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Praktikum Smart Data Analytics

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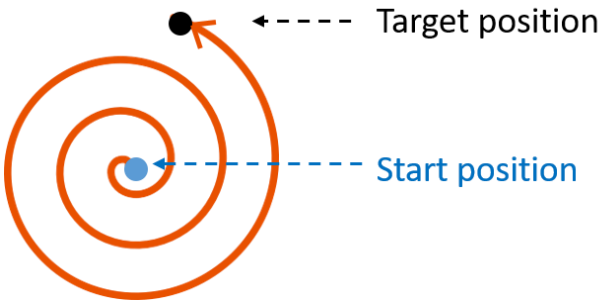
Assignment 4

Introduction

In through-hole assembly, electronic components with wire connections (e.g., integrated circuits) are inserted into contact holes on a printed circuit board and then soldered. Robotically inserting such a component without damaging the wire connections is anything but trivial. It is necessary to first find the exact location of the contact hole and then insert the component very carefully. In order to find the exact hole-location, spiral search strategies are usually used.



In the spiral search, the robot arm places the component at a predefined starting position on the PCB and then carefully pushes it spirally over the board until it finds the correct target position. For some reasons, such as vibration-

induced displacement, the relative positions of the starting points and the targets point are stochastically distributed. Different relative positions result in different search durations. Long search durations lead to fewer orders being completed within the specified time. In this assignment, you will analyze the process data collected during assembly, in order to optimize the assembly process (minimize the search duration).

The data was provided by Artiminds Robotics Gmbh from Karlsruhe, which produces Robot Programming Suite (RPS) software for robot arms that is intuitive, flexible and robot manufacturer independent. For more details, refer here.

Data Description

The data consisted of 74 trials collected on May 30, 2017. In each trial, the robot arm inserted eight components into the PCB board. The process of each insertion is divided into three segments. First, the robot arm moves to a specified starting position, then the robot arm descends to a specified height, and finally begins the spiral search. Each trial is referred to as a "run" in the data set and typically contains 24 "segments".

