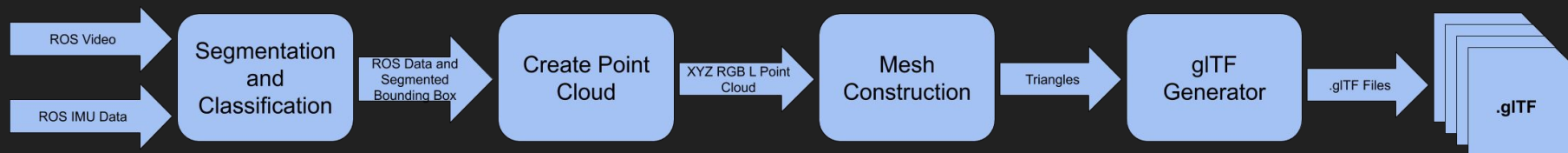# DroneMOM

Drone Model Output Machine

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Overview

Create a tool that converts incoming visual and inertial measurement unit data from an Unmanned Aerial Vehicle and use it to generate glTF models of classified objects in the scene.

ROS Video → | ROS IMU Data → | **Segmentation and Classification** | ROS Data and Segmented Bounding Box → | **Create Point Cloud** | XYZ RGB L Point Cloud → | **Mesh Construction** | Triangles → | **glTF Generator** | .glTF Files → | **.glTF**

Jetson Challenges

- Many Low memory warnings
- Classification networks must be lightweight
- Feature matches using SURF instead of SIFT for performance reasons
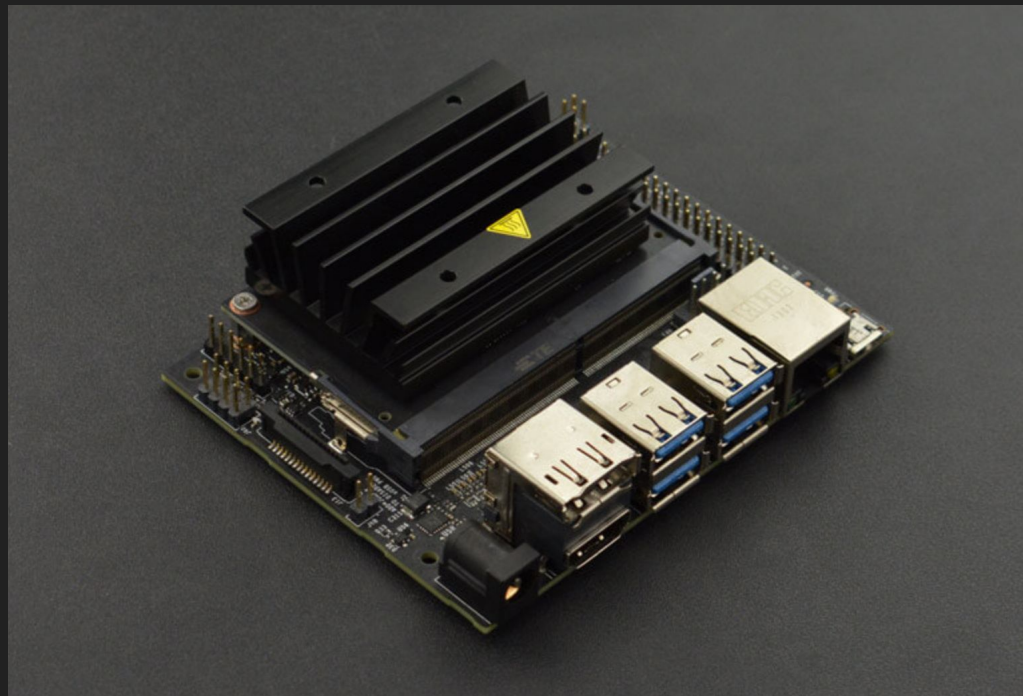
Classification

- Accomplished
  - Integrated TensoRT with a Universal File Format
  - Using SSD-Mobilenet Architecture
- Challenges
  - Converting incoming IMU data into world position
  - Synchronizing data between pipeline stages
- Next Week
  - Convert IMU into a position for point cloud use
  - Find a suitable ROS bag for demoing
  - Benchmark + Stream TensorRT implementation to prove correctness
  - Create own ROS msg that bundles all messages together in a time synced manner

