Information Technology Institute

Lecture 0 – Friday March 8, 2012

# Robotics

# Outline

- Course Description

- Course Outline

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# Course Description

This course covers the **foundations of robotics** addressing different topics including robot morphology, actuators, sensors, forward, inverse and differential kinematics, trajectory planning and motion control. In addition, special topics will be introduced such as computational intelligence and visual servoing.

This course a **lecture-exercise-paper-project** course that covers the foundations of robotics addressing different topics including:

# Course Outline

| Week | Date | Lectures | Self-Study | Lab/Tut. |
|------|------|----------|------------|----------|
| 1 | March 8 | Course Presentation | | |
| 1 | March 8 | Introduction to Robotics | | |
| 1 | March 8 | Robot Morphology | | |
| 2 | March 15 | Position Analysis | SS-A.1: Robot Statistics and Market Penetration | |
| 2 | March 15 | Forward Kinematics | | |
| 2 | March 15 | Inverse Kinematics | | |
| 3 | March 22 | Differential Motions and Velocities | SS-A.2: Actuation Systems | |
| 3 | March 22 | Trajectory Planning | | |
| 4 | March 29 | SS-B: Literature Survey Paper and SS-C: Paper Critics Presentation | | |
| 5 | April 5 | Motion Control Systems | SS-A.3: Sensors for Mobile Robots | Tutorial |
| 5 | April 5 | Microcontrollers & Input-output Systems | | |
| 6 | April 12 | Industrial Robots Programming | | |
| 6 | April 12 | Computational Intelligence and Visual Servoing | | Lab |
| 7 | April 19 | Mini-project Presentation | | |
| 8 | April 26 | Final Exams | | |

# Course Outline

- **Self-study**

**Self-study**

Robot Report  ∩  Literature Survey Paper ∩  Paper Critics
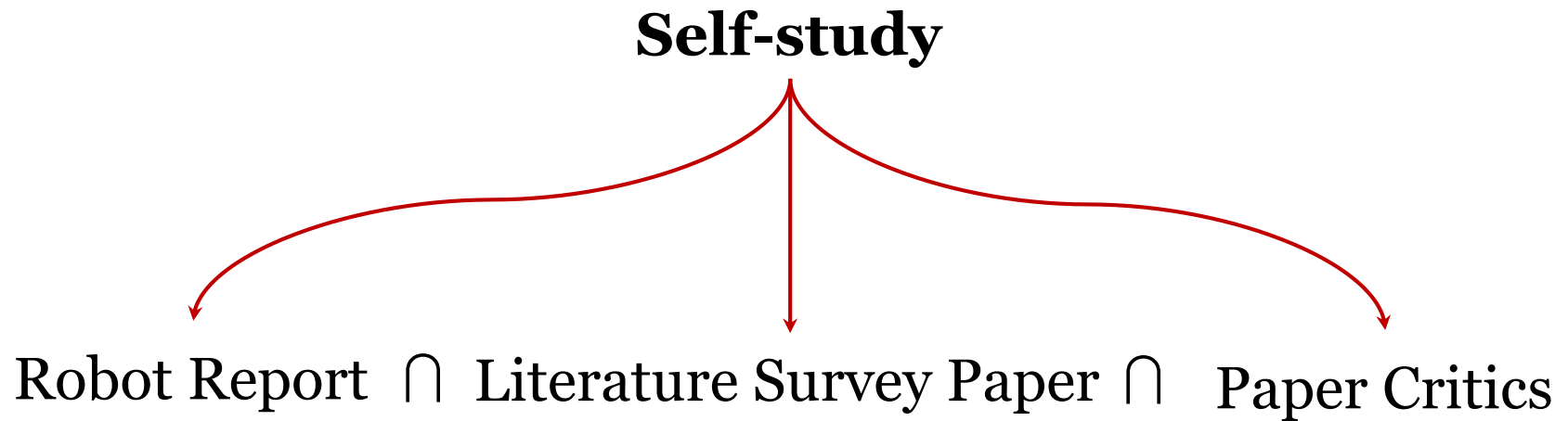
# Course Outline

