UTS:CAS

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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- 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).
  - **Two options:**
    - The project will be FULLY carried out in Fetch Simulator.
    - 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: Dominik Slomma
  - 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 1: Fetch robot following the path
  - Supervisor: Dominik Slomma
  - 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.
  - **Robotics Studio 1 Extra:** Guider/target lost and re-tract need to be considered and demoed in this project.

6. Group Projects

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Group Project 2: Fetch robot grasping

- Supervisor: Dominik Slomma
- 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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❖ Group Project 2: Fetch robot grasping

- Supervisor: Dominik Slomma
- 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.
- **Robotics Studio 1 Extra:** Grasping at least two complex objects that have a few grasping positions (unlike a coke can). Detection of the grasping pose of the object in 3D is required.

6. Group Projects

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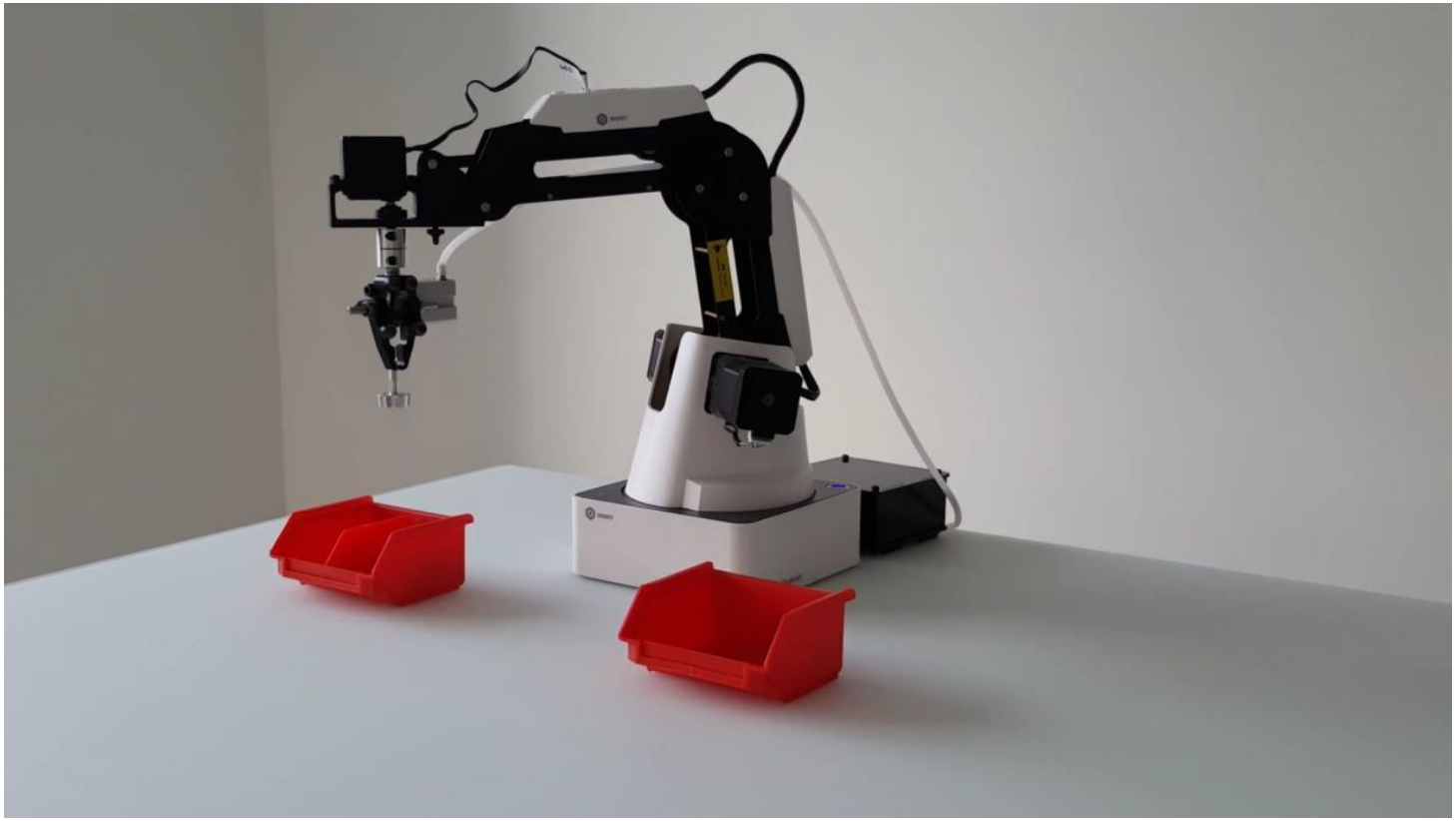
- DoBot Robot Mechatronics Lab Projects
  - **Real Robot Only**



