Course Syllabus

Course Information
Course Number/Section  CS 6301.001
Course Title          Special Topics in Computer Science: Introduction to Robot Manipulation and Navigation
Term                 Fall 2022
Class Level          Graduate
Activity Type        Lecture
Days & Times         Monday & Wednesday 1:00 PM – 2:15 PM
Location             ECSW 3.210
Course Modality      Face-to-Face
Credit Hours         3

Professor Information
Instructor           Prof. Yu Xiang, Ph.D.
Office Phone         (972) 883-3891
Email Address        yu.xiang@utdallas.edu
Office Location      ECSS 4.702
Office Hours         Monday & Wednesday 3:30PM – 4:30PM

Teaching Assistant Information
Teaching Assistant   Ninad Khargonkar
Email Address        ninadarun.khargonkar@utdallas.edu
Office Location      ECSS 3.618
Office Hours         Tuesday 1:00PM – 2:00PM

Course Pre-requisites, Co-requisites, and/or Other Restrictions
MATH 2418 Linear algebra, MATH 2413 Differential Calculus or MATH 2417 Calculus I, CS 2336 Computer Science II, CS 5343 Algorithm Analysis and Data Structures

Course Description
Theory and practice of robotics. Provides in-depth overview of robot manipulation and robot navigation, including kinematics, statics, and dynamics of robot manipulators, motion planning, state estimation, environment mapping and robot control.

Student Learning Objectives/Outcomes
- Ability to understand the design of robot manipulators and wheeled robots.
- Ability to understand kinematics, statics, and dynamics in robot manipulation
- Ability to solve motion planning problems in manipulation and navigation
- Ability to understand state estimation with filtering techniques in robot navigation
- Ability to perform environment mapping for robot navigation
- Ability to understand robot control for manipulation and navigation
**Required Textbooks and Materials**
ISBN-10: 1107156300
http://hades.mech.northwestern.edu/images/7/7f/MR.pdf

Textbooks and some other bookstore materials can be ordered online or purchased at the UT Dallas Bookstore.

**Technical Requirements**
In addition to a confident level of computer and Internet literacy, certain minimum technical requirements must be met to enable a successful learning experience. Please review the important technical requirements on the Getting Started with eLearning webpage.

**Course Access and Navigation**
This course can be accessed using your UT Dallas NetID account on the eLearning website. Please see the course access and navigation section of the Getting Started with eLearning webpage for more information.

To become familiar with the eLearning tool, please see the Student eLearning Tutorials webpage. UT Dallas provides eLearning technical support 24 hours a day, 7 days a week. The eLearning Support Center includes a toll-free telephone number for immediate assistance (1-866-588-3192), email request service, and an online chat service.

**Communication**
This course utilizes online tools for interaction and communication. Some external communication tools such as regular email and a web conferencing tool may also be used during the semester. For more details, please visit the Student eLearning Tutorials webpage for video demonstrations on eLearning tools.

**Distance Learning Student Resources**
Online students have access to resources including the McDermott Library, Academic Advising, The Office of Student AccessAbility, and many others. Please see the eLearning Current Students webpage for more information.

**Server Unavailability or Other Technical Difficulties**
The University is committed to providing a reliable learning management system to all users. However, in the event of any unexpected server outage or any unusual technical difficulty which prevents students from completing a time sensitive assessment activity, the instructor will provide an appropriate accommodation based on the situation. Students should immediately report any problems to the instructor and also contact the online eLearning Help Desk. The instructor and the eLearning Help Desk will work with the student to resolve any issues at the earliest possible time.
Grading Policy
Credit Distribution
- Homework (50%)
  - (10%) Homework #1
  - (10%) Homework #2
  - (10%) Homework #3
  - (10%) Homework #4
  - (10%) Homework #5
- Team Project (45%)
  - (5%) Project proposal
  - (10%) Project mid-term report
  - (15%) Project presentation
  - (15%) Project final report
- In-Class Activity (5%)

