Motion Estimation

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Motion Estimation

- Optical Flow in Computer Vision
  - Related topics: feature correspondence, image alignment, image registration
  - Main consideration: **Accuracy**

- Block Matching Algorithms (BMA) in Signal Processing
  - Related topics: video compression
  - Main consideration: **Efficiency**

# We are living a moving world

- Perceiving, understanding and predicting motion is an important part of our daily lives
- Even "impoverished" motion data can evoke a strong percept [1]
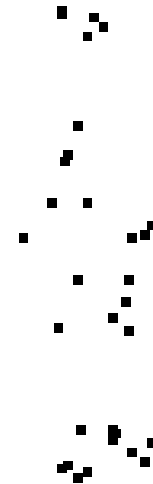
Outline

- Optical Flow (Pixel-level)
  - What is optical flow?
  - Lucas-Kanade (LK) algorithm [2]
  - Horn-Schunck (HS) algorithm [3]

- Block Matching Algorithm (BMA) (Block-level)
  - The principle of BMA
  - Full search scheme
  - Three step search [4]
  - New three step search [5]
  - Four step search [6]
  - Diamond search scheme [7]

What is Optical Flow?
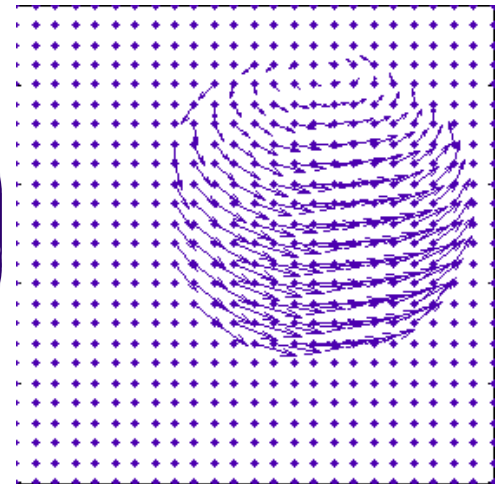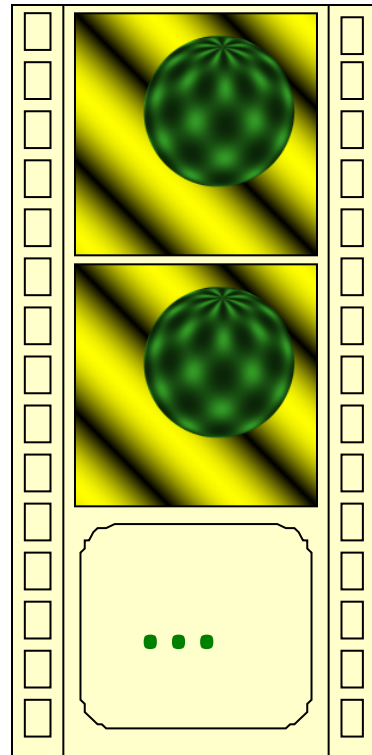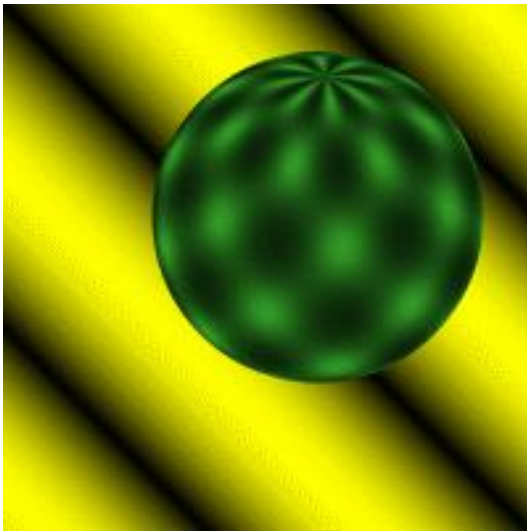
Definitions

The **optical flow** is a velocity field in the image which transforms one image into the next image in a sequence [3]

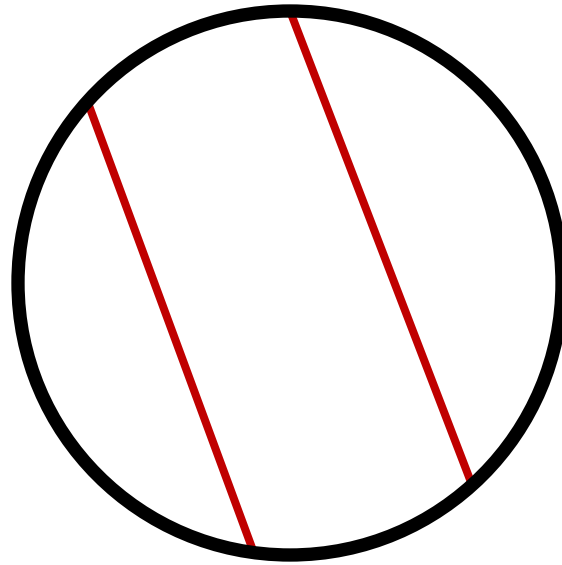frame #1   flow field   frame #2
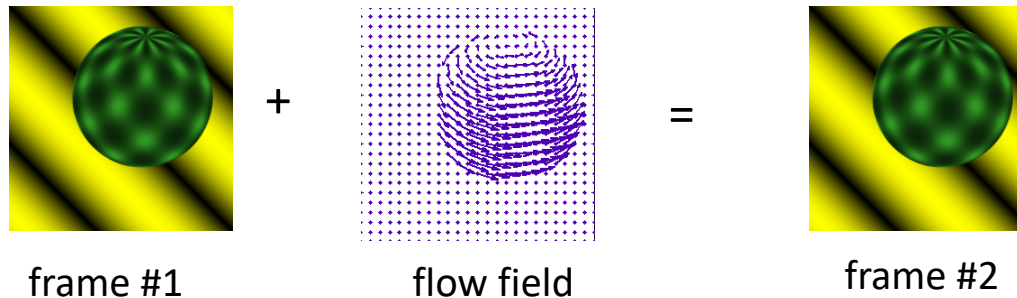
The **motion field** … is the projection into the image of three -dimensional motion vectors [3]
The major limitation of optical flow is that it treats the 3D motion field as a 2D structure.

