Course descriptor B31XO

Course code	B31XO
Course title	Real time imaging and control
Credits	15
School	Maths and Computer Sciences?
SCQF Level	11
Semester	1
Aims	• To provide an introduction to modern hardware and software for the implementation of time-critical vision and robotics • To provide practical experience of both parallel and vector processing techniques • To give a critical understanding of robot dynamics and classical/ advanced position control methods for a robotic manipulator • To provide an introduction to control methods for closed and open 'vision in the loop' • To allow implementation of an integrated vision/ robotics system
Syllabus	• Introduction to contemporary architecture for the time-critical algorithmic implementation, shared and distributed memory parallel computer architectures; DSP, FPGA, ASIC, SoC and GPU processors. How appropriate are these for vision and robotics? • Mutlicore programming: shared memory algorithms and implementation in C/D++ using openMP. Software optimisations and design paradigms for image analysis and robotic control. • GPU programming: pipelining and the SIMD model; extending from graphics and to visual algorithms • Hardware/ software co-design for image and video processing in real time. Mixed multicore and GPU programming for specific applications such as tracking and image compression. Code profiling and optimisation. • Introduction to robot dynamics – Lagrange-Euler and Newton-Euler methods. Equations of motion for an n-link manipulator. • Classical control techniques for joint angle control of a robotic manipulator. • Advanced control methods – feedback linearization, model reference, self-tuning adaptive and nonlinear. • Resolved motion control and hybrid position/ force control methods. • Design and development of an application in visual control of an actuator: examples of an appropriate task would include control of a directional CCTV camera to track and zoon on given subject, steering a small robot vehicle (e.g. a pioneer

	robot or a subsea pod) using sensors or control of an articulated robot in a bin-picking task.

Learning Outcomes	
Subject Mastery	An understanding of the topics in the syllabus and the ability to demonstrate their use in practical situations.
Personal Abilities	• Ability to critically review, evaluate and implement a range of techniques in parallel and vector processing. • Ability to design and simulate a closed-loop position control system for a robotic manipulator using MATLAB/SIMULINK • Ability to analyse a system having disparate sensing and actuation components, using appropriate mathematical tools • Ability to design and implement a system for dynamic actuation under visual control.

Assessment method	100% course work