CE410 ROBOTICS AND AUTOMATED CONSTRUCTION

Co-ordinator : Dr. R.D. Wing (Room 332), r.wing@imperial.ac.uk

Status: Elective (limited to 32 students)

Lecturer: Dr. R.D. Wing (Room 331)

Structure: 60 hours, comprising lectures plus laboratory sessions and class projects.

Pre/co-requisites: None.

Aims

To introduce students to mechanisation and prefabrication concepts for the construction industry, including the general use of Information Technology and its future potential for improving competitiveness. There is a strong emphasis on understanding the basics of the technologies involved, from logic and control through to networking and communications.

SYLLABUS

1. Introductory. General introduction to the use of I.T. in construction, benefits, inhibitors, rationale, examples. (6 hr.)
2. The current state of the industry globally, in Europe, and in the U.K. Government initiatives; the Latham and Egan reports. (2 hr.)
3. Industrialisation. Construction as a manufacturing process. Comparison with other engineering sectors. Industrialised building systems. Prefabrication. (4 hr)
4. Automation. Design for automation. Design for assembly. (2 hr.)
5. Robotics. Configurations and basic mechanics. Load capacity. Forward and Reverse Kinematics. End effectors. Tele-operation principles. (4 hr.)
6. Sensors. Sensor requirements for robotic and automated devices. Transducers, amplifiers, filters, A/D and D/A conversion. Sampling theory. (6 hr)
7. Logic and Control. Electronic logic (laboratory sessions). Analogue and digital control. Microprocessors and programmable logic controllers. (14 hr)
8. Navigation. Vision systems, laser positioning applications, satellite positioning, locomotion. (2 hr)
9. Computer Integrated Construction. Trends in CAD, simulation, visualization. Application of Virtual Reality. Construction databases. Integration of systems. (2 hr)
10. Construction process analysis. Task analysis for automation. The use of IDEF-0 and DSM modeling for process analysis. (2 hr.)
11. Economics. Economics and social aspects in the use of automation and robotics. The balance between site and factory production. (1 hr.)
12. Mini-projects. Presentations by class members of case studies in automation and robotics applied to construction. (8 hr.)
13. Revision session. (2 hr.)

Coursework and Submission Dates

1. Exercises based on supplied introductory material (marked); due end week 4.
2. Logic exercises in Boolean algebra (marked); due end week 6.
3. Logic and control exercises (self marked).
4. Problems on module material in sensors and control (marked); due end week 20.
5. Individual case studies (written report (due at end of first term) and class presentation, marked).

Assessment

One 3 hour written examination at the end of the module; five out of eight questions to be answered (60% module mark), and coursework assignments as above (40% module mark).

Recommended Textbooks/Reading

FULLER, JAMES L. 'Robotics Introduction, Programming, and Projects' – 2nd Ed. ISBN: 0-13-095543-4. Prentice Hall 1999.

CECELJA, FRANJO 'Manufacturing information & Data Systems' ISBN 1 8571 8031 3 Penton press 2002.

Also proceedings from international conferences (notably ISARC), and handout material.

Learning Outcomes

At the end of the module, students are expected to :

- understand the driving forces which motivate some organisations towards developing construction robots and automation.
- recognise the impact that newer forms of construction automation and the use of prefabrication and I.T. tools are likely to have on the construction industry.
- recognise the existence of inhibitors to the development and deployment of construction robots and automation and the means for overcoming them.
- appreciate current achievements in terms of real developments, and the regions of the world where these have occurred.
- understand the underlying theories of automation, control, and manufacturing.