Deep Learning and its Applications Project Presentation on Ego-motion Computation
Group-11

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Ego Motion

- Generally, ego-motion is defined as the cameras motion within an environment, where the movement of the camera can be in 3D.
- With respect to our project, ego-motion is limited to the motion of a **human head-mounted camera.**

Need for Egomotion estimation

- Augmented reality
- Indoor localization [2]
  - GPS sensors are incapable of working indoors or under tree shelters
  - Object has to be in line of sight of Satellite
- Autonomous navigation
  - Advanced driving assistance systems.
  - Determining behavioral patterns of the driver.
- Visual Odometry
  - IMU sensors, Rotary encoders use the rotation of wheels to find motion.
  - fails when wheels slip or when human/humanoid.

Image sensor is compact, low-cost and self-contained devices, and can be very useful for high-precision applications.

Challenges faces in egomotion estimation

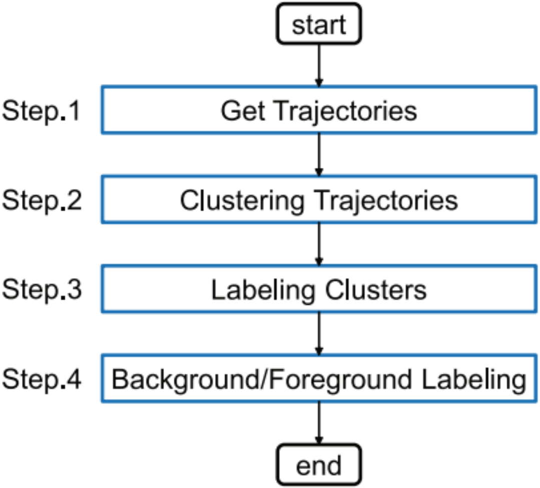
- Occlusion
  - can be caused by depth discontinuities
  - self occlusion occurs in forward motion when the shape of the scene is affected and scale changes in domain.
- Noise
  - Affects stereo and feature tracking performances.
  - Affects ability to compute translational parameters.
- Camera Calibration
  - Join the image plane coordinates to absolute coordinates,
  - Orientation, camera position and camera constant must be determined.

Basic motion estimation concepts

- Independent moving objects
  - objects in the scene that are non-static
  - detecting moving objects is key information when estimating egomotion
  - frame differencing algorithm - not applicable when egomotion present
- Focus of expansion
  - image features seem to diverge from a specific image location
  - intersection point of translation vector with the image plane
- Motion Field
  - projection of 3D scene points onto camera surface.
  - each pixel in image is assigned with a velocity vector.
  - Location of projection of a fixed point may vary with time.
- Optical Flow [1]

Tentative Work Plan

Real-Time Segmentation



Real-Time Segmentation

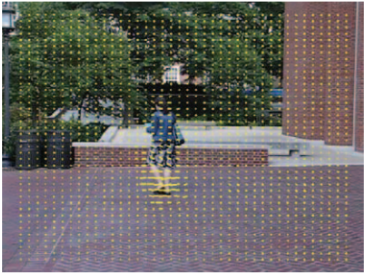


Figure: Trajectory

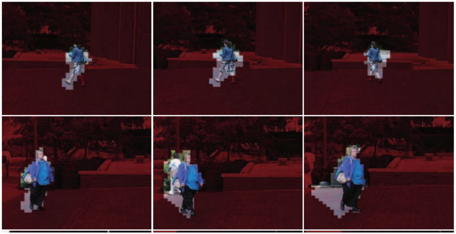


Figure: Results

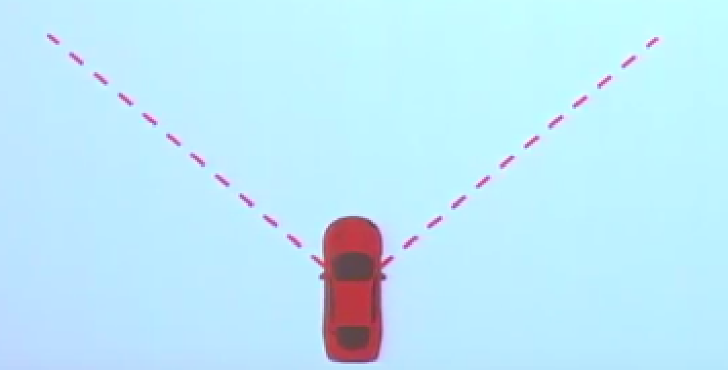
Modifying the image frame

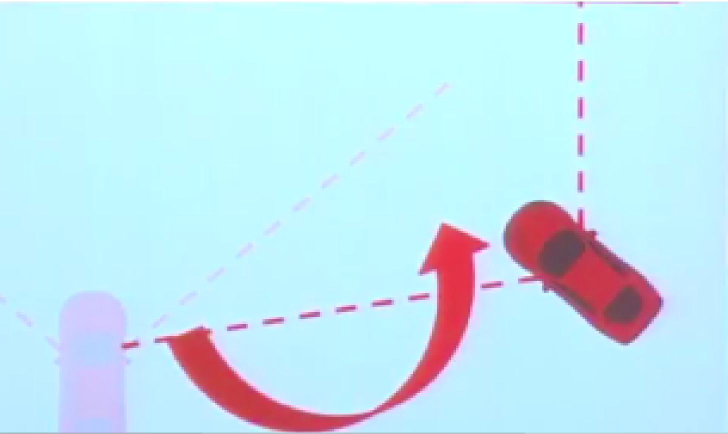
Once we have segmented the foreground from the background, we can blacken the foreground pixels in order to get a static background with no IMOs.

Geometric methods

- Salient feature extraction
- Fails in case of low texture background or blurred images

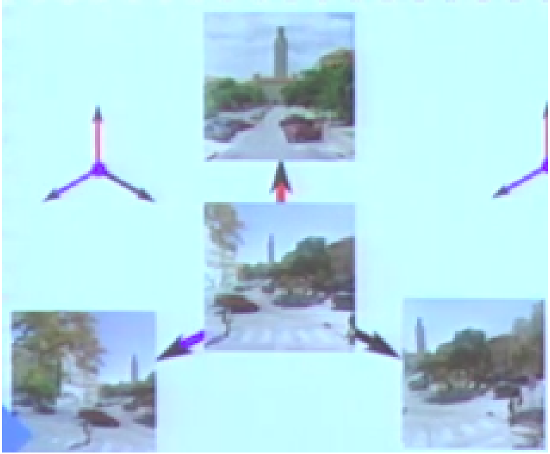
Learning methods





Learning methods Contd

- Learn how the images transform after all possible egomotions
- Create a feature map which takes in a frame as input and gives us all the possible frames after rotational or translational motion.



R. Roberts, H. Nguyen, N. Krishnamurthi, and T. Balch, "Memory-based learning for visual odometry," in *2008 IEEE International Conference on Robotics and Automation*, pp. 47–52, May 2008.

G. Costante, M. Mancini, P. Valigi, and T. A. Ciarfuglia, "Exploring representation learning with cnns for frame-to-frame ego-motion estimation," *IEEE Robotics and Automation Letters*, vol. 1, pp. 18–25, Jan 2016.