Data-Driven Feature Tracking for Aerial Imagery

Github: https://github.com/xxender13/DL Final Project Team6/tree/main

Group 6

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Introduction

Brief Explanation:

- **Topic**: Feature tracking in aerial imagery using event cameras.
- **Relevance**:
  - Aerial navigation and mapping demand accurate and efficient feature detection.
  - Traditional methods struggle with latency and noise; event cameras offer a robust alternative.
- **Objective**:
  - Leverage event cameras to enhance feature tracking for 3D reconstruction and pose estimation.

Main Points

1. **Dataset Overview**:
   - MultiFlow for asynchronous event streams.
   - EDS dataset for pose fine-tuning.
   - Augmented lab dataset for noise testing.
2. **Key Contributions**:
   - Generated flows using events and RGB data.
   - Integrated COLMAP for pose refinement.
   - Evaluated model performance under various noise conditions.

Problem Statement and Methodology

Problem Statement:

- **Challenge**: Existing feature tracking methods are inefficient for high-speed aerial imagery.
- **Solution**: Develop a deep learning model leveraging event-driven data.

Methodology:

1. **Data Pipeline**:
   - Event and RGB-based flow generation.
   - Preprocessing with CSV packages.
2. **Model Architecture**:
   - Spatio-temporal feature extraction.
   - Pose refinement using COLMAP.
3. **Evaluation**:
   - Tested with augmented noise datasets.

Results and Conclusion

Results:

- **Key Metrics**:

Condition	Feature Age	Expected Feature Age
Original Tracks	0.0529	0.149
Defocus Blur Tracks	0.0521	0.146
EDS Tracks	0.576	0.472

- **Visualization**:
  - Predictions on original and blurred tracks.

Conclusion:

- Event cameras significantly enhance feature tracking robustness.
- Future Work:
  - Real-time implementation.
  - Advanced noise-handling techniques.