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On event-based optical flow detection

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Optical Flow based on event-data

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Overview

1. Definition of optical flow
2. Bio-inspired view for optical flow
3. Filters design
4. The approach to computing the velocity
5. github repository for implementation

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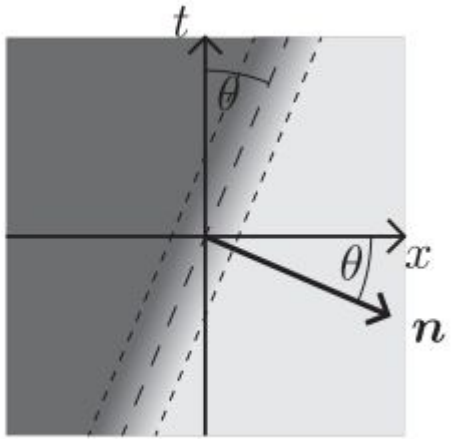
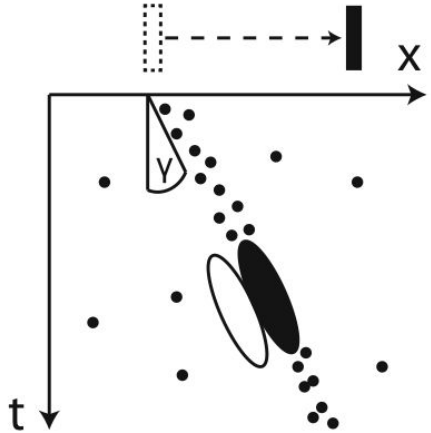
Definition of optical flow

1.General idea to calculate velocity



2.Event-base data for velocity



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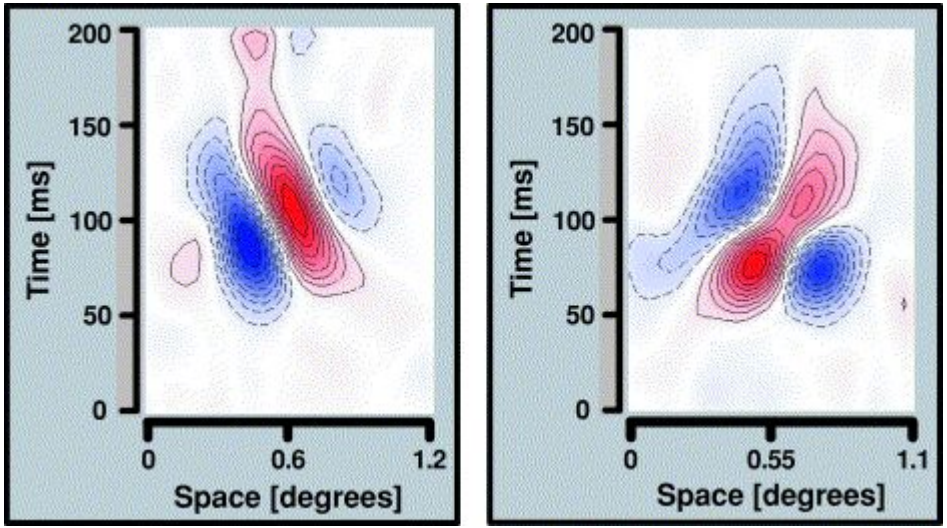
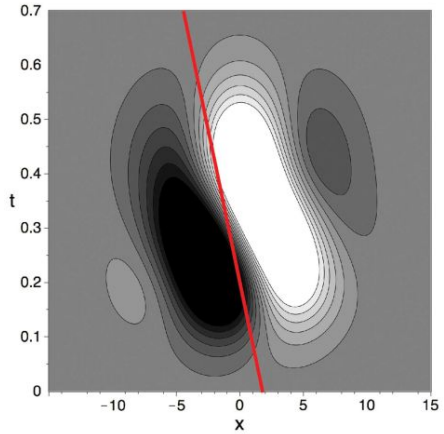
Bio-inspired view to caculate optical flow

1.Examples of the spatio-temporal receptive fields (RFs) of a sample of V1 simple cells



2.Deduce the change of sequences events



The red line indicates the preferred speed selectivity identified by a Fourier analysis of the filter function

Spatial and temporal receptive fields of geniculate and cortical cells and directional selectivity, DeAngelis et al. 2000

