Visual-Inertial SLAM

For SLAM Competition @SLAM FORUM 2023

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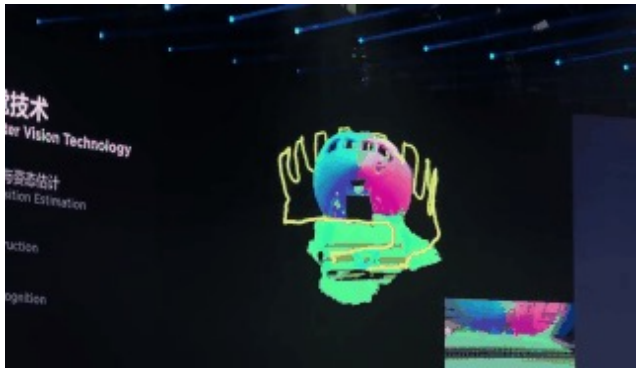
Developed SLAM For AR Glass in 2017

- **Real-time SLAM algorithm on mobile soc**
  - VIO accuracy(99.5%)
  - Low latency: 3ms@400FPS
  - CPU usage: <15% on mobile soc（Snapdragon845）



2017 — Daystar AR

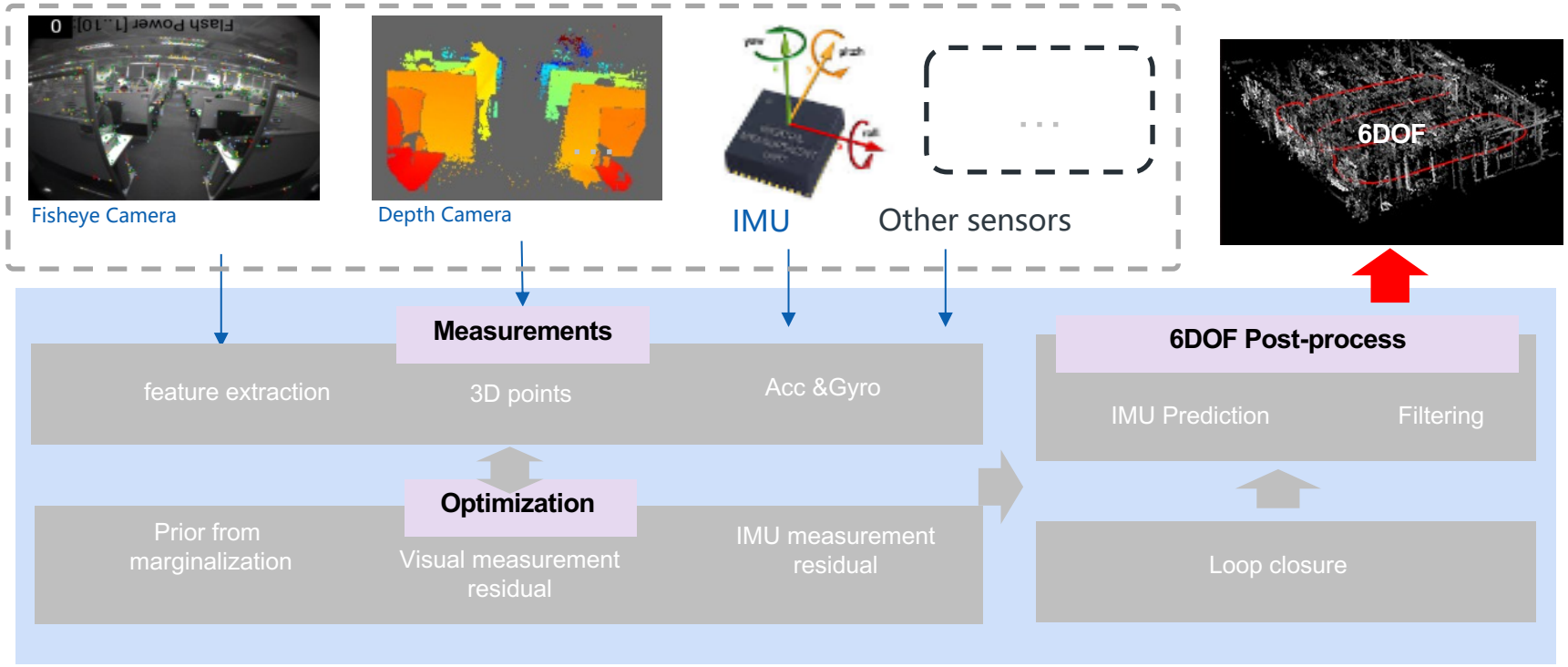
2018 — Daystar SDK

2019 — XR Application

Multi Sensor fusion SLAM algorithm

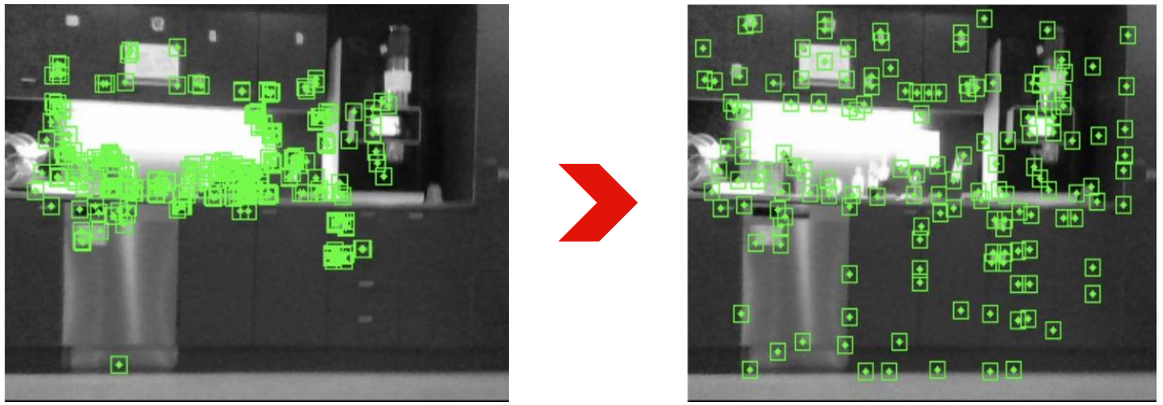
SLAM For AR Glass

