Event-based Vision for Augmented Reality

Workshop on Event-based Vision, CVPR 2019

Stefan Isler

stefan@insightness.com
Our vision is truly convincing augmented reality
We need a device to display virtual content and sensors to enable an interactive and immersive experience.
Tricking the Brain: Subconscious Latency

The device has to be faster than the brain: Photon-to-Photon Latency < 20ms!

→ We need fast sensing
→ Event-based sensors provide always-on vision at:
  • Low latency
  • High temporal resolution
  • Low power

The device has to be faster than the brain: Photon-to-Photon Latency < 20ms!

→ We need fast sensing
What Is Sensing Needed For?

Mixed Reality Device

Visual Processing

Environment Understanding
- Static
- Dynamic

Pose Estimation
- Head
- Eyes

User Interaction

Sensor

Processors

Display

Photon IN ➔ Visual Processing ➔ App ➔ Rendering ➔ Photon OUT
Founded 2014 by PhD students as a spinoff of ETH Zurich and the University of Zurich

Striving to improve the sensing system by...
  - developing our own, application targeted sensors
  - developing our own computer vision algorithms fitting the functionality of our sensors
Combining Events and Frames: The DAVIS

• The basis of Insightness sensors, invented by our co-founders Raphael Berner and Prof. Tobi Delbrück

• Combined active pixel sensor readout with event-based readout:
  • Change events and a global shutter grayscale frame
  • Shared photodiodes but no interference

• Relevance for software:
  • «Conventional» computer vision on APS frames
  • Use events where they are strong: fast motion, low latency
Insightness Rino 3 (2018)

• Features events and global shutter grayscale frames on the same sensor (non-interfering)

• 320 x 262 px (~QVGA) resolution
Insightness Rino 3 (2018)

• Events:
  • > 100 dB dynamic range
  • Configurable sensitivity
  • Up to 10 kHz time resolution (configurable)
  • <1 ms latency for >1 lux chip illumination
  • > 50 Meps bandwidth

• APS frames:
  • Up to 30 Hz
  • 10 bit grayscale resolution
  • Global shutter

• IMU:
  • Invensense MPU-9250
  • 1 kHz
  • 9 DoF
Rino 3: Latency vs Illumination

![Graph showing latency vs chip illumination for living room and office lighting.]
Insightness Rino 3 (2018)

• Available as evaluation kit e.g. for research:
  • 35 x 35 x 28 mm sensor module
  • 15 g weight
• M12 lens mount
• USB 2.0 (~20 Meps bandwidth)
• C++ API
• ROS package available (rpg_dvs_ros/dvs_msgs topics)
Insightness **Rino 3 (2018)**

1x  

0.1x
SW: Optical Flow Approximations (2016)
SW: Drones (2016)
Introducing the Rino 4 (2019)

- 1024 x 768 pixels resolution
- Events and grayscale global shutter frames (non-interfering)
- Stacked BSI process
- 7.2 µm pixel pitch
Introducing the Rino 4 (2019)

- ~100% fill factor
- Optical format: 1/1.7”

Fits into compact camera modules
Introducing the Rino 4 (2019)

- Configurable resolutions:
  - 1024 x 768
  - 800 x 600 (SVGA ROI option)
  - 640 x 480 (VGA ROI option)

- Evaluation kit:
  - M12 or C mount lens
  - USB 3.0 / MIPI
  - Includes 9 DoF IMU
  - C++ API
  - ROS package available (rpg_dvs_ros/dvs_msgs topics)
Introducing the Rino 4 (2019)

• Events:
  • > 100 dB dynamic range
  • Configurable sensitivity
  • 10 kHz time resolution (configurable)
  • <1 ms latency for >1 lux chip illumination
  • > 80 Meps bandwidth

• Global shutter APS frame:
  • 30 Hz (full res.) – 50 Hz (VGA)
  • 10 bit grayscale
Introducing the Rino 4 (2019)

Available Q3 2019!
Insightness And You

• Get one of our evaluation kits:
  • Rino 3
  • Rino 4
• Get in contact for collaborations
• Join our team

Contact us: info@insightness.com
Thank you

Are there any questions?

Stefan Isler

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