6. Group Projects

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- Group Project 3: Control and grasping for the DoBot Robot
  - Supervisor: Dominik Slomma
  - 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
  - **Robotics Studio 1 Extra:** Two different setups of camera need to be considered and demoed in this project: 1) Camera on hand; and 2) Global Camera mount.

6. Group Projects

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- Group Project 4: Hand-eye calibration for the DoBot Robot
  - Supervisor: Dominik Slomma
  - 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
  - **Robotics Studio 1 Extra:** At least two different setups of camera as mentioned above need to be calibrated and demoed in this project.

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- Group Project 5: 3D reconstruction using RGB-D camera and EM sensor
  - Supervisor: Dominik Slomma
  - 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: Dominik Slomma
  - **Robotics Studio 1 Extra:** No extra task.

6. Group Projects

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- Turtlebot Projects
  - **Two options:**
    - Turtlebot Simulator.
    - Real Robots

6. Group Projects

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- Group Project 6: Robot following a straight line by observing a square using Turtlebot
  - Supervisor: Dominik Slomma
  - 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 or Simulator** and design the environment to control the robot with noise in the observation.
  - Desirable skills: Linux, ROS,C++, Matlab programming, localization
  - **Robotics Studio 1 Extra:** At least two complicated trajectories (other than straight line) need to be considered and demoed. Accuracy needs to be validated as well.

6. Group Projects

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- Group Project 7: Turtlebot robot following each other
  - Supervisor: Dominik Slomma
  - 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 with **real robots** or in the **Turtlebot Simulator** with a certain distance.
  - Desirable skills: Linux, ROS,C++, Matlab programming, localization
  - **Robotics Studio 1 Extra:** Guider/target lost and re-tract need to be considered and demoed in this project.

6. Group Projects

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- Group Project 8: Visual servoing of a handheld monocular camera
  - Supervisor: Dominik Slomma
  - 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
  - **Robotics Studio 1 Extra:** Robot-held (Dobot or UR3) camera instead of handheld.

6. Group Projects

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- Group Project 9: Visual servoing of a handheld RGB-D camera
  - Supervisor: Dominik Slomma
  - This project is the same as Project 8, but using an RGB-D camera.
  - Desirable Skills: MATLAB/C++ programming, image processing, visual servoing
  - **Robotics Studio 1 Extra:** Robot-held (Dobot or UR3) camera instead of handheld.

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: Dominik Slomma
  - 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
  - **Robotics Studio 1 Extra:** No extra task.