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
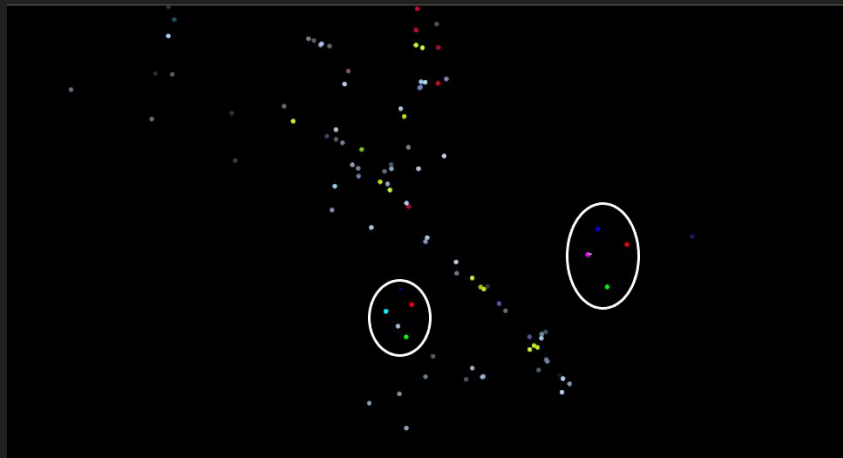
Point Cloud Generation

- Accomplished
  - Learned a lot
  - Discovered the difficulty of working with uncalibrated camera data
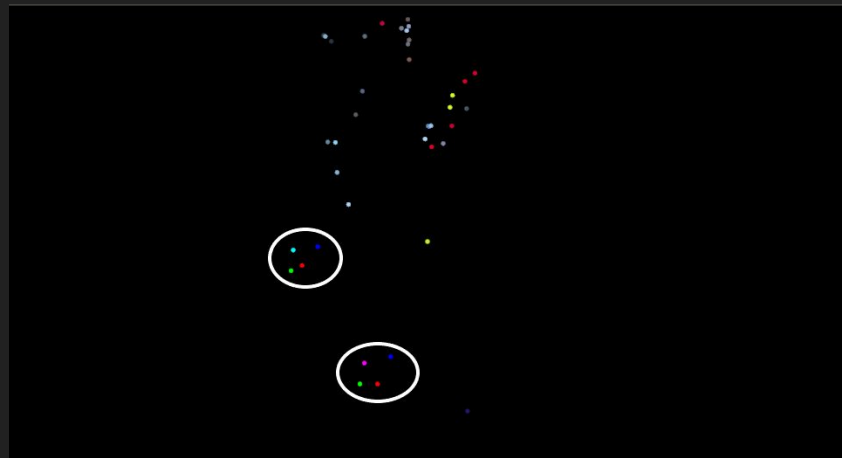 - Got feature matching between subsequent frames using SURF feature detection

Point Cloud Generation

- Challenges
  - Using made-up FoV values lead to issues
- Next Week
  - Feature matches and 3d reconstruction on calibrated camera data
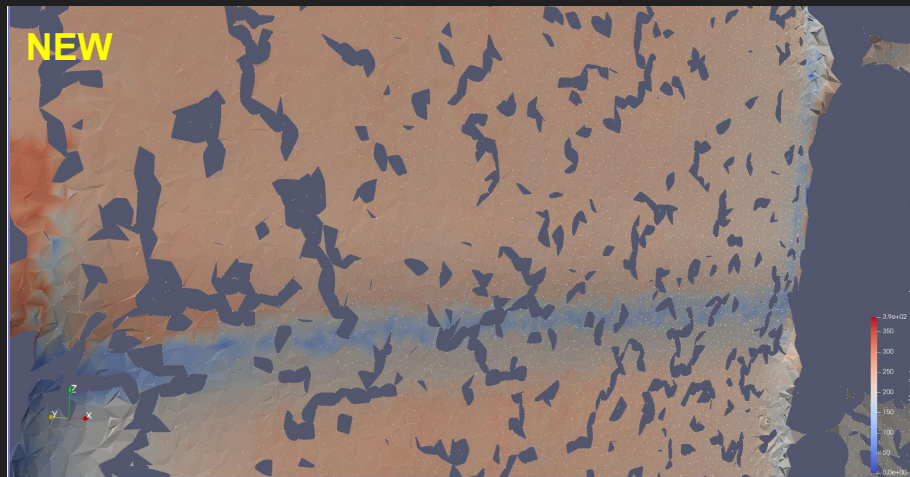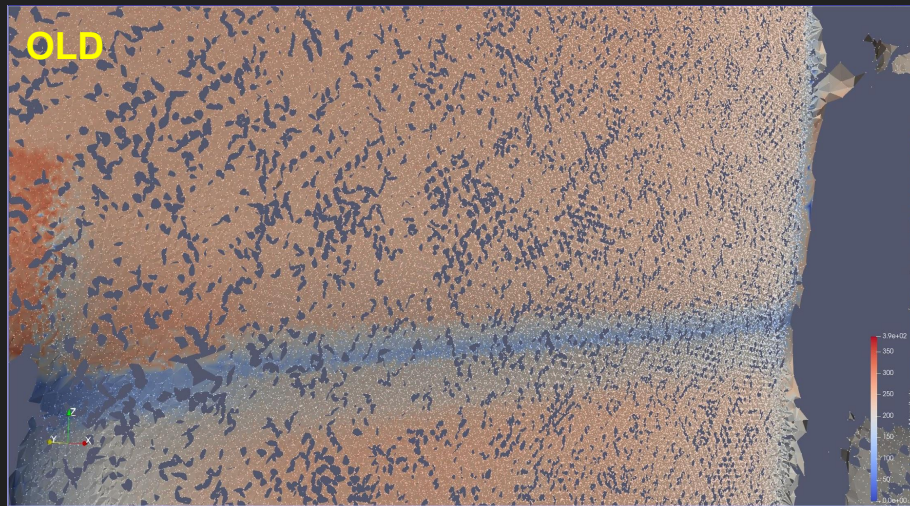
FOV: 90

