Event-aided Direct Sparse Odometry
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Methodology

- The camera tracking problem is a joint optimization of the normalized brightness increment error over the camera motion parameters (6DoF pose and velocity):

\[
(\delta T^*, T^*) = \arg \min_{\delta T, T} \left\| \frac{\delta L}{\Delta L} - \frac{\Delta L}{\Delta L} \right\|
\]

- \(\Delta L\) is the event generation model (EGM) and \(\delta L\) the events:

\[
\Delta L(u) = -\nabla L(u) \cdot J(u, d_u) \Delta T, \quad \text{and} \quad \delta L(u) = \sum_{T \in T} \omega_{T,u} C(u - u_T)
\]

- In comparison to previous work [1,2], the optimization is done by transferring the brightness increments of a sparse set of points to the keyframe and finding the parameters of \(\delta T^*, T^*\).

- EDS w.r.t. event-based (left) and frame-based (right) methods.

Experiments

- Test on sequences from the standard RPG DAVIS stereo dataset [3]

- Low frame rate experiments

Conclusion

- EDS is the first direct visual odometry method combining events & frames.
- EDS produces more accurate results than previous event-based methods.
- Events improve classical photometric image alignment in frame tracking.
- EDS opens the door to low-power motion-tracking applications.

References


What is an event camera?

- Transmits brightness changes
- Outputs asynchronous events

EDS: Event-aided Direct Sparse Odometry is a direct monocular visual odometry method using events and frames. Our algorithm leverages the event generation model to track the camera motion in the blind time between frames. The method formulates a direct probabilistic approach of observed brightness increments.

[Paper and code] https://rpg.ifi.uzh.ch/eds