Department of Electrical and Computer Engineering

Robotics Research Laboratory

NUS National University of Singapore

ABOUT ROBOTICS RESEARCH LABORATORY

The Robotics Research Laboratory (RRL), previously known as the Edutainment Robotics Laboratory (ERL), focuses on the development of autonomous vehicles/robots that are capable of accomplishing complex tasks involve scene understanding, outdoor/indoor navigation, localization and mapping and target engagement. The laboratory involves practical and significant research issues in the areas of perception/sensing, decision making, intelligent control, industrial automation, and so forth. RRL is well equipped, with rich expertise in autonomous systems, intelligent control, sensor fusion, pattern recognition, motion capture systems, as well as abundant engineering experience stemming from ongoing projects. The major facilities housed in RRL are as follows: Robot X1 (a fully autonomous robot developed on the Packbot from iRobot Corporation) with various sensors (GPS, IMU, Laser, Sonar, Camera), AIKO driller machine (ZJQ4116A, 230V, 50Hz, 3/4 HP) and industrial cameras (Fujinon, Point Grey, FL2G-13S2C-C).

ON-GOING PROJECTS

Intelligent Autonomous Robot

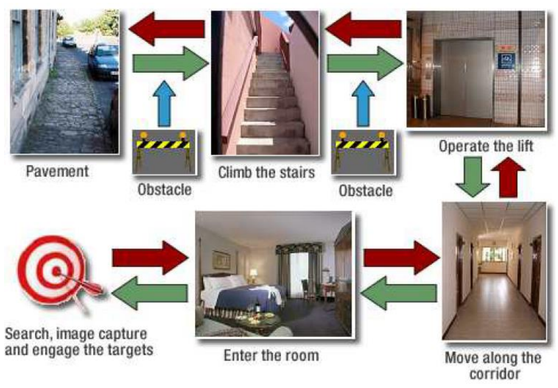

Figure 1: Robot X1

We have developed a mobile urban robot, X1, which can simultaneously build a dynamic map, conduct outdoor/indoor localization, global/ local path planning in an unknown environment without any human intervention.

The developed robot is also capable of avoiding dynamic and static obstacles, performing target recognition and searching/ climbing stair, and operating an elevator.

Research issues in the areas of scene understanding, sensing, decision making, intelligent control, software engineering have been intensively investigated in make it fully autonomous. Current focus on this project is to introduce learning capability to the robot which allows it to rapidly adapt to and interact with new environment without little prior knowledge.

Floatel Control under Shielding Effects

Offshore operations have been moving towards ultra-deep waters, more challenging environment and arctic areas where richer resources are detected and to be mined. One of the unavoidable challenge we have to cope with is the large amount of shielding effects due to Floating Production Storage and Offloading (FPSO) in the vicinity.

Figure 2: A floatel system

Safety and smoothness of operation between the floatel and Floating Production Storage and Offloading (FPSO), uptime and lifespan of gangway will be severely affected due to the existing shielding effects. To solve this problem, a robust adaptive learning control scheme is to be developed. For the first time, thorough research is to be carried out by synthesizing the most advanced control technologies including robust control, adaptive control, learning control, and adaptive neural network control together in a systematic manner to handle unknown disturbances, parametric uncertainties and capture the dominant dynamic behaviours with stability and performance guaranteed.

Sensing/Perception for Industrial Robots

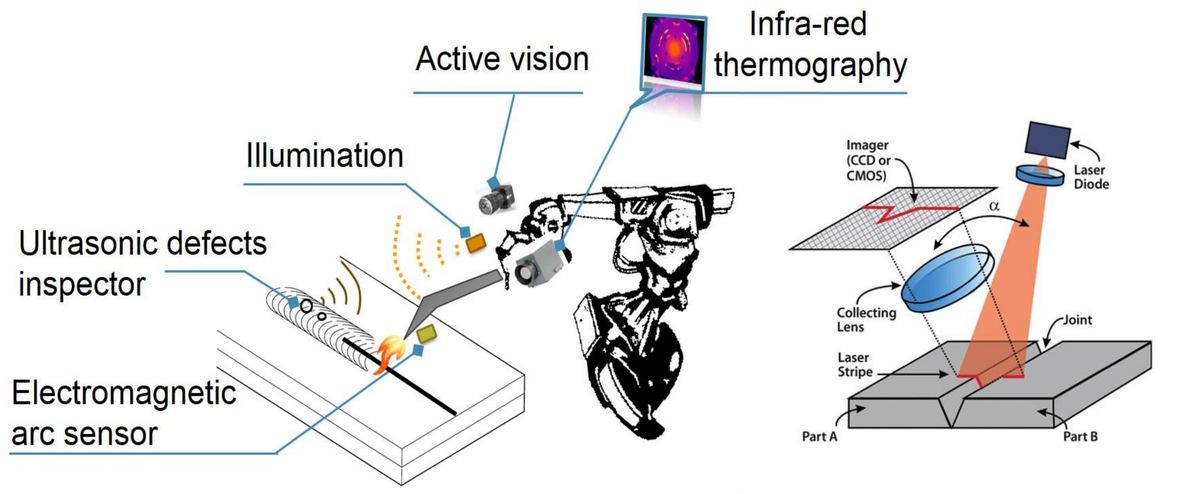

Figure 3: Seam tracking for a welding robot

Sensing and perception are essential capabilities for any robotic systems to sense, understand and interact with the environment/humans in real time. This project aims to develop key sensing and perception modules for improving the productivity of all stages of robotic welding/finishing processing of the industrial robots.

Figure 4: Test platform- Baxter Robot

The main focus of this project lies on 1) High-fidelity and high speed 3D construction of work piece for welding/finishing planning; 2) Real-time process monitoring for welding and finishing; 3) Efficient autonomous scene classification; representation and understanding; 4) Seam tracking based on multiple non-contact active vision; 5) Adaptive compressed sensing and 6) Quality evaluation and safety monitoring.

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