FOV: 120

GLTF Mesh Construction

- Accomplished
  - Batching of mesh construction jobs to reduce delay
  - Downsample and smoothing before reconstruction to remove unimportant data points
  - Research into possible improvements to mesh reconstruction
- Old
  - 20 Frames, 28MB Mesh, 1318 Seconds
- New
  - 20 Frames, 3MB Mesh, 15 Seconds

GLTF Mesh Construction

Combining more frames data gives better models...
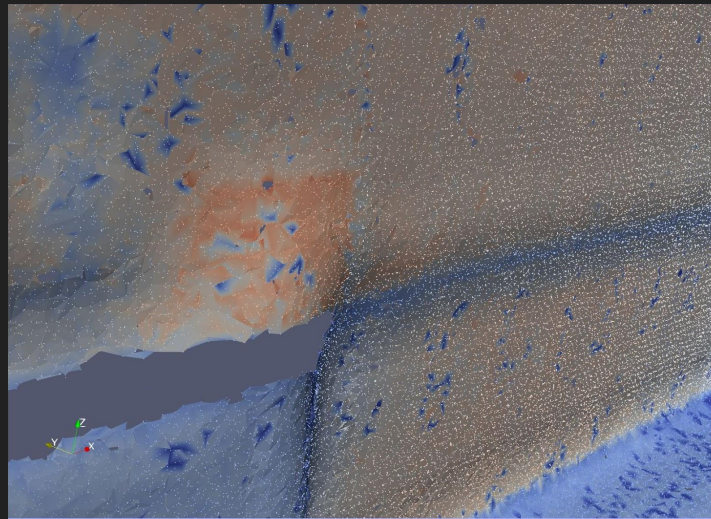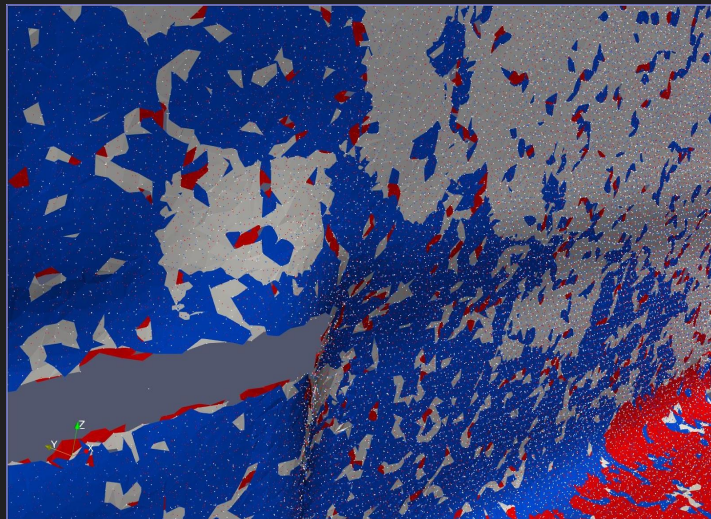
...but takes more time and resources to process.

GLTF Mesh Construction

- Challenges
  - Almost every GLTF tool is written in JavaScript.
  - Point Cloud Library CUDA support is limited. .
  - VTK file format not good for GLTF conversion.
- Next Week
  - Finalize GLTF export
    - Using cgltf library, allows for writing mesh to memory and then dumping out to a file.
  - Implement Mesh Construction on GPU.
    - Still deciding on implementations best for our platform.

End

Questions?