4. Coding by Undergraduate Students

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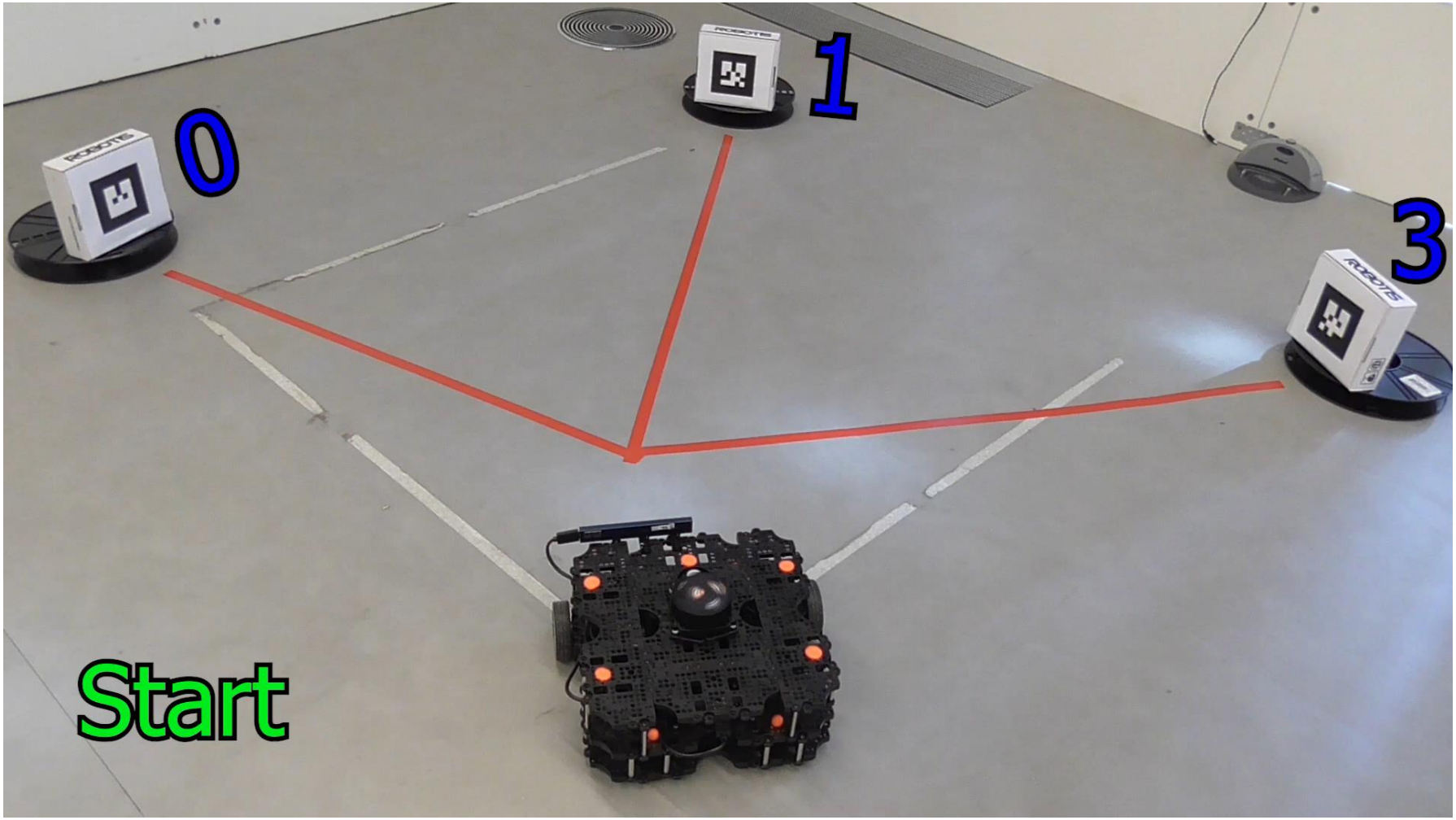
- TurtleBot – MATLAB/ROS



