Lip-motion Analysis by Optical Flow

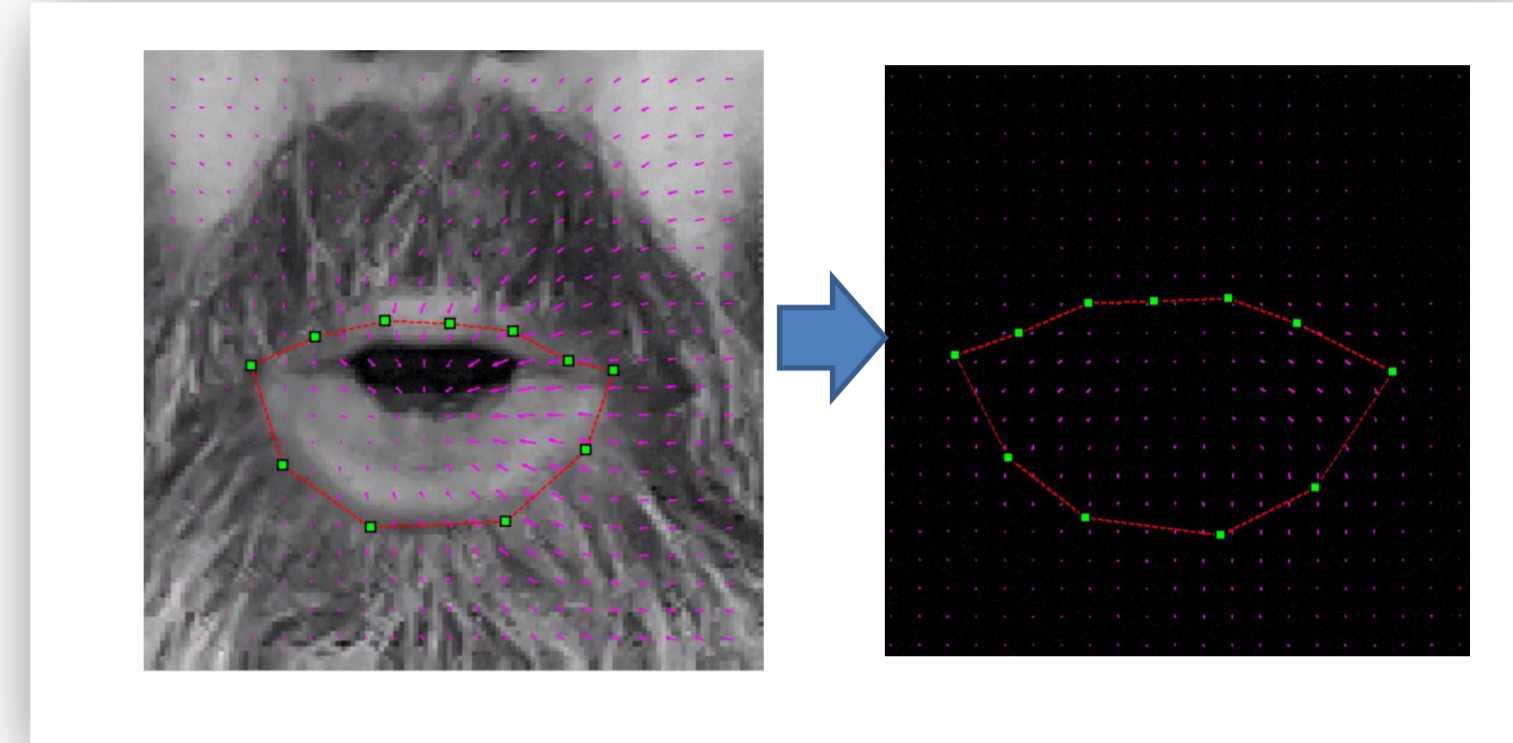**Stefan.Karlsson**@hh.se
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Overview