- Tightly-coupled visual-inertial SLAM system
- Support multiple visual-inertial sensor types
- Building on multiple open-source SLAM systems



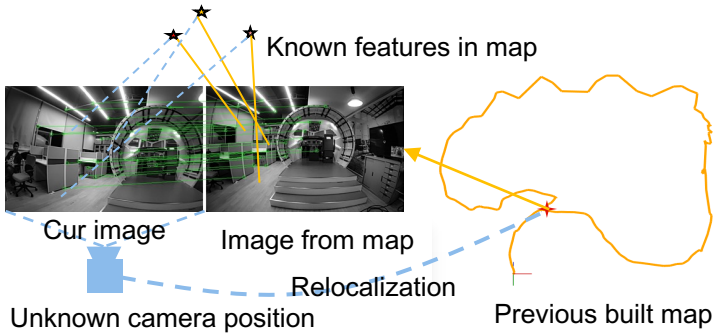
Hybrid methods to optimize visual tracking

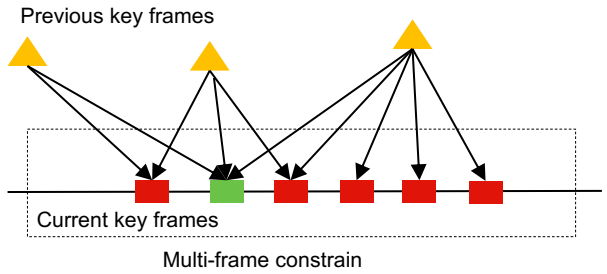
- **Algorithm optimization**
  - Image Enhancement by CLAHE
  - Make the position of feature points uniformly distributed by quadtree
  - Forward and backward LK optical flow
  - Optical flow optimize by assume constant velocity motion model
  - Filter optical flow tracking result by feature descriptor