4. Coding by Undergraduate Students

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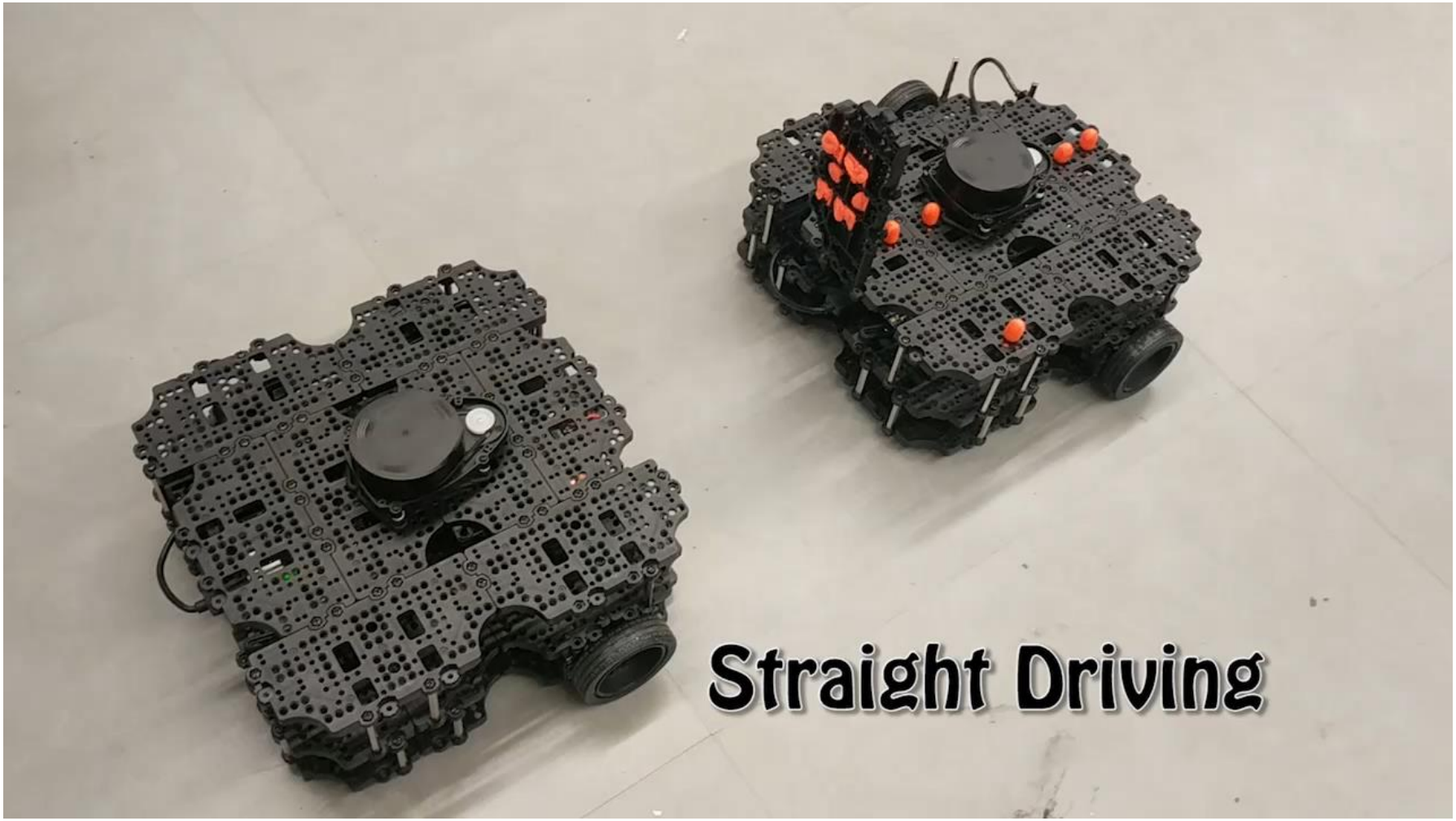
- TurtleBot – C++/ROS



