Final Assignment – Robotic simulation of a manufacturing process

60 points of your final grade

For your final assignment, you will create a robotic simulation of a manufacturing (or other industrial) process.

The simulation will be constructed in the RoboDK robot simulator.

You are free to choose any manufacturing/assembly/construction or other industrial process you wish. Furthermore, this assignment allows you to put emphasis on your personal engineering background. This means that if you are more comfortable with programming, that can be a large part of your process. If you are more comfortable with CAD design, that can be a large part of your process, etc.

Your simulation MUST contain the following:

- At least one robotic arm
- A multi-stage process conducted by the robotic arm(s)

Furthermore, your simulation must contain **at least five** of the following. The lines marked in bold are more difficult, and count as two.

1. Multiple robotic arms working simultaneously
2. **Multiple robotic arms working in collaboration**
3. Sensory simulation (such as a camera)
4. A robot tool of your own design
5. **Assembly of a machine of your own design**
6. Imported external parts (not from RoboDK)
7. **An API interface in any programming language, with appropriate high-level functionality**
8. **A robot arm that does not exist in RoboDK**
9. Auxiliary machines, such as a conveyor belt, turntable, linear track etc.
10. Path planning
11. Collision detection
12. Decision making (given randomized conditions)

While you must incorporate five of these, you are encouraged to include more. **The more complex your simulation is, the better.**

If you wish to incorporate a process that is not mentioned here, you are welcome to.

You are permitted to build upon existing examples from RoboDK, but nothing pre-existing will count towards your

Example 1: CAD oriented

Process description: Assembly of a bicycle frame

Detailed description:

Robot #1 removes parts of a bicycle frame from shelves using a parallel-jaw gripper, and hands them to Robot #2. Robot #2 has a custom made gripper that holds four bicycle parts simultaneously, so that they are all in place. Robot #3 performs welds between the parts while Robot #2 is holding them. Robot #2 moves the bicycle as needed to enlarge the workspace. When the welding is finished, robot #2 places the frame on a "finished" shelf. This is repeated for 4 bicycles.

This process includes the following: **(2) Multiple robotic arms working in collaboration,** (4) A robot tool of your own design, (5) **Assembly of a machine of your own design.** Since tasks 2 and 5 are considered double, this constitutes a valid process.

Example 2- programming oriented

Process description: Circuit board testing

Detailed description:

Robot #1 is next to a conveyor belt. The conveyor belt transports circuit boards. When a circuit board arrives at Robot #1, the conveyor belt stops. The robot uses a testing tool to check 10 predetermined points on the board. Each check is either "good" or "bad" with probability 0.95 for "good".

After checking is completed, the conveyor belt transports the circuit board to Robot #2, which performs "Fixes". The robot attempts to "Fix" a bad point by touching it with a fixing tool. The point is fixed with probability 0.8 (but success is unknown to the robot). After passing through Robot #2, the circuit board continues to Robot #3. Robot #3 moves the circuit board to the "good" pile, or places it on a conveyor belt that loops back to repeat the process. An API keeps track of each circuit board, and its good or bad points. The API makes decisions on what points to fix, or where to move the board, based on evidence from the testing process.

This process includes the following: (1) Multiple robots working simultaneously, (6) Imported external parts (not from RoboDK), **(7) An API interface in any programming language, with appropriate high-level functionality,** (9) Auxiliary machines, such as a conveyor belt, turntable, linear track etc., (12) Decision making (given randomized conditions)

Since task 7 is considered double, this process fulfills 6 out of 5 requirements, which is good.

You do not need to approve your simulation ahead of submission. However, if you are unsure about the complexity of the process you have chosen, you are welcome to contact me by WeChat or email, and I will happily advise you.

You must submit your RoboDK simulation (*.rdk file), along with any auxiliary files (such as API files) to the course website by 23.6.2021.

Good luck!