10/1/89

MSc in Information Technology: Knowledge Based Systems

Intelligent Assembly Systems

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Objectives of the course:

* To introduce the current state of Industrial Robotic Assembly Systems, the current state of research into Intelligent Robotic Assembly Systems, and how this is related to Artificial Intelligence.

* To provide an understanding of the underlying principles, in so far as these are known.

* To equip the student to pursue further details in the research literature.

* To become acquainted with the basic problems of programming assembly robots to perform tasks reliably, and some helpful techniques.

Timetable:

Note that due to resource limitations the laboratory tutorials are only for *graduating* students.

Mondays 2:00 - 3:00 pm, normally South Bridge, F10.

Mondays 3:00 - 4:00 pm, normally Forrest Hill Laboratory Tutorial.

Fridays 2:00 - 3:00 pm, normally South Bridge, F10.

Changes from the normal venue as specified above will be notified at least at the previous lecture, verbally and by email (you should all have a login on the edai vax, and consult it regularly for mail messages). Further Laboratory tutorials may be arranged outside these times.

Text books and other reading matter:

The two books which will generally be referred to during the course will be Critchlow, *Introduction to Robotics*, Macmillan, 1985; and Brady et al (eds), *Robot Motion: Planning and Control*, MIT Press, 1982.

Reference will also be made to individual papers available in the Departmental library. The most important book is Critchlow, if you are only going to buy one. There is no textbook which covers all the material of this course. Reference will also be made to papers from the Departmental library.

Lecture notes will be issued from time to time. These may contain references to further reading in books or papers. The Forrest Hill Library contains most of the books and papers which will be referred to for borrowing, and all of the important ones. The South Bridge Library contains some of the more commonly recommended ones on the reference only shelves. Some video tapes will be shown. Some of these are available for borrowing, or copies can be obtained, from the South Bridge library.

Course work and Laboratory practicals:

Course work will sometimes be set. Some of these exercises will be formally assessed, which will be clearly indicated at the time of issue. Use of robot equipment is subject to observation of the rules set out in the handout "Use ofTeaching Laboratory Equipment". A copy of this will be prominently displayed in the lab.

All course work and laboratory exercises are to be carried out in your own time and will sometimes require access to the Department edai VAX. If you do not already have a user id on this machine you should get one now (from Ken Dawson). Note, also, that anyone working after 5:30 pm in Forrest Hill requires keys (from Janet Lee) and an identification card (from Margaret Pithie). You should also sign in and out when working after 5:30 pm in the book placed on the shelf outside the janitor's office. This is a question of fire and security regulations and failure to comply can get you into trouble with the night security staff.

You may be examined on any of the material presented in the lectures, recommended reading, exercises, or laboratory practicals. A distinction will always be explicitly drawn when reading references are given between *recommended reading*, which is examinable, and *further reading*, which is not. Any extra reading or references mentioned in the notes which is not stated to be *recommended reading* is not examinable.

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SYLLABUS

The following topic areas will be covered, but due to relationships between them, individual lectures may address more than one topic, and individual topics may be covered in more than one lecture. In general, the sequence will be as laid out below.

The current state of industrial assembly robotics -- why robots are seldom used in assembly tasks.

13/1/89. Artificial intelligence and robotics -- the contributions of one to the other.

Overview of the mechanics, kinematics, and dynamics of assembly robots.

On-line robot control architectures and programming languages -- what the market place provides, and where research is leading.

Useful techniques applicable today in the programming of assembly robots: iterating towards reliability; controlling uncertainty without sensors; programming to simplify on-line debugging.

A survey of off-line programming languages and techniques -- where research prototypes are going.

Automated planning of the assembly task -- the decomposition of the problem, research progress on the items, the problems of integration.

The problems of integrating the use of sensors into planning and programming assembly robots -- why using sensors is so difficult and tedious, and current research addressing this problem.

Behavioural operators versus geometric operators -- a current research controversy.

Computer Aided Design systems and Computer Integrated Manufacturing systems -- robotic assembly systems in the integrated systems of the future.

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