4. Coding by Undergraduate Students

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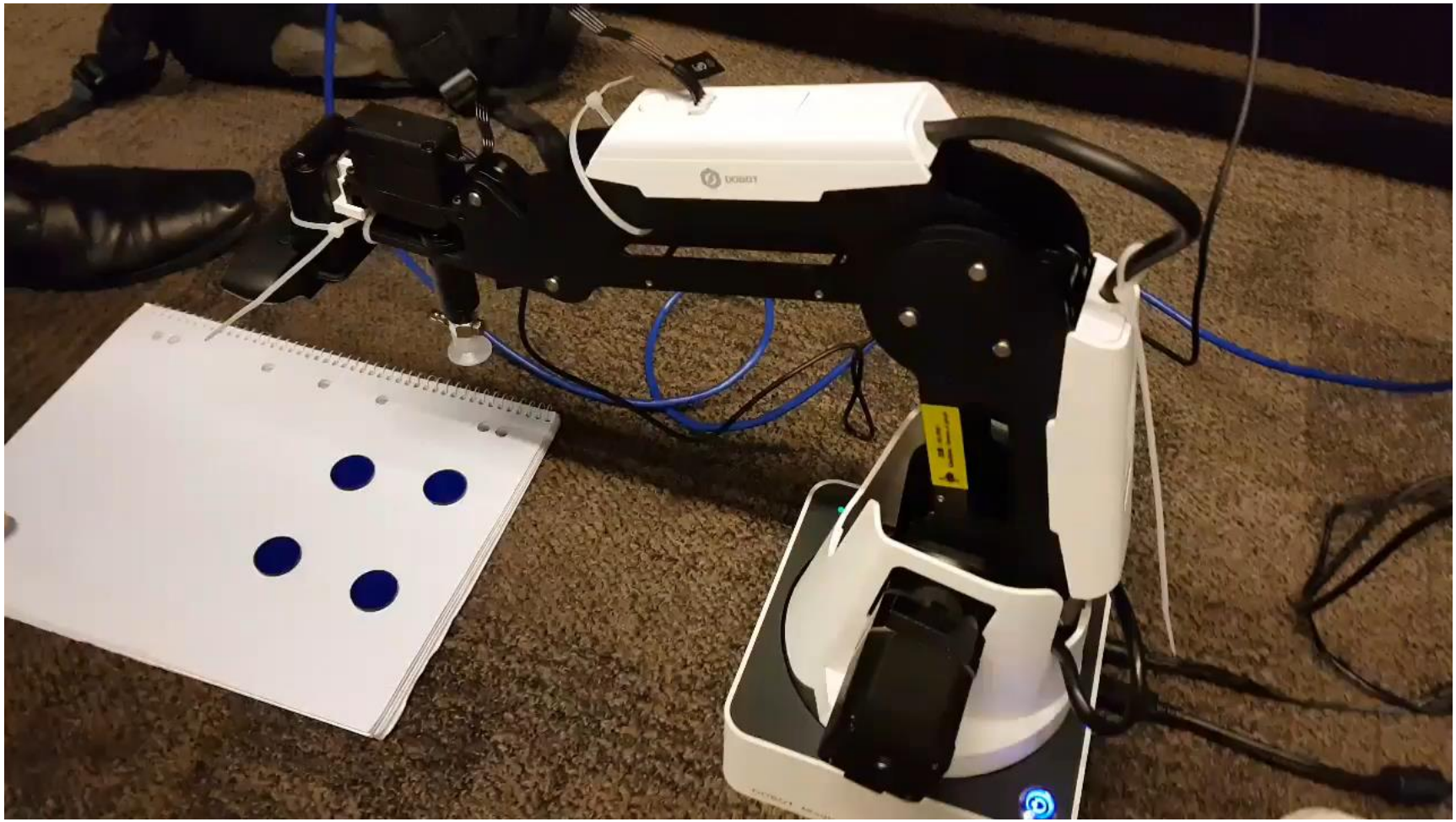
- Dobot -- MATLAB