Grading Scale
- A  93 or above
- A-  90-93
- B+  87-90
- B   83-87
- B-  80-83
- C+  77-80
- C   70-77
- F   70 or below

Course Policies
- eLearning is the official information portal for this course. Course announcements, homework, lecture slides, assignments, and grades will be communicated via eLearning
- Final course grade will be posted in Galaxy by the Records Office
- Attendance:
  - Required for mandatory class sessions. There will be 1-point deduction for each mandatory class absence in Team Project participation score (5%). There will be zero point for class participation if the number of absences is three or more.
- If you decide to stop attending class, be sure to drop or withdraw from the course. Otherwise, you risk receiving an ‘F’ or ‘NF’ for the course.
- No additional individual assignments can be assigned for extra credit. Only assignments that are available to the entire class may count toward the course grade.

UT Dallas Syllabus Policies and Procedures
Please visit [http://go.utdallas.edu/syllabus-policies](http://go.utdallas.edu/syllabus-policies) for other policies
<table>
<thead>
<tr>
<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
<th>Deadlines</th>
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<tr>
<td>1</td>
<td>8/22 Introduction to Robotics</td>
<td>8/24 Configuration Space</td>
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<td>2</td>
<td>8/29 Task Space, Workspace, Introduction to ROS</td>
<td>8/31 2D Rigid-Body Motions and Rotation Matrices</td>
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<td>3</td>
<td>9/5 Labor Day</td>
<td>9/7 Course Project Description</td>
<td>HW1 release on 9/5, due 9/12 at 11:59PM CT</td>
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<td>4</td>
<td>9/12 Angular Velocities and Exponential Coordinates of Rotations</td>
<td>9/14 Matrix Logarithm of Rotations and Homogeneous Transformation Matrices</td>
<td>Project description release on 9/12, proposal due 9/19 at 11:59PM CT</td>
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<tr>
<td>5</td>
<td>9/19 Twists and Screw Axes</td>
<td>9/21 Exponential Coordinates of Rigid-Body Motions and Wrenches</td>
<td>HW2 release on 9/21, due 9/28 at 11:59PM CT</td>
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<td>6</td>
<td>9/26 Forward Kinematics and Denavit-Hartenberg Parameters</td>
<td>9/28 Forward Kinematics and Product of Exponentials Formula</td>
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<td>7</td>
<td>10/3 Velocity Kinematics</td>
<td>10/5 Inverse Kinematics</td>
<td>HW3 release on 10/5, due 10/12 at 11:59PM CT</td>
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<td>8</td>
<td>10/10 Dynamics I</td>
<td>10/12 Dynamics II</td>
<td>Project mid-term report due 10/26 at 11:59PM CT</td>
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<td>10/17 Dynamics III</td>
<td>10/19 Robot Control I</td>
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<td>10/24 Robot Control II</td>
<td>10/26 Robot Control III</td>
<td>HW4 release on 10/26, due 11/2 at 11:59PM CT</td>
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<td>11</td>
<td>10/31 Motion Planning I</td>
<td>11/2 Motion Planning II</td>
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<td>12</td>
<td>11/7 Wheeled Mobile Robots</td>
<td>11/9 Grasp Planning</td>
<td>HW5 release on 11/9, due 11/16 at 11:59PM CT</td>
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<td>13</td>
<td>11/14 Reinforcement Learning I</td>
<td>11/16 Reinforcement Learning II</td>
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<td>11/21 Fall Break</td>
<td>11/23 Fall Break</td>
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<td>15</td>
<td>11/28 IRVL Visit</td>
<td>11/30 Guest Lecture: Dr. David Held</td>
<td>Project final report due 12/14 at 11:59PM CT</td>
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<td>16</td>
<td>12/5 Project Presentation I</td>
<td>12/7 Project Presentation II</td>
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The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.