- ## Self-study

| A: Robot Reports |
|---|

- Robot Statistics and Market Penetration
- Actuation Systems
- Sensors for Industrial Robots.
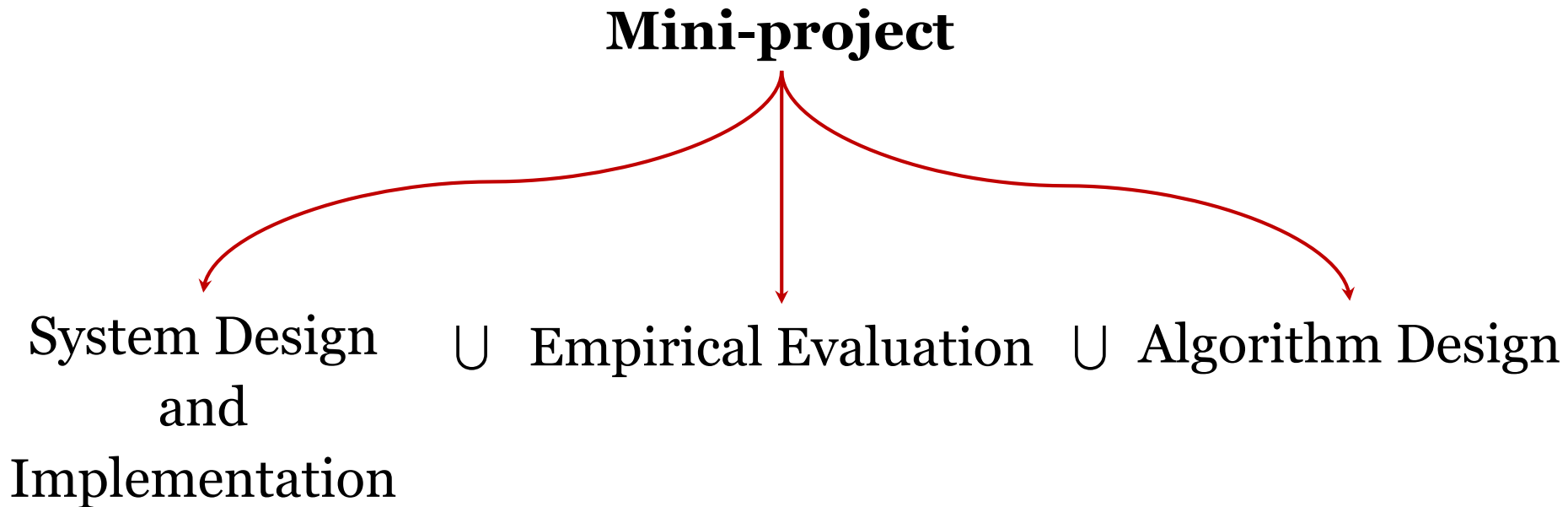
| B: Literature Survey Paper |
|---|

- Students will pick a robotics problem that interests them.
- The students will be asked to put themselves in the shoes of authors of a conference or a journal survey paper.
- They are supposed to search the literature for approaches to tackle this problem.
- Then they survey and discuss the relative strengths of each approach.
- The paper will be 4-6 pages. Student must comply strictly with the formatting instructions using the IEEE template, which can be downloaded from here.

| C: Paper Critics |
|---|

- The students must pick one of the papers available in Journal of Robotics as an open access journal. The paper must be related to Industrial Robotics, Robotic Arms or Mechanical Manipulators.
- The students will be asked to put themselves in the shoes of a reviewer for a conference or journal.
- They should give constructive feedback to the authors.
- They will mention also the good and weak aspects of the paper.
- For every criticism, students will make a suggestion to improve the paper.
- Paper Critics form must be used.

# Course Outline

- **Mini-project**

**Mini-project**

System Design and Implementation $\cup$ Empirical Evaluation $\cup$ Algorithm Design

# Course Outline

- ## Mini-project

### Type A: System Design and Implementation

- Students identify a problem in a pertinent area of academic, industrial or commercial importance for which there are no available system with reasonable cost and capabilities. This system must contain a combination of mechanical, electronic, computer and control components integrated together in order to solve the problem at hand.
- Design and develop a new robotic system to solve this problem.
- Analyze experimentally the performance of the developed system.

### Type B: Empirical Evaluation

- In this type of projects, student will pick a problem that interests him/her.
- Student is supposed to search the literature for approaches to tackle this problem, identifies strong and weak points of each approach and selects the most appropriate appraoch.
- He/she must implement and experiment with the selected technique to quantitatively evaluate its performance in tackling the problem.

### Type C: Algorithm Design

- Student identifies a problem for which there are no satisfying approaches.
- Develop a new technique to tackle this problem.
- Analyze theoretically and/or empirically the performance of his/her technique.

# Course Policy

| Evaluation Method | Weight |
|---|---|
| Attendance | 5% |
| In-class participation | 5% |
| Self-study | 15% |
| Mini-project | 35% |
| Final Exam | 40% |
| Total | 100% |

# Course Resources

- ## Course Website

  http://www.alaakhamis.org/teaching/MCT200/index.html

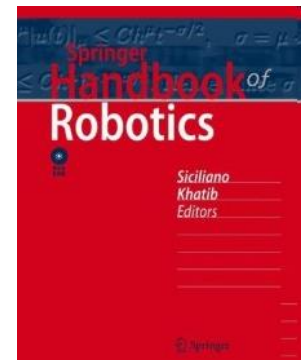- ## Textbook

  - Saeed Benjamin Niku. *Introduction to Robotics: Analysis, Control, Applications*. 2nd Edition, Wiley, 2010.
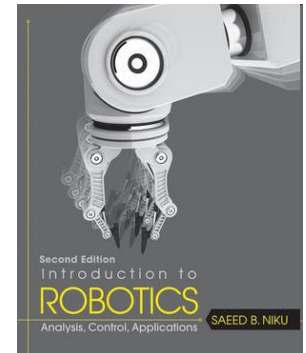
  - B. Siciliano and O. Khatib. Springer *Handbook of Robotics*. Springer-Verlag Berlin Heidelberg 2008.

# Course Resources

- **Course Instructor**

  Dr. Alaa Khamis

  Email: alaakhamis[at]gmail[dot]com

- **Course TA**

  Eng. Omar Mahmoud

  Email: omar[dot]mohamad[at]guc[dot]edu[dot]eg

# *Questions?*