

## Motivation

### Autonomous flight through cluttered environments



### Platform



- Quad core arm based controller running linux
- IMU Microstrain 3DM-GX3-25
- Pseye front facing camera 640x480 @ 30 Hz

- Optical flow is used for pose estimation
- Pose from optical flow is noisy and fails over bad textured terrain.
- Semi Dense Visual Odometry is used for perception and it also provides pose. However, it fails when unable to track points between keyframes.
- Need to fuse data from the two sources to get accurate and reliable pose.

## Approaches

### Lie Algebraic Averaging

- $N$  images parametrized by  $N-1$  independent motions. There exist  $(N(N-1)/2)$  image pairs each of which provide a constraint on global motion.
- Lie algebra representation provides efficient system for averaging this overdetermined system of equations.
- Disadvantage – both SDVO and flow tracker are equally weighted in the average.

### Kalman Filter

- Inputs weighted by their variance and then averaged .
- We find results are only marginally better

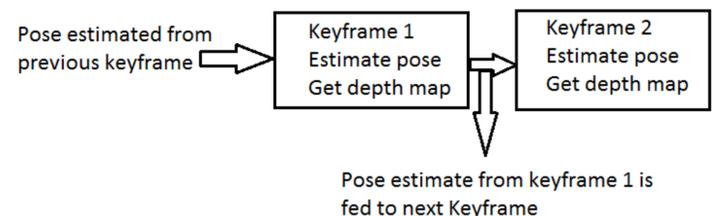
### RMSE over 45 meters



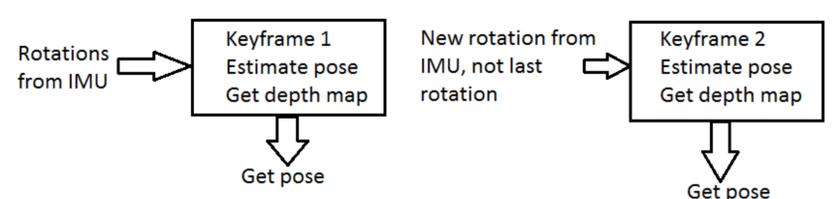
### IMU pose injection for SDVO

- SDVO tracks points to get depth maps. It tracks points between multiple frames.
- Instead of using rotations estimated from camera frame, we inject rotations from IMU which are more accurate.

#### Current SDVO system



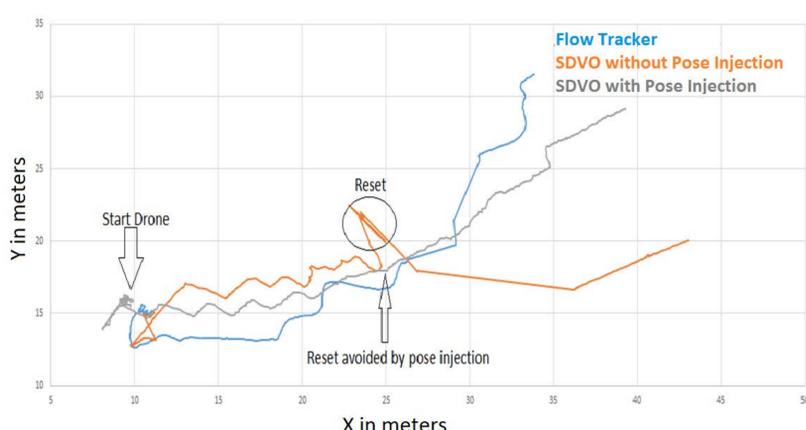
#### SDVO with pose injection



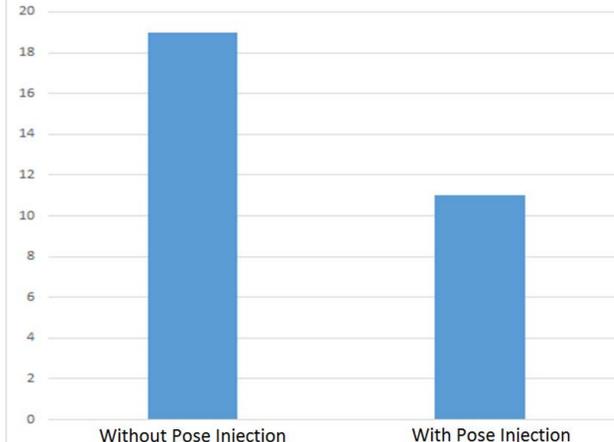
- Average number of resets (instances where SDVO crashes) during flight time reduced by 42%.

## Performance with Pose injection

### Pose Evaluation



### Number of resets over 1000 m



## Acknowledgement

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