4. Coding by Undergraduate Students

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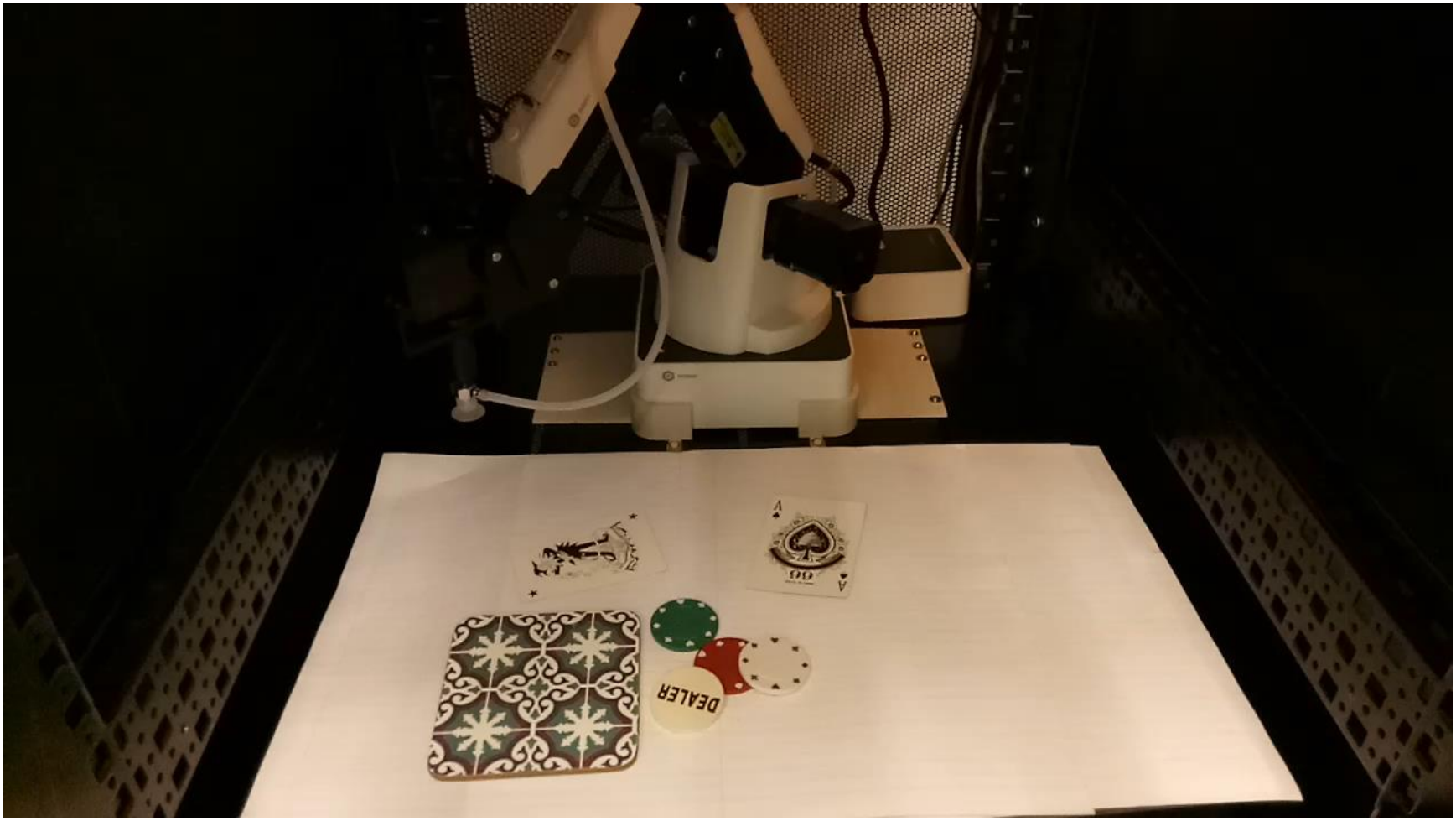
- Dobot – C++