Lip-motion dynamics for hand-held devices:
• Lip biometric(identify).
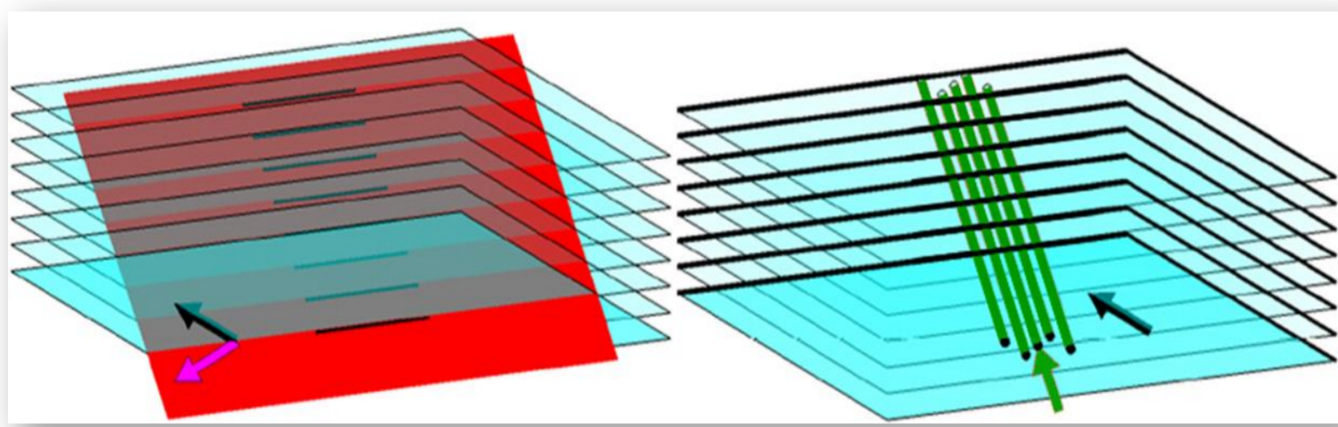• Lip-reading.
• Avatar emulation.

Challenges:
• Fast optical flow which handles line motion in lips.
• Invariant Features that handle motions of device.
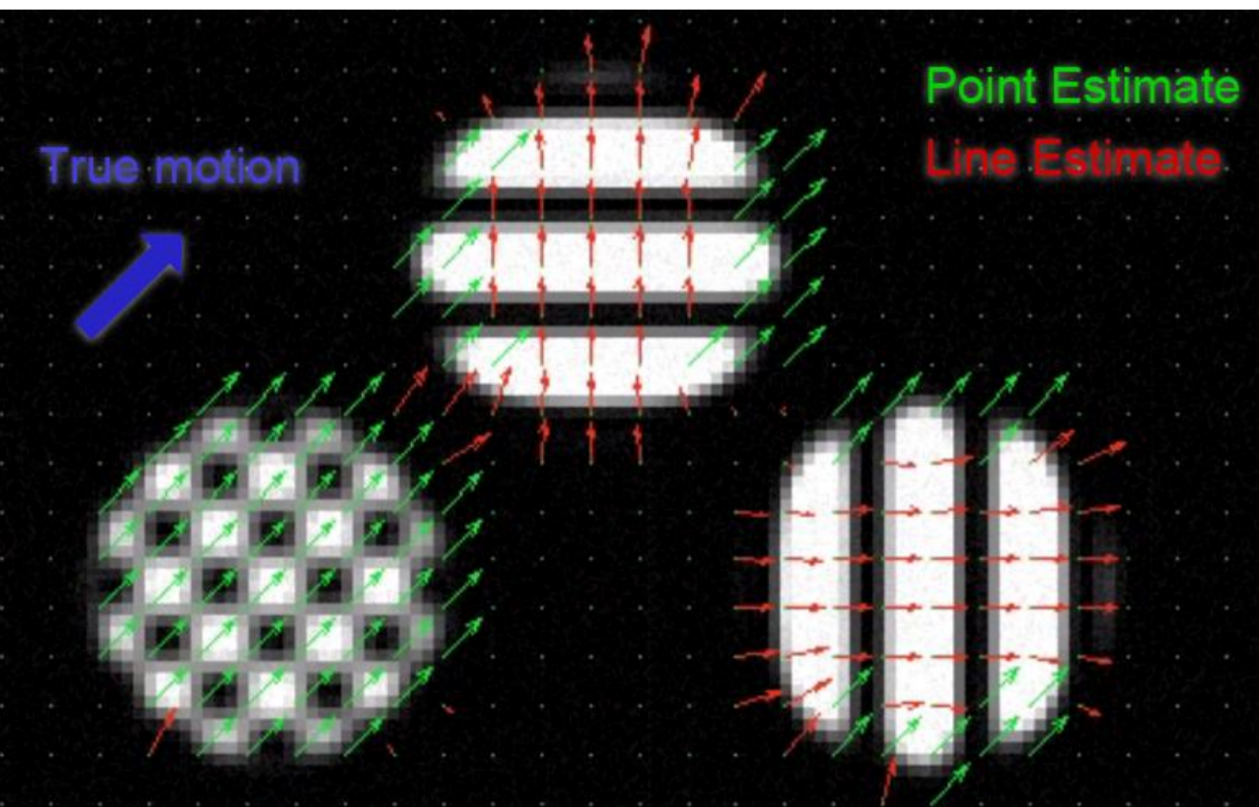• Detecting Lip Events.

