

Gradient reconstruction from DVS sensor

3D Photography Project Proposal

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GROUP MEMBERS

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I. DESCRIPTION OF THE PROJECT

A Dynamic Vision Sensor (DVS), also called event camera, is a camera that outputs only single spikes for each pixel separately when the sensed intensity change in the pixel exceeds a given threshold, in contrast to full images at a fixed frequency like a normal camera. Our goal is to implement the approach of [1] to reconstruct a gradient map and finally a grayscale image of the scene from the DVS signal.

II. WORK PACKAGES AND TIMELINE

The approach in [1] consists of three main parts: tracking the camera motion, building a gradient map on basis of the estimated camera rotation and the single pixel spikes, and computing a grayscale image from this gradient map. Our main challenge is likely the chicken-and-egg nature of the gradient map building and tracking. The tracking of the camera rotation relies on the existence of a gradient map while the construction of such a map requires an estimation of the orientation to work. To handle this problem we will build a simple simulation of the sensor output based on a given image. The simulation will enable us to test the tracking algorithm without any mapping. To test the construction of the gradient map independently, we will capture test data where the orientation of the camera is obtained by an external sensor.

The tracking of the camera rotation is done using a particle filter that tries to estimate the camera rotation from the estimated movement of each single pixel. The gradient map is build using a pixel-wise Kalman filter that estimates the gradient of a pixel based on the estimated camera rotation. For the reconstruction of the grayscale image from the gradient map is a Poisson image reconstruction. Here we can rely in large parts on publicly available code what reduces the complexity of this task significantly.

The system will run on a PC using MATLAB. The project schedule is as following:

Task	Responsible	Until
Proposal presentation		March 9
Simulation of camera output	Marcel	March 15
Capture test data with rotation	Samuel	March 15
Image reconstruction from gradient map	Marcel	March 22
Gradient map building	Samuel	April 10
Rotation tracking	Marcel	April 10
Project updates		April 13
Component integration	Marcel	April 26
Refinement + tuning	Samuel	May 10
Project demo		May 18

III. OUTCOMES AND DEMONSTRATION

We plan to be able to reconstruct a grayscale image of the scene from the camera signal as in [1]. The evaluation of the method will be a manual qualitative comparison of the generated images to the actual scene and to images taken with a standard camera. For the demonstration we want to show a standard picture of the scene together with an offline visualization of the raw camera signal and reconstruction of the image from this signal, or possibly an online reconstruction of the scene directly from the camera signal.

REFERENCES

- [1] Hanme Kim, Ankur Handa, Ryad Benosman, Sio-Hoi Ieng, and Andrew J. Davison. Simultaneous mosaicing and tracking with an event camera. In *British Machine Vision Conference, BMVC 2014, Nottingham, UK, September 1-5, 2014*, 2014.