

Event-Based Cameras -- Sensor Fusion (TBC - To Be Completed)

Event-based cameras (also known as neuromorphic cameras) are imaging sensors that respond to local changes in brightness. They process information in a similar way to the human neural system.

- Because they can process large amounts of data and react to changes in brightness, contrasts, and movements, this technology proves useful in reducing the amount of data being transmitted drastically whilst still getting a clear and detailed picture of what is being conveyed.
- The focus is on the change, not in recapturing every little static detail

Event-based cameras vs Image-based cameras (sensors)

- Image-based: Higher latency, transmission of complete data from the entire sensor surface regularly
- Event-based: Lower latency, transmission of a much smaller amount of data in the same period of time
 - No need to compromise between highly redundant data and high framerates
 - Instead of producing the complete amount of data, it instead produces pixel events, tracking if a property of the pixel changed enough to trigger an "event"

Some examples of applications are the flow analysis of liquids and gases, extracting speed and direction information for numerical analysis of object movement, and visualizing how and on which paths objects move in a time domain.

Limitations of Event-Based Cameras

- Difficulty interpreting event streams and the need for specialized algorithms to process asynchronously-collected data
 - Frame-based cameras however, excel in this category, as they provide rich spatial information that is easier for people to understand (feature extraction, object recognition)
 - We fuse to leverage the strength of both modalities (frame-based & event-based)

Space-Based Applications

- Computer vision techniques to aid with landing, integration into the control system of a landing probe [able to measure time to contact, which was sufficient theoretically for guidance control]
- Enhancing traditional visual or LiDAR-inertial odometry
 - Event-based cameras, frame-based cameras, IMUs, LiDAR
 - Improving robustness and accuracy in harsh environments with high-speed needs