Optical Flow

• **Speed** and **consistency** (rather than **accuracy**)
• Handle **line motions** (prevalent in lips)

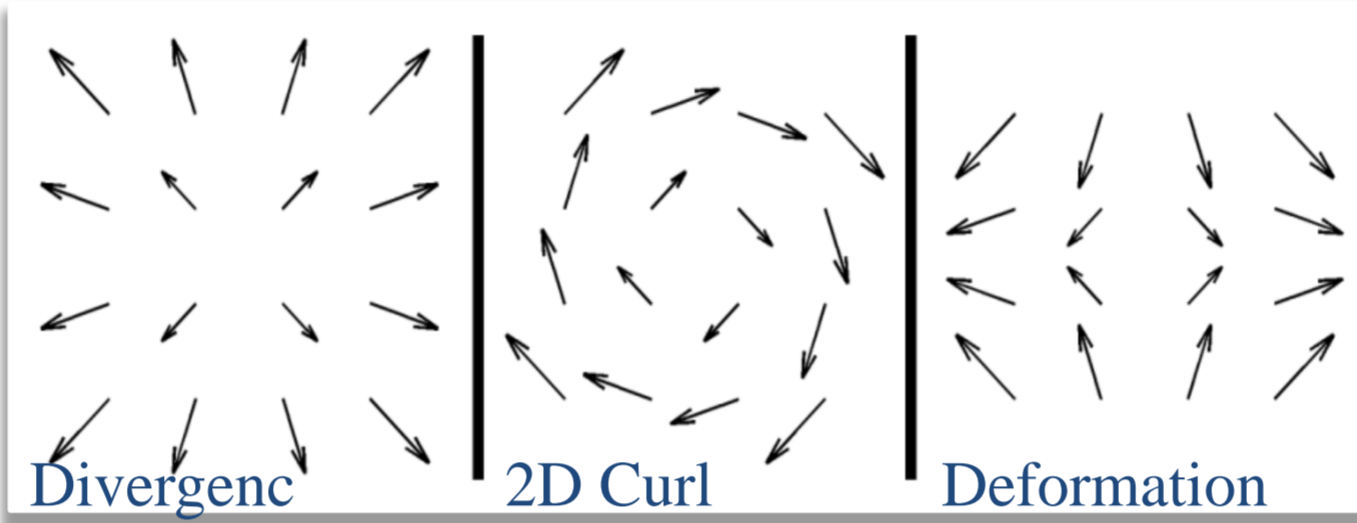•**Line motions** are planes through spatio-temporal volumes

• Detected by moments:

