

Event-based Robot Vision

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Discussion

What enables image reconstruction?

Smoothing or “**Regularization**” (also known as “Prior”)

- In **space**:
 - Neighboring pixels are processed together.
- In **time**:
 - In ACCV 2018 pixels are processed independently, only filtering in time.
- In **space-time**: most methods do this, implicitly.
 - What is the (best) **regularizer / prior**?
 - Hand-crafted? TV-L1, some norm
 - Learned from natural images? LPIPS...
 - What's the accuracy vs. computational effort **trade-off**?
- As event cameras improve, the image reconstructions will also improve (first sensors were very noisy and of low resolution)

A variety of Representations and Methods

Just by looking at the task of image reconstruction we find a variety of:

- **Event representations**

- Event packets, event frames, voxel grids, stacks of events, ...

- **Event processing methods**

- Temporal filters, EKFs, variational methods, artificial neural networks, GANs, ...

Exercise: go over the paper and identify these (event representations and processing methods used)

What is image reconstruction good for?

- For **visualization**:
 - Visual feedback (if camera does not output grayscale)
 - Camera Calibration (geometric)
 - High Dynamic Range (HDR) imaging
 - High-speed video generation
- To show the amount of **information contained in the event stream**
- For “**transferability**”: Off-the-shelf computer vision algorithms work very well on the reconstructed images
 - Object classification
 - Visual odometry, depth estimation
 - Labels from image-based datasets can be transferred to events
- As a **baseline** (comparison): how well does my method perform using events directly, as compared to using standard computer vision methods on reconstructed images?

Is image reconstruction needed?

- It depends on the **task**
 - For ego-motion estimation (SLAM), it is not needed: RAL-17
 - For optical flow estimation it is not needed
 - ...
 - (We will see examples in upcoming lectures)
- But it may be **useful**, as we have seen
 - For video generation, it is essential

References

Reading:

- **Section 4.6** of [Event-based Vision: A Survey](#), TPAMI 2020.
- E. Mueggler et al., [The Event-Camera Dataset and Simulator](#), IJRR 2017, page 3.
- List of Event-based Vision Resources, section on “Image reconstruction”:
https://github.com/uzh-rpg/event-based_vision_resources#image-reconstruction