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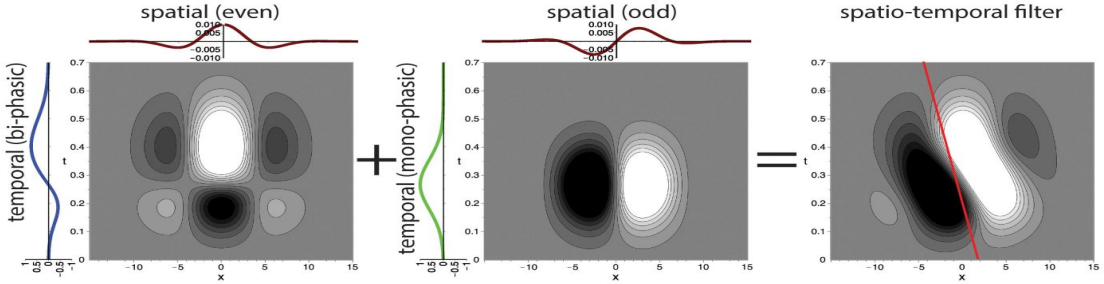
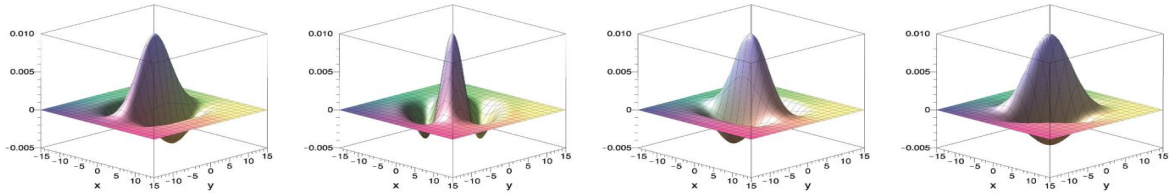
Filter Design

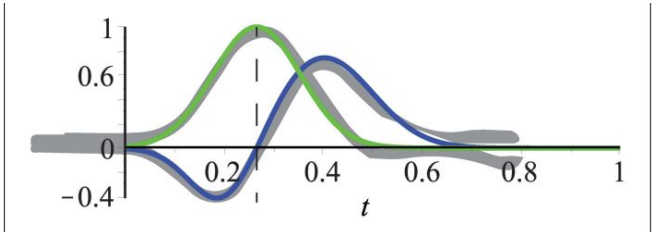
$$G_{\sigma,f_x^0,f_y^0}(x,y) = \frac{2\pi}{\sigma^2} \cdot \exp\left[2\pi j\left(f_x^0 x + f_y^0 y\right)\right] \cdot \exp\left[-\frac{2\pi^2 \cdot (x^2+y^2)}{\sigma^2}\right],$$



Two separable filters are superposed to create the final motion direction selective spatio-temporal filter



Filter Bank:



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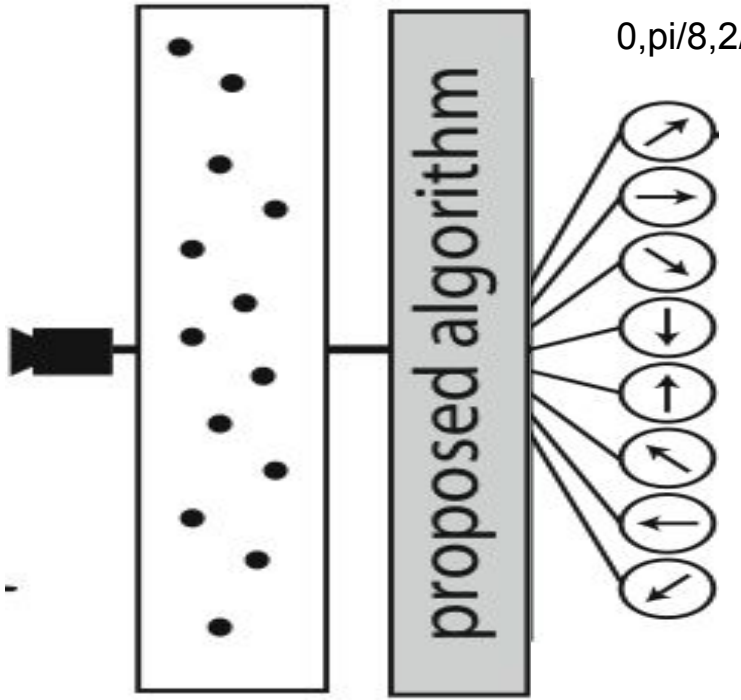
Computing Velocity



0,pi/8,2/8pi,...,7/8pi

Aggregation

$$\begin{pmatrix} u_p \\ v_p \end{pmatrix} = \sum_{k=1}^{N} I_k \cdot \begin{pmatrix} \cos(2\pi(k-1)/N) \\ -\sin(2\pi(k-1)/N) \end{pmatrix}$$

optic flow

event stream

convolution with filter bank

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Github Repository for reimplementation of this paper

https://github.com/tub-sgg/Bio_inspired_Optical_flow/blob/master/src/optical_flow.ipynb

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Any Question?