$$\vec{u}_l = -\frac{(m_{200} - m_{020})^2 + 4m_{110}^2}{(m_{200} + m_{020})^3} \begin{pmatrix} m_{011} \\ m_{101} \end{pmatrix}$$
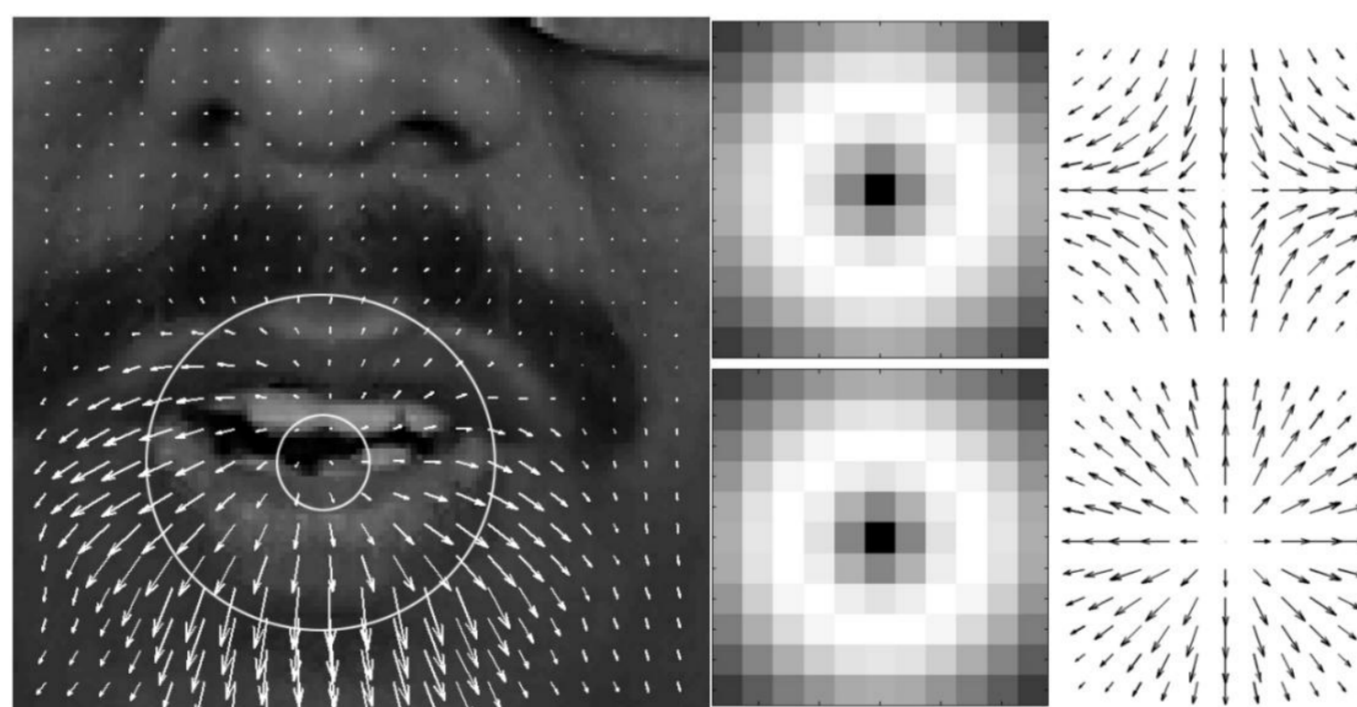
$$\vec{u}_p = \frac{4}{(m_{200} + m_{020})^2} \begin{pmatrix} m_{101}m_{110} - m_{011}m_{200} \\ m_{011}m_{110} - m_{101}m_{020} \end{pmatrix}$$

Invariant Features

Divergence   2D Curl   Deformation

• Desired invariance to **motions of head/device**
• **Divergence** and **deformation** used
• **Curl** and **translation** discarded

• Flow field can be filtered for finding invariants
• Flow field can be represented as complex field
• Filtering can be done in Fourier domain
• Over 200 frames/second implementation in Matlab

