Mobile Robotics Winter term 2024/2025

Lecturer: Prof. Kai Arras
Lab instructors: Till Hielscher, Dennis Rotondi, Fabio Scaparro

Socially Intelligent Robotics Lab
Institute for Artificial Intelligence
Faculty of Computer Science
University of Stuttgart

Submission and voting deadline: see ILIAS

Submission Instructions: For the solution of theoretical tasks, use a header with your name and Matrikelnummer on each sheet and combine all files (pictures, scans, LaTeX-ed solutions) into a single `.pdf` document. For code solutions, if not stated otherwise, your code should execute correctly when called from a single `.m` or `.mlx` script (external functions are ok as long as they are called from the script). Each file you submit must include a header with your name and Matrikelnummer. Please add comments to make your code readable and to indicate to which task and subtask it refers to. For submission, all files should be included in a single `.zip` archive named as: `Ex08_YourLastname_Matrikelnummer.zip`. Remember to vote on the tasks that you solved and be ready to present them.

Exercise 08: LeastSquaresBasics&ICP

Exercise 08.1: Iterative Closest Point implementation

You are provided with two point clouds stored in `P.mat` and `P_new.mat`. Your task is to determine the transformation that aligns the points in `P` with those in `P_new` through various approaches. Implement this exercise in the main script file. Data association: same index.

a) **Closed Form Solution:** Implement the closed-form variant of the Iterative Closest Point (ICP) algorithm. Apply the resulting transformation to `P` and plot the transformed points alongside `P_new`, using different colors for each set.

b) **Iterative Solution:** Implement the iterative variant of ICP, initializing it with the Identity. Apply the resulting transformation to `P` and plot the transformed points alongside `P_new`, using different colors for each set.

c) **Relaxed + Iterative Solution:** Implement the iterative variant of ICP, initializing it with the results of Relaxed ICP. Apply the resulting transformation to `P` and plot the transformed points alongside `P_new`, using different colors for each set.

Exercise 08.2: Real world Example

For this task, you will be working with a renowned Laser Scanner dataset stored at the file path `point_correspondences.mat`. The dataset comprises an array of information, where each position contains details about a specific laser scan denoted by `data`(i).

The fields within `data`(i) are:

- `points`: a collection of all points representing the laser scan at index i.
- `correspondence_with`: the index of the laser scan that can be matched with scan i.
- `correspondences`: a two-column array. Each row denotes data associations between the indexes of the point clouds i (first column) and *correspondence_with* (second column).

Your task involves applying an ICP method of your choice to the pair of matching point clouds at each index in the dataset. Subsequently, you are required to plot the outcome from the perspective of a single frame. Implement this exercise in the full_icp script file.