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CENTRE FOR AUTONOMOUS SYSTEMS

41014 Sensors and Control for Mechatronic Systems

Dr. **Liang Zhao**

Centre for Autonomous Systems
University of Technology, Sydney

UNIVERSITY OF TECHNOLOGY SYDNEY

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41014 Sensors and Control for Mechatronic Systems

Group Projects

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6. Group Projects

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- Group Projects:
  - Form ***30%*** of the assessment for the subject
  - Form ***a group of 3*** students
  - Minimum 2 choices each group
  - Submit choices and grouping through UTSOnline Discussion Board before ***6pm, 12 April 2018***
- Deadlines:
  - **Project Proposal**: 18/04/2018
  - **Final presentation (with demo)**: 04/06/2018, during the last lecture
  - **Project report**: 04/06/2018

6. Group Projects

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- Fetch Robot Projects:
  - The groups which work on the Fetch Robot related projects may be selected to represent UTS:CAS to demo their works with Fetch Robot in the future (e.g. UTS Open Day). The project will first be carried out in simulations, when the algorithms are working well in simulations, they will be tested using the Fetch robot.

6. Group Projects

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- Group Project 1: Fetch robot following the path
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - Using the learnt and state-of-art control algorithm to control the Fetch robot to follow the path of the guider in front. Both depth images and RGB images can be used to the control. Special designed artificial markers or patterns can be put on the back of guider.
  - Target: The Fetch robot follows the guider in front moved in the office and corridor environment with a certain distance.
  - Necessary skills: Linux, ROS, C++ programming
  - Preferable: basic computer vision and control Skills

6. Group Projects

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- Group Project 2: Fetch robot grasping
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - Control the Fetch robot to grasp the object on the table, e.g. can of coke, box of cookies, using the robotic arm and hand by using visual servoing method. Depth images and/or RGB images can be used for the visual servoing. The end-effector of the robot arm has been calibrated with the RGB-D
  - camera.
  - Target: The Fetch robot grasps different interested objects on the table without falling down.
  - Necessary skills: Linux, ROS, C++ programming
  - Preferable: basic computer vision and control

6. Group Projects

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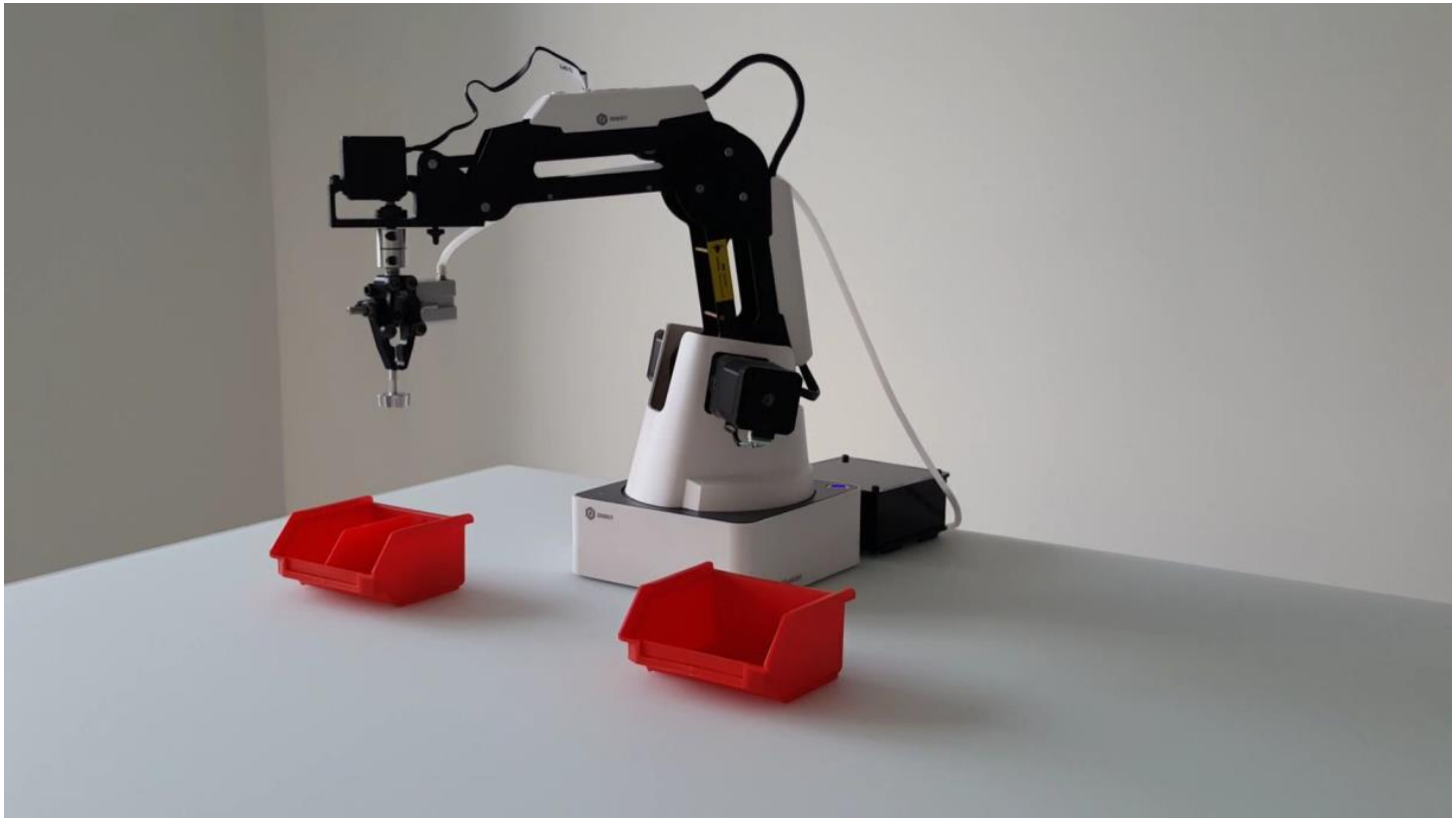
- DoBot Robot Mechatronics Lab Projects



