

**Exercise 07 for MA-INF 2201 Computer Vision WS22/23**  
**08.12.2022**  
**Submission on 15.12.2022**

**Notice.** You are only allowed to use *OpenCV*, *Numpy*, and *matplotlib* libraries.

## 1 Iterative Closest Points

The goal of this task is to estimate the template model. Using the given image *hand.jpg* and set of landmark points *hand.landmarks.txt*:

- Estimate the transformation  $\Psi$
- Visualize the transformed landmark points using the estimated transformation  $\Psi$

(10 Points)

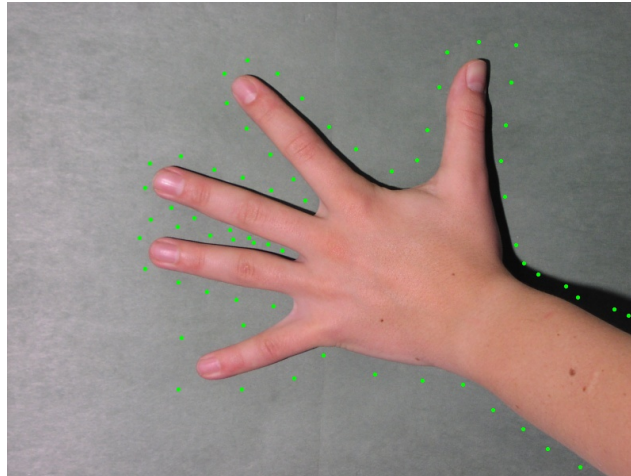


Figure 1: Visualization of the given landmark points on the image

## 2 Extended Kalman Filtering

You need to implement the Extended Kalman Filtering algorithm. You observe a set of 2D noisy observations  $(x_i, y_i)$  which are the coordinates of the 2D space as shown in Figure 2.

**State:** The state of the object should be the 4D vector  $(x, y, v_x, v_y)$  which denote the location and the velocity in each axis.

**Initial State:** You should consider the initial state of  $(-10, -150, 1, -2)$ .

You should write code for performing the Extended Kalman filtering. At the end visualize the filtered output.

(5 Points)

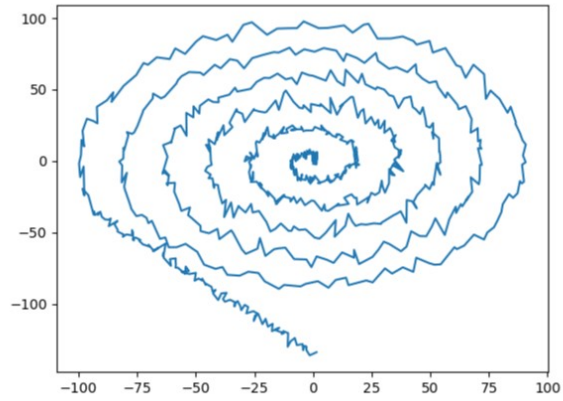


Figure 2: Observations from the location of a clockwise rotating object.

### 3 Unscented Kalman filter

You need to implement the Unscented Kalman Filtering algorithm with the above definition and data. At the end visualize the filtered output. *(5 Points)*