ECE564/565, Fall 2019, Fundamentals of Autonomous Robots/Lab.

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**HW#1**

**Due on: Thursday, September 5th, in class.**

# Problem 1: (15 Points)

## Name the three robotic paradigms, and draw the relationship between the primitives.

The three robotics paradigms are the Hierarchical Paradigm, Reactive (Biological) Paradigm, and the Hybrid Deliberative/Reactive Paradigm. The Hierarchical Paradigm utilizes all three primitives in series first sensing, planning, and then acting. On the other hand, the Reactive Paradigm does no planning, just a concurrent mix of sensing and acting. Lastly, the Hybrid Deliberative/Reactive Paradigm does some upper level planning while utilizing some strict Reactive Paradigm components.

# Problem 2: (10 Points)

## List three problems with teleoperation.

The three problems with teleoperation are cognitive fatigue, communications, and many to one human robot ratios. Cognitive fatigue relates to the finite amount of time a human can control a robot without getting tired. Communications speaks to the requirement to have a connection between the robot and the teleoperator. And lastly, achieving intuitive control systems for facilitating the control of many robots by a single human has proven to be a tough challenge.

# Problem 3: (15 Points)

## Describe the difference between telepresence and semi-autonomous control.

The main difference between telepresence and semi-autonomous control has to do with who the primary controller of the robot is. In telepresence, the operator is the primary controller of the robot while in semi-autonomous, both the human and the computer are always involved in the control.

# Problem 4: (15 Points)

## List the six characteristics of applications that are well suited for teleoperation.

The six characteristics of applications that are well suited for telesystems include (taken from lecture 4):

* Tasks that are unstructured and not repetitive
* Task workspace cannot be engineered to permit the use of industrial manipulators
* Key portions of the task require
  + Dexterous manipulation, especially hand-eye coordination, but not continuously
  + Object recognition or situational awareness
* The needs of the display technology do not exceed the limitations of the communication length (bandwidth, time delays)
* The availability of trained personnel is not an issue.

# Problem 5: (15 Points)

## List advantages and disadvantages of the Hierarchical Paradigm.

The main benefit to a Hierarchical Paradigm is the descriptive nature of the process. It is clear in every moment of a well logged program the steps the program took during execution regarding sensing, planning, and acting. The main disadvantages are a requirement for a lot of memory, slow planning, and the difficulty of programming.

# Problem 6: (15 Points)

## Explain “shared control”.

Shared control is when a human has continuous interactions with a remote robot. The human interacts by adding feedback and can interrupt the execution as needed. In addition, the robot will continue concurrent processes such as those that follow the Reactive Paradigm.

# Problem 7: (15 Points)

## What are the two improvements to a classic teleoperation?

## And what do they (improvements) aim for?

The two teleoperation improvements discussed in class are telepresence and collaborative teleoperation. Telepresence’s goal is to reduce simulator sickness and cognitive fatigue by providing sensory feedback to the teleoperator. This works to convince the teleoperator’s brain they are “present” in the robot’s environment. Collaborative teleoperations improve the effectiveness of remote-controlled teleoperations by allowing multiple teleoperators to operate different components of the robot simultaneously.