4. Coding by Undergraduate Students

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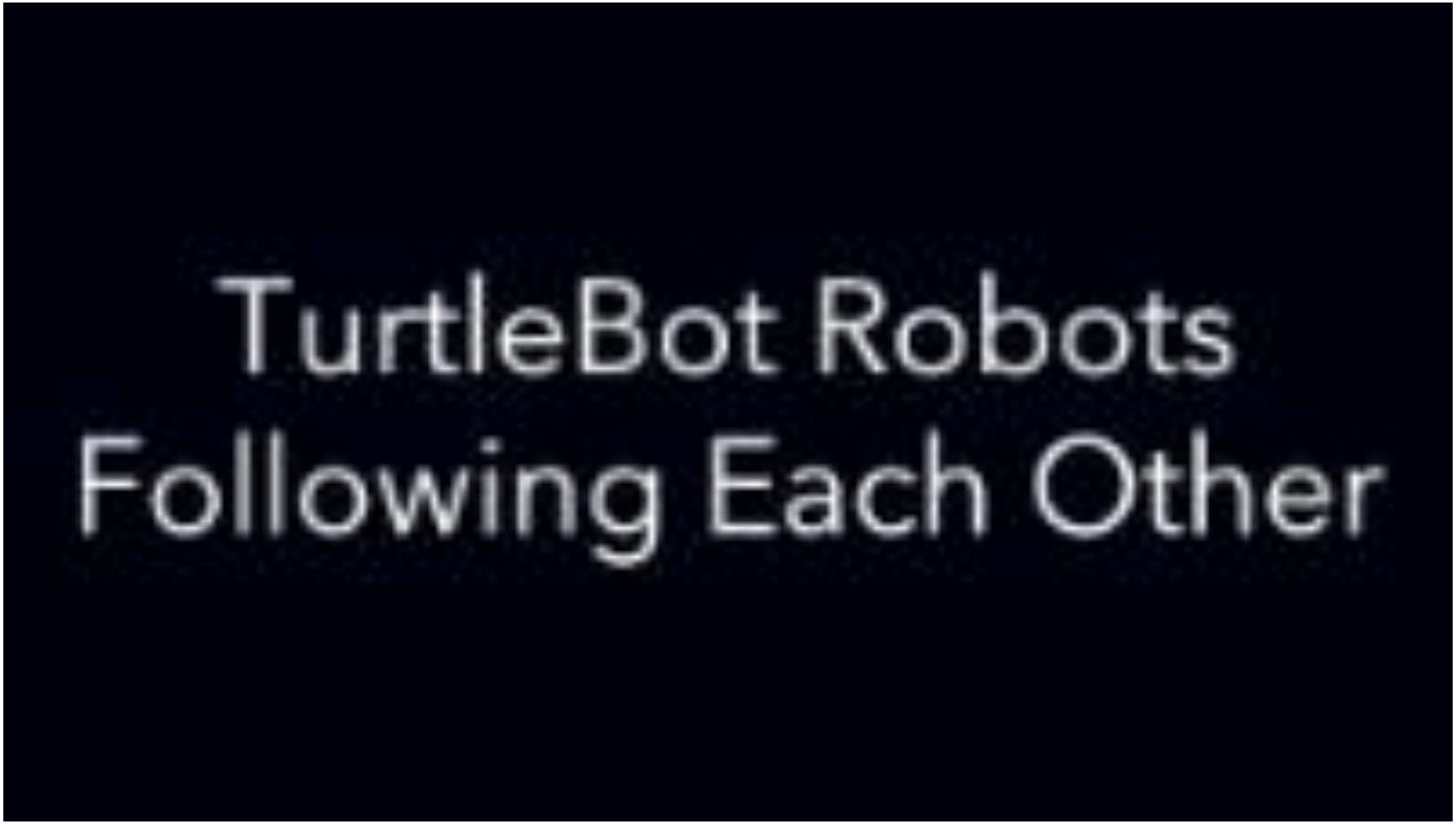
- TurtleBot – C++/ROS



4. Coding by Undergraduate Students

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- Dobot – C++

4. Coding by Undergraduate Students

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- Fetch – C++/ROS

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THANK YOU

Questions?

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