Optimization for loop closure

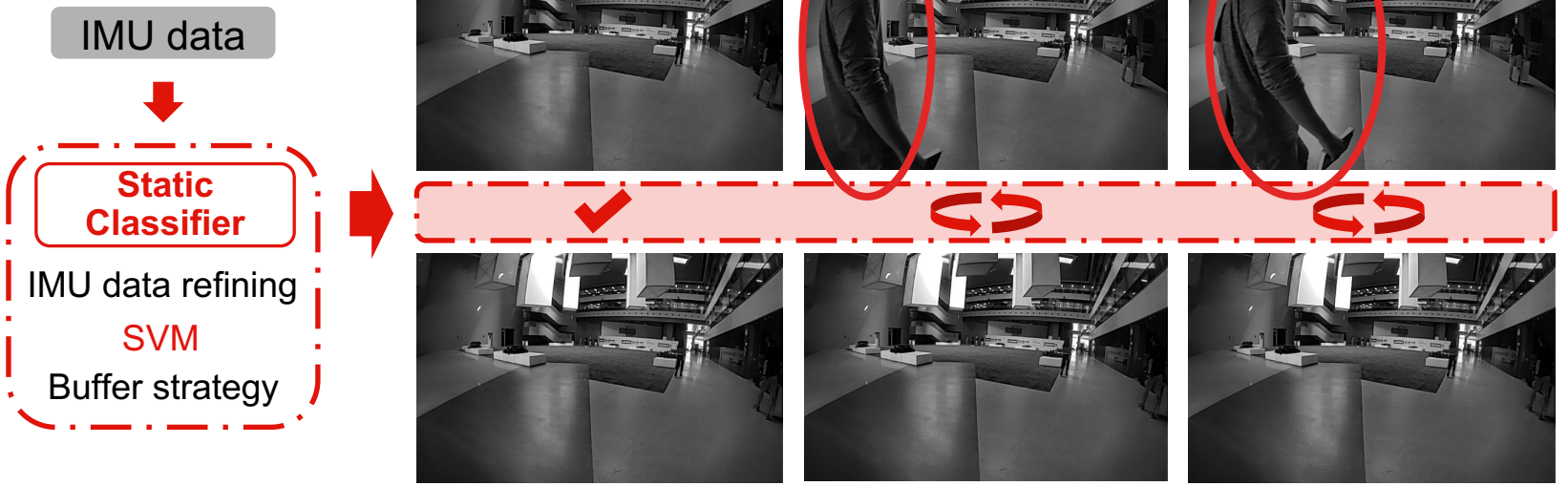
- **Feature descriptor based on deep learning**
  - Based on lightweight neural network, recompute feature point descriptor
  - Improve feature matching, pnp result
- **DBOW with dl descriptor**
  - Use deep-learning descriptor instead of traditional descriptor in DBOW
  - Improve the accuracy and robustness of image retrieval
- **A multi-frame constrain algorithm**
  - Use multi-frame constrain in pnp and ba
  - Improve the accuracy of pose solving





Optimization for extreme scene

- **Static mode**
  - Use imu + svm to determine whether device is static
  - Provide better stability in static state with almost no extra calculation
- **Optimization with dynamic weights**
  - Adjust the covariance matrix according to the visual tracking results
  - Improve pose stability
- **IO mode while visual tracking fail**
  - Activate IO mode while in textureless scenes, fast moving, etc.
  - Improve tracking robustness



Optimization for SLAM Competition

- **Used Method**
  - Use LibQPEP in vio initialization
  - A simple filter to preprocesses the imu data
- **Tried Method**
  - Line feature
  - Neural inertial odometry
  - Feature extractor and matcher by deep learning

Wu, J., Zheng, Y., Gao, Z., Jiang, Y., Hu, X., Zhu, Y., Jiao, J., Liu, M. (2022) Quadratic Pose Estimation Problems: Globally Optimal Solutions, Solvability/Observability Analysis and Uncertainty Description, IEEE Transactions on Robotics

Summary

- **Algorithm Optimization**
  - Visual tracking
  - Loop closure
  - Extreme scene
- **Acceleration**
  - Frontend move to Hexagon DSP
  - Some other modules use NEON
  - Optimize third-party libraries & approximate calculation
- **From AR Glass To Robot**

thanks.

Different is better