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# The Manchester Summer School in Robotics at the Orkney Science Festival

## 1 Introduction

The Orkney Science Festival is one of the biggest Science Festivals in the United Kingdom, attracting speakers of international reputation to deliver lectures, demonstrations, masterclasses and practical sessions on scientific subjects, including for instance physics and geophysics, genetics, biology, geology, electrical engineering and robotics. In 1995 the Orkney Science Festival will be held for the fifth time.

The Orkney Islands are renowned for their rugged beauty, their wildlife (notably birds) and prehistoric monuments.

The first Manchester Summer School in Robotics will be held from September 5th, 1995 until September 14th, 1995, in Kirkwall, Orkney Islands. It will form part of the 1995 Orkney Science Festival.

## 2 Format of the Summer School

The summer school will last for ten full days, comprising lectures and practical sessions. Each morning session will consist of two lectures (see section 3) of 60 minutes each. The afternoon session will be a practical session of about 2 hours, in which actual robot programming and exercises in signal processing are done (see section 4).

The summer school is intended for University undergraduates who are interested in an introduction to the area of (mobile) robotics. Some (basic) knowledge in mathematics, physics and computer programming is assumed. It is not necessary, however, to know C, the programming language used. Electronics skills are also not required.

## 3 Lectures

There will be sixteen lectures in total, eight on autonomous mobile robotics, and eight on sensor signal processing. They will be given by Ulrich Nehmzow, lecturer in artificial intelligence at the University of Manchester, and Iain Garden Richardson, lecturer in electrical engineering at the Robert Gordon University in Aberdeen respectively.

The purpose of the lectures is to introduce the students to the area of autonomous mobile robotics, focussing on sensor signal processing, and to give them practical experience in programming mobile robots.

## 3.1 Autonomous Mobile Robotics

Syllabus of lectures on autonomous mobile robotics:

1. Introduction to robotics
2. Robot controller architectures
3. Programming the Manchester mobile robots
4. Animal navigation
5. Robot navigation
6. Artificial neural networks
7. Reinforcement learning in robots
8. Chaos theory , conclusion.

## 3.2 Sensor Signal Processing

Syllabus of the lectures on sensor signal processing:

1. Introduction to robot sensing
2. Robot sensors (ultrasonic, infrared, visual, tactile, odometric) and actuators
3. Transmitting sensor data
4. Digital transmission (digital techniques, error handling, compression)
5. Signal processing
6. Image processing
7. Digital video techniques
8. Application examples (offshore examples, teleoperated vehicles)

# 4 Practicals

There will be eight practical sessions, during which the full-time students will program small mobile robots, similar to *Grasmoor* (see figure 1). There will also be signal processing exercises based on PCs, which support the lectures on sensor signal processing.

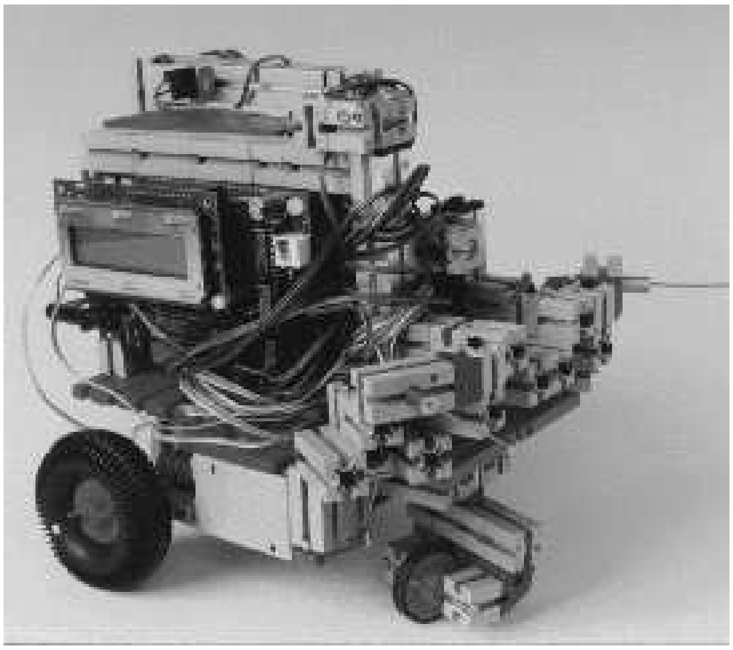

Figure 1: The mobile robot *Grasmoor*

The robots are equipped with infrared range finding sensors, light sensors and tactile sensors. They also possess a number of user input devices (both for binary and analogue values), and an LCD display. The robots are programmed in C, and are fully autonomous.

During the practical sessions students will develop simple control programs to begin with, then apply the material covered in the lectures to achieve more sophisticated control of mobile robots. Practicals will include exercises on simple robot behaviours, robot navigation, as well as robot learning. The last practical session will consist of a robot contest.

Students will use signal processing and data transmission teaching software to explore basic signal and image processing techniques and to illustrate digital communications techniques.

## 5 Timetable

| Date | Time | Subject |
|---|---|---|
| 5.9.95 | 9.30h | Introduction to Robotics |
| | 11h | Introduction to Robot Sensing |
| | 14h-16h | Practical |
| 6.9.95 | 9.30h | Robot Controller Architectures |
| | 11h | Robot Sensors and Actuators |
| | 14h-16h | Practical |
| 7.9.95 | 9.30h | Programming the Manchester Mobile Robots |
| | 11h | Transmitting Sensor Data |
| | 14h-16h | Practical |
| 8.9.95 | 9.30h | Animal Navigation |
| | 11h | Digital Data Transmission |
| | 14h-16h | Practical |
| 9.9.95 | | free time |
| 10.9.95 | | free time |
| 11.9.95 | 9.30h | Robot Navigation |
| | 11h | Signal Processing |
| | 14h-16h | Practical |
| 12.9.95 | 9.30h | Artificial Neural Networks |
| | 11h | Image Processing |
| | 14h-16h | Practical |
| 13.9.95 | 9.30h | Reinforcement Learning in Robots |
| | 11h | Digital Video Techniques |
| | 14h-16h | Practical |
| 14.9.95 | 9.30h | Summary and Outlook, Chaos Theory |
| | 11h | Application Examples of Signal Processing |
| | 14h-16h | Robot Contest |
| | Evening | John D. MacKay Memorial Lecture |

## 6 Registration

The number of places available in the summer school is limited to twenty full time students (i.e. students who attend lectures *and* practicals). It is possible to attend lectures only (the numbers of attendees of the lectures is not limited). Early registration is recommended.

The study fee for full time students is £ 15. This includes all lectures and practicals, as well as course material. There will be a charge of £ 1.50 per lecture for part-time students, wishing to attend lectures only.

Travel and accommodation to the Orkney Islands has to be organised by the student. British Airways supports the Orkney Science Festival, and special air fares are available.

To obtain information about special air fares to Kirkwall, and about accommodation (which can be anything from Youth Hostel to first class hotel), contact

The Orkney Science Festival
6/8 Broad Street
Kirkwall KW15 1NX
Orkney Islands
Scotland
Tel. +1856 - 876 214
Fax +1856 - 876 284

Further information can be found on the worldwide web at

http://www.cs.man.ac.uk/robotics/orkney95.html

or by ftp to ftp.cs.man.ac.uk (/pub/robotics/orkney95.ps.Z)

You can also contact

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