Avatar and Lip Events

•Invariants can be used to control area change and deformation of Avatar model
•Rendering in 200 frames/s
•Insensitive to motion of camera and head
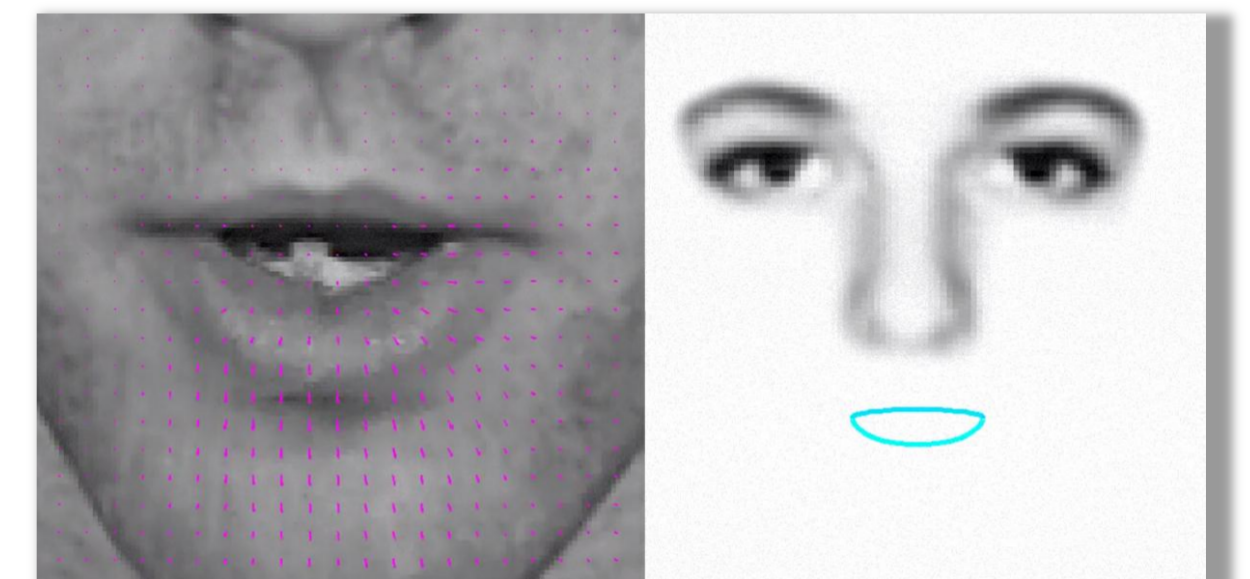
•Another option is to estimate the lip contour area over time
•Estimation of mouth opening and closing events possible
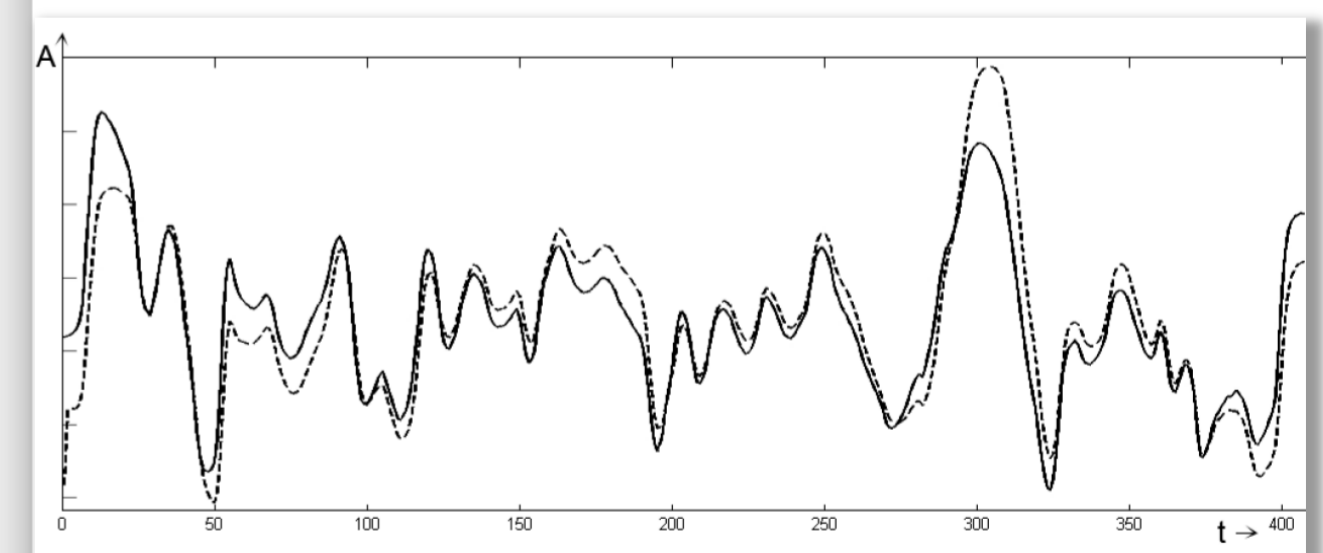
•Full line: groundtruth area
•Dashed line: estimation