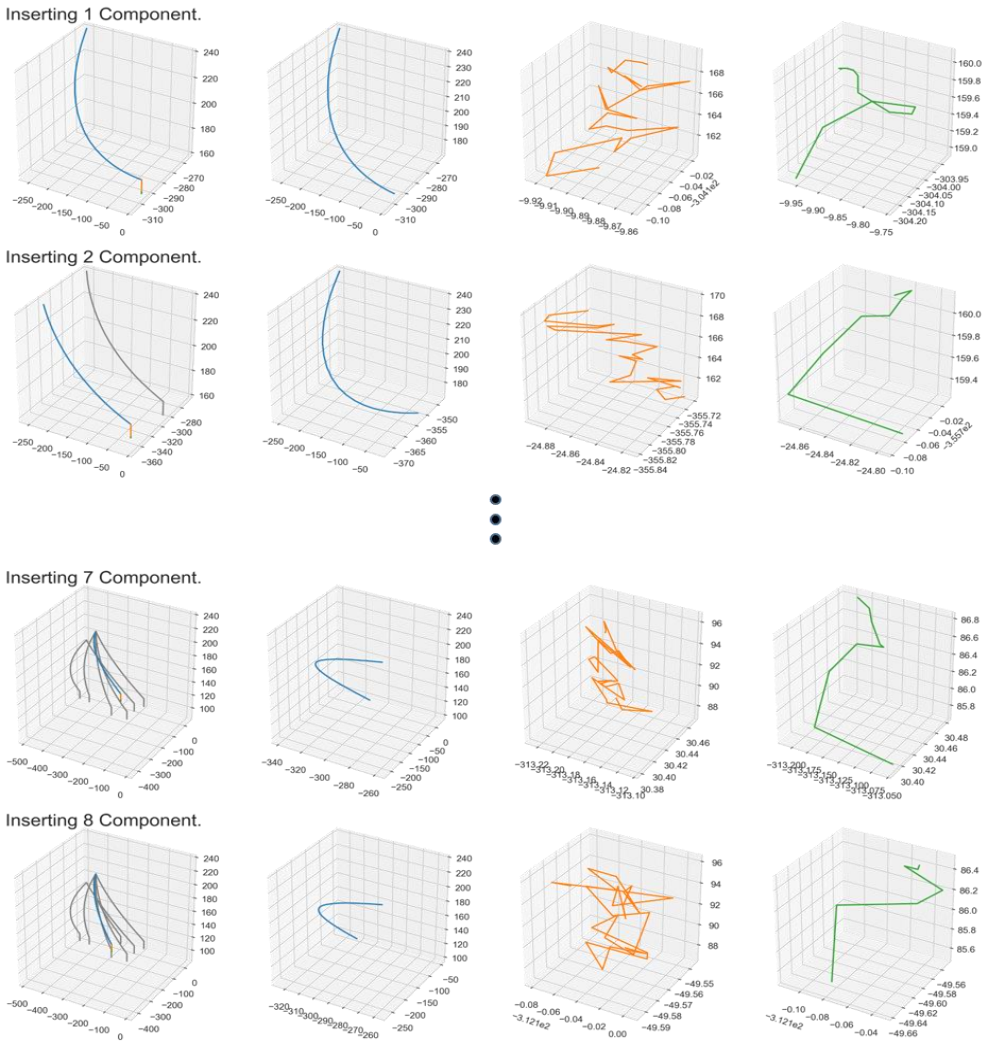
	id	run	timestamp	segment	start_time	end_time	force_x	force_y	force_z	pos_x	pos_y	pos_z	rot_x	rot_y	rot_z
0	163.0	0.0	2017-05-30 09:21:13.150	11.0	2017-05-30 09:21:05	2017-05-30 09:22:41.607	-0.543045	-2.924596	-7.257000	-257.695704	-265.980105	240.007357	-0.008832	0.034723	179.958414
1	164.0	0.0	2017-05-30 09:21:13.200	11.0	2017-05-30 09:21:05	2017-05-30 09:22:41.607	-0.465969	-3.278856	-7.522000	-257.617629	-265.999590	240.004745	-0.000171	0.019928	179.968161
2	165.0	0.0	2017-05-30 09:21:13.250	11.0	2017-05-30 09:21:05	2017-05-30 09:22:41.607	-0.317475	-3.435834	-7.705999	-256.626803	-266.602650	239.791224	-179.993978	179.989304	0.164766
3	166.0	0.0	2017-05-30 09:21:13.300	11.0	2017-05-30 09:21:05	2017-05-30 09:22:41.607	-0.298383	-3.457754	-7.580999	-254.594017	-267.926090	239.323013	-179.992478	179.999036	0.577883
4	167.0	0.0	2017-05-30 09:21:13.350	11.0	2017-05-30 09:21:05	2017-05-30 09:22:41.607	-0.289898	-3.447854	-7.539000	-251.411919	-269.894497	238.550625	-179.996649	179.988091	1.210269

The figure above is an example of the data, it contains a total of 15 columns:

- Id: Identification number of the data point
- Run: Identification number of each trial
- timestemp: timestamp of the data point
- segment: identification number of each segment

- start_time: Start time of each trial
- end_time: End time fo each trial
- force_x/y/z: value of the 'force sensor' at the given timestamp
- pos_x/y/z: position of the robot arm at the given timestamp
- rot_x/y/z: rotation of the robot arm at the given timestamp

The Figure below shows the assembly process for run=11. The column on the left shows the robot arm inserting eight electrical components in sequence. Each insertion is divided into three segments (indicated by three colors). The three columns on the right show the corresponding trajectory of each segment. The segment in green is the spiral search segment.



Task

- Date exploration
- Optimize the search strategy to minimize the search duration
- Design how to evaluate your methods and then conduct the evaluation