6. Group Projects

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- Group Project 3: Control and grasping for the DoBot Robot
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au), Dr Gavin Paul (Gavin.Paul-1@uts.edu.au)
  - This project aims to control the UTS remote lab DoBot robot.
  - http://www.dobot.cc/dobot-magician/product-overview.html
  - There will be an Asus Xtion pro sensor to monitor the robot, the data collected could be used to identify the object and decide the way points for the robot.
  - Necessary skills: MATLAB, ROS

6. Group Projects

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- Group Project 4: Hand-eye calibration for the DoBot Robot
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au), Dr Gavin Paul (Gavin.Paul-1@uts.edu.au)
  - This project aims to calibrate the relative pose between camera-end effector, pattern-end effector or robot base-global RGB-D sensor.
  - http://www.dobot.cc/dobot-magician/product-overview.html
  - There will be an Asus Xtion pro sensor to monitor the robot, pattern will be provided as well for calibration. The data collected could be used to calculate the relative poses for robot/camera.
  - Necessary skills: MATLAB, ROS

6. Group Projects

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- Group Project 5: 3D reconstruction using RGB-D camera and EM sensor
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - This project aims to implement an efficient 3D dense reconstruction of the indoor environments by using RGB-D camera and the electromagnet tracking system. First the calibration between the EM sensor and the RGB-D camera has to be done to obtain the relative pose between the two sensors. Then, at each frame, the pose of the RGB-D camera can be provided by the EM sensor. At last, when performing the 3D reconstruction, the point cloud at each frame will be transformed back to the global (EM field generator) coordinate frame and fused together.
  - Necessary skills: MATLAB/C++ programming
  - Preferable: basic knowledge on sensors and coordinate transformation

6. Group Projects

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- Group Project 5: 3D reconstruction using RGB-D camera and EM sensor
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)

6. Group Projects

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- Turtlebot Projects

6. Group Projects

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- Group Project 6: Robot following a straight line by observing a square using Turtlebot
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - This project aims to control the robot to follow a straight line by using the information observed from a sensor on-board the robot. Suppose there is a square in front of the robot, and there is a sensor which can observe the positions of the 4 corners of the square in the current robot coordinate frame. Control the robot to follow a straight line which is perpendicular to the square. Use Turtlebot and design the environment to control the robot with noise in the observation.
  - Desirable skills: Linux, ROS,C++, Matlab programming, localization

6. Group Projects

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- Group Project 7: Turtlebot robot following each other
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - Using the learnt and state-of-art control algorithm to control the Turtlebot to follow the path of the guider Turtlebot in front. Both depth images and RGB images can be used to the control. Special designed artificial markers or patterns can be put on the back of guider.
  - Target: The Turtlebot follows the guider Turtlebot in front moved in the office, corridor or lab environment with a certain distance.
  - Desirable skills: Linux, ROS,C++, Matlab programming, localization

6. Group Projects

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- Group Project 8: Visual servoing of a handheld monocular camera
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - The aim of this project is to use visual servoing techniques to control a handheld camera. The students can choose any pattern, and design any desired position on the image. Then, hold the camera with hand, and when moving the camera, the algorithm can online indicate which direction should the camera move.
  - Desirable Skills: MATLAB/C++ programming, image processing, visual servoing

6. Group Projects

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- Group Project 9: Visual servoing of a handheld RGB-D camera
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - This project is the same as Project 7, but using a RGB-D camera.
  - Desirable Skills: MATLAB/C++ programming, image processing, visual servoing

6. Group Projects

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- Group Project 10: 3D control and path planning for the surgical robotic catheter in the aorta based on ultrasound
  - Supervisor: Dr Liang Zhao (Liang.Zhao@uts.edu.au)
  - Use state-of-art control and path planning methods to control the surgical robotic catheter following the centerline in the 3D environment of aorta. Real-time intravascular ultrasound images can be used to provide the distances from the robotic catheter to the vessel wall.
  - Target: Control the surgical robotic catheter following the centerline by using the phantom
  - experiments dataset.
  - Necessary skills: MATLAB/C++ programming
  - Preferable: basic path planning and control

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THANK YOU

Questions?

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