Aperture Problem

Actual motion
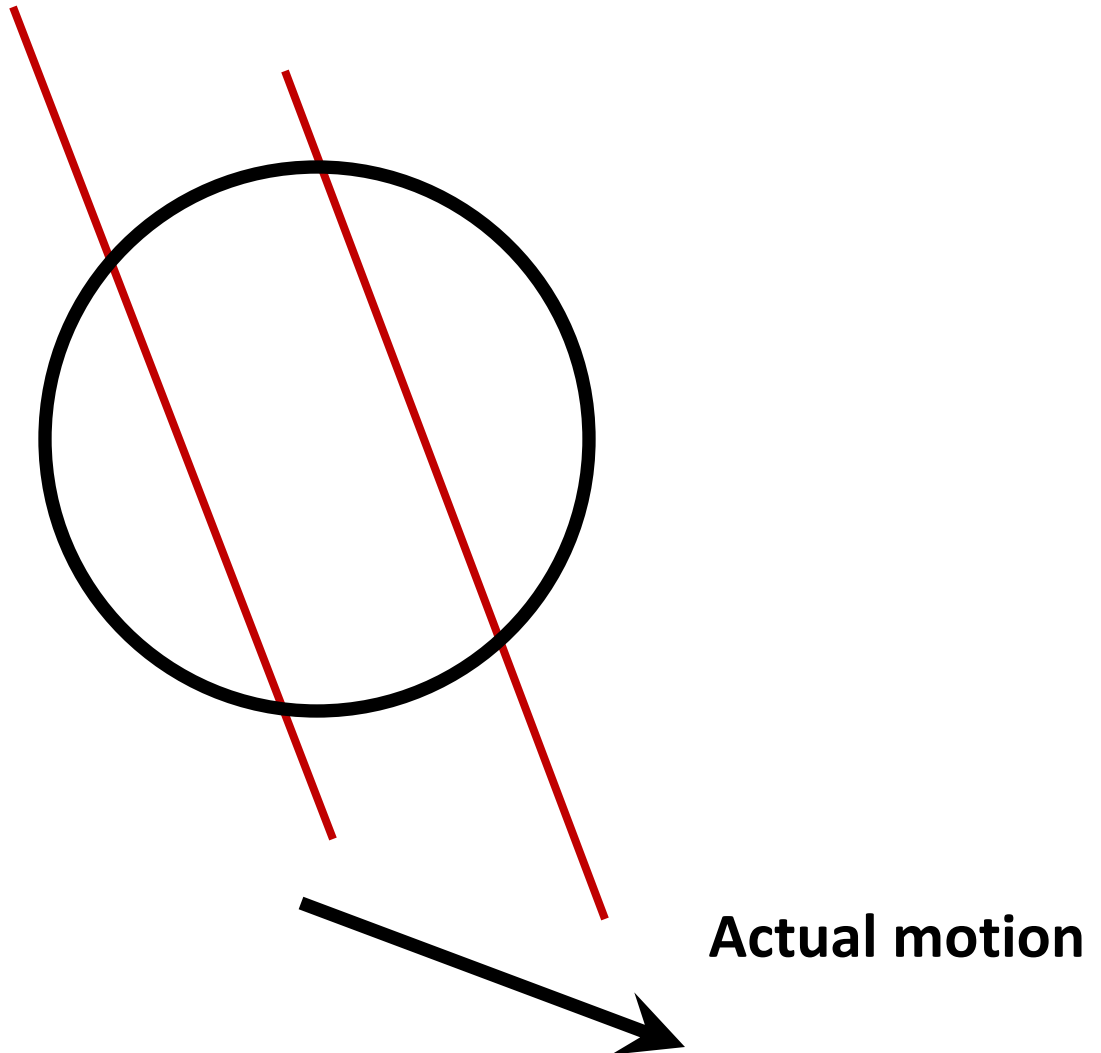
Aperture Problem

Perceived motion

References

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- [2]   B. Lucas and T. Kanade, "An iterative image registration technique with an application to stereo vision," in Proc. of *International Joint Conf. On Artificial Intelligence*, pp.674-679, 1981.

- [3]   B. Horn and B. Schunck, "Determining optical flow," *Artificial Intelligence*, 17:185-203, 1981.

- [4]   T. Koga, K. Iinuma, A. Hirano, Y. Iijima, and T. Ishiguro, "Motion compensated interframe coding for video conferencing," *Proceedings of national Telecommunications conference*, New Orleans, LA, pp.G5.3.1–G5.3.5, Dec. 1981.

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- [7]   S. Zhu and K.-K. Ma, "A new diamond search algorithm for fast block-matching motion estimation," *IEEE Trans. On Image Processing*, 9(2): 287-290, 2000.

Thank You!

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