

CS 585: Image and Video Computing

Homework 5 - Solution

May 7, 2021

1 Exercise 1: Single-Object Tracking (5 pts)

1.1 (a) What is meant by the term “tracking by detection” in computer vision?(2 pts)

In computer vision, the tracking by detection is a tracking paradigm that first applies a detector to obtain all the instances (or detections), and then run a tracker on the set of detections to perform data association, i.e. link the detections across the frames to obtain full trajectories.

1.2 Briefly describe the difference between such a tracker and the alpha-beta tracker. (3 pts)

Both trackers involve detection and data association. The different part is that, alpha-beta trackers do data associations between predictions and measurements while “tracking-by-detection” trackers merely associate measurements from adjacent frames. No predictions about a tracked object will be made in “tracking-by-detection” methods.

2 Exercise 2

Solutions are based on two dimensional points.

1. (4 pts) Assuming a state vector containing position and speed, and measurements of only position, write down a state evolution function / matrix and measurement model matrix for a constant velocity model.

State evolution matrix:

$$\begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Measurement model matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

3 Exercise 3

2. (6 pts) Write down how you would change the state vector, state evolution matrix, and measurement model matrix for a constant position model (where you believe that the value is not changing but is only corrupted by noise).

State vector:

$$\begin{bmatrix} x \\ y \end{bmatrix}$$

State evolution matrix:

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Measurement model matrix:

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

4 Exercise 4: Multi-Object Tracking: Data Association (2 pts)

Advantage of GNNSF: Simple.