Project No:

Department of Communication Systems

Project Title: Software and algorithms development for novelty detection and landmark recognition by Pioneer-3 mobile robots

Degree Scheme: CCS ⊠ ITM □ ECS ⊠ TCS ⊠

Level: BSc/BEng □ MSci/MEng ⊠

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Project Description:

A number of important tasks in intelligent and robotic systems such as *landmark* (interesting objects that stand out from the environment) recognition, novelty (new objects seen for a first time on the scene) detection, navigation (wall following, obstacle avoidance) etc. require computational intelligence (fuzzy logic, rule-based classifiers, clustering, etc.). In this project software will be developed that realises computationally intelligence algorithms which can be applied to real robots (Pioneer-3DX available in the Intelligent Systems Research Laboratory of the Department). The development environment will be:

- a) Microsoft Visual Studio for C language and ARIA which is a C based library (classes of software) used by Pioneer-3DX and produced by MobileRobots Inc, USA;
- b) Matlab language (a script language with convenient graphical library and user interface). The experimental work will consist of video clips, the robot simulator and the real mobile robots.

The problems that will be addressed will include:

- a) a mobile robot explores an unknown environment using a pan-tilt-zoom camera, sonar sensors and on-board PC, but NO GPS information. The software and algorithms should enable it to:
 - i. travel following walls (if they exist) or searching for a goal avoiding (static and moving) obstacles;
 - ii. collect video stream, process it in real-time and analyse aiming to recognise autonomously landmarks without any pre-training, any prior knowledge.
- b) a robot observes a scene and should be able to:
 - i. detect automatically any object that is new to the scene (visual novelty);
 - ii. track this novelty as it moves;
 - iii. if there are several novelties and extension that copes with each one for them should also be considered.

This work is novel, and of interest to companies such as BAE Systems, Thales, QinetiQ; it can well lead to a research publication (subject to good results) which is an excellent opportunity for a possible career in research or related industry.

Skills required: Programming in C and/or Matlab, image processing, data clustering.

References:

^{1.} Pioneer-3DX, User Guide, ActiveMedia Robotics, Amherst, NH, USA, 2004.

^{2.} P. Angelov, X.-W. Zhou, Evolving Fuzzy Classifier for Real-time Novelty Detection and Landmark Recognition by a Mobile Robot, In *Mobile Robots: The Evolutionary Approach (N. Nedja, L. Coelho, L. Mourelle Eds.)*, Studies in Computational Intelligence Series, Springer, March 2007, pp.95-124, ISBN 978-3-540-49719-6.

3. Zhou, X., P. Angelov, An Approach to Autonomous Self-localization of a Mobile Robot in Completely Unknown Environment using Evolving Fuzzy Rule-based Classifier, *First 2007 IEEE International Conference on Computational Intelligence Applications for Defense and Security,* April 1-5, 2007, Honolulu, Hawaii, USA, to appear 4. Angelov, R. Ramezani, X. Zhou, Autonomus Novelty Detection and Object Tracking in Video Streams using Evolving Clustering and Takagi-Sugeno type Neuro-Fuzzy System, 2008 IEEE Intern. Joint Conference on Neural Networks, IEEE World Congress on Computational Intelligence, Hong Kong, June 1-6, 2008, pp.1457-1464.