Project: Single Object Tracking with Mean-shift
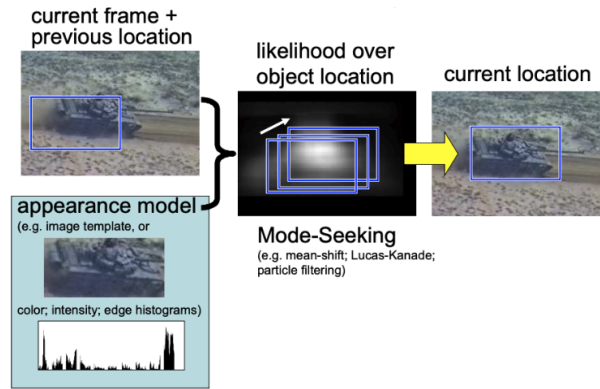
October 17, 2022

Description

Figure 1: Appearance-Based Object Tracking

Object tracking is one of the foremost assignments in computer vision that has numerous commonsense applications such as traffic monitoring, robotics, autonomous vehicle tracking, and so on. Algorithms for this task have been developed for decades from traditional methods like Kanade-Lucas-Tomasi, Mean-shift, CAM-shift to current Deep Learning based method like ROLO, DeepSORT. In this project, we will first have a gentle introduction to Object Tracking (Single Object Tracking specifically) and its performance evaluation metrics, then deep dive into Mean-shift and CAM-shift in the later sections. The classic algorithms of Mean-shift and CAM-shift will not only putted in place and re-implemented from scratch, but also its variants including the combination of Mean-shift with Hough Transform or Scale-Invariant Feature Transform aka SIFT. The problem of fixed window size of Mean-shift will also be discussed. Finally, every considered Object Tracking algorithms in this project will be evaluated in Visual Object Tracking 14 (VOT-14) dataset to better see the improvements through the progress.
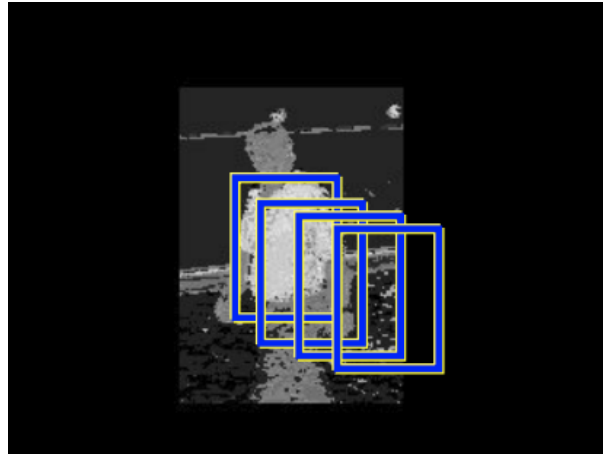
Figure 2: Mean-shift when applied in Single Object Tracking

To be summarized, this project will include the following contents:

- Introduction to Object Tracking and Single Object Tracking

- Deep dive into Mean-shift and its applications

- Analysis Mean-shift in Single Object Tracking

- Mean-shift with some advanced hand-crafted features

- Mean-shift and its fixed window size problem

Prerequisites

For better in following this project, we highly recommend that you are already have had the below knowledges:

- Familiar with Python programming language and OOP

- Familiar with some python packages like Numpy, OpenCV and Matplotlib or similiar.

- Basic knowledges in Calculus and Probability

- Basic knowledges in Machine Learning and Computer vision

We have already prepared some references in the case you wanted to self-revive:

- https://realpython.com/python3-object-oriented-programming/

- https://www.learndatasci.com/tutorials/applied-introduction-to-numpy-python-tutorial/

- https://www.geeksforgeeks.org/matplotlib-tutorial/

- https://www.youtube.com/watch?v=oXlwWbU8l2o

- https://www.3blue1brown.com/topics/calculus

- https://www.3blue1brown.com/topics/probability

- https://www.probabilitycourse.com/

For those want a directly jump in the topic:

- Mean shift, mode seeking, and clustering
- Computer Vision Face Tracking For Use in a Perceptual User Interface
- Kernel Density Estimation - Visual Explained