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Postgraduate Engineering Studies in the School of Engineering at the University of Greenwich*

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The purpose of this paper is to describe the main areas of research, postgraduate student training, and progress assessment of research and development within the School of Engineering.

INTRODUCTION

THE School of Engineering is one of three schools within the Faculty of Technology at the University of Greenwich. The School of Computing and Information Technology, and the School of Mathematics, Statistics and Computing are the other two. The three schools are all based on one site with postgraduate students, staff and laboratory accommodation physically located within one block. The main objective of this paper is to describe the research and development (R&D) activities of the School of Engineering.

RESEARCH AND DEVELOPMENT

Objectives

In research, fundamental analysis and investigation should ideally be carried out to produce new knowledge for long-term benefit. Although it is also true that development activities involve updating, enhancing and producing a new product, system or process using existing technologies and materials, in our school the distinction between research and development is somewhat blurred. Overall, our R&D objetive may be summarised as follows:

(1) to identify and formulate projects in areas relevant to the national need and the staff expertise;
(2) to produce high quality, highly trained postgraduates and research assistants;
(4) to put forward projects in areas relevant to the need of local industries and thus increase the staff contact with industry;
(5) to increase the revenue of the school;
(6) to demonstrate the academic vigour of the staff and improve the image of the school at validation and accreditation events;
(7) to develop the management skills and business acumen of the school.

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Main areas of R&D

Postgradute students and research assistants working on our R&D projects normally register for the M.Phil. or Ph.D. degrees of the Council for National Academic Awards (CNAA). In recent years, R&D activities of our school in electrical and electronic engineering have been expanding very rapidly. The total value of contract and donations for the period 1989 to 1992 is about half a million pounds. One of our most successful achievements has been the establishment of Science and Engineering Research Council (SERC) and Department of Trade and Industry (DTI) Teaching Company Schemes. The aim of these schemes is to develop partnerships between academic institutions and industry to improve the industrial performance of the U.K. in terms of both profitability and management. We have been able to simplify some of the research projects into undergraduate and M.Sc. projects. Some research is also being done outside the university through staff contacts with other institutions such as London University, University of Manchester Institute of Science and Technology, and Brunel University.

Our current R&D projects can be broadly divided into the three major areas of

(1) energy, power electronics, control and instrumentation;
(2) solid state electronics, materials and engineering education;
(3) computer-aided design and manufacture.

Most of the experimental work is carried out in the laboratories of the school, which are equipped with modern facilities. Our research students also have access to the equipment in other schools, notably the School of Computing and Information Technology, and the School of Mathematics, Statistics and Computing. Most of the research projects involve computer control and interfacing, as well as data modelling, making use of the extensive computer facilities and staff expertise within the School, and faculty as a whole.

At least in part, the programme of work for each project is in conjunction with industry and/or other academic institutions. The title and scope of some of our current projects are listed below.

Energy, Power Electronics, Control and Instrumentation

- *Development of a Remote Condition-Monitoring Control Station (a Teaching Company Scheme with PGI Manufacturing Ltd).*

This project involves the design and application of a program to remotely monitor or control a diesel-generating set via a mouse-driven graphical interface. This requires the generating set to be equipped with the appropriate hard/software and to have a connection into the public switch telephone network [1, 2].

- *Flexible Electronic Motor Drives (a Teaching Company Scheme with Coercive Systems Ltd).*

This project involves utilisation of new control techniques, and electronic power devices for development of a range of flexible electronic drive systems. The technical aspects of the control strategy will be developed and implemented in a production item. The final objective will be the establishment of a complete range of modules that can be utilised in the optimum design, build, cost and delivery of a range of drive systems from 1 kW to 100 kW.

- *Design and Development of Brushless Products (a Teaching Company Scheme with Small Electric Motors Ltd).*

The main objectives of this project are

(1) the design and development of a resolver-type feedback device and to assist in the ongoing development of the Company's range of brushless servomotors;
(2) to devise and plan the production assembly and testing of the resolver's manufacture and review in-house manufacturing to accommodate the change from brush to brushless production [3].

Solid State Electronic, Materials and Engineering Education

- *Evaluation of Anodised Aluminium for Applications in Electronic Manufacturing (industrially based project supported by Webard Ltd).*

Within electronic manufacturing industry, there is a great demand for new types of substrates which offer advantages of heat dissipation, close match of temperature coefficient of expansion with silicon, flexible geometry, weight and price [4, 5].

The main aims of this project are to prepare various anodised aluminium alloy substrates and to measure and interpret their electrical and thermal properties [6].

- *Charge Transport in α-Se Based Multilayer Xerographic Photoreceptors (industrially supported project in collaboration with Imperial College).*

In recent years, with the emergence of non-impact printers for electronically processed or stored information, the interest in α-Se based multilayer structures has grown [7]. High speed printers sensitive to commercially available lasers can be made from α-Se alloys [8]. The objects of this project are to build the necessary experimental apparatus and to investigate the charge transport mechanisms in α-Se based multilayer photoreceptors [7, 8].

- *Radar Sea Clutter, an Alternative Approach (industrially based project in collaboration with Kelvin Hughes Ltd and Waltham Forest College).*

The aim of this project is to review the current state-of-the-art in the processing of radar sea clutter and involve alternative strategies making use of current solid state devices and VLSI signal processing.

- *Xerographic Properties of Hydrogenated Amorphous Silicon Photoreceptors (industrially supported project in collaboration with Imperial College).*

The application of hydrogenatecd amorphous silicon (α-Si:H) as a photoreceptor is popular because of its photosensitivity in the red region, thermal stability and mechanical durability [9]. There are insufficient detailed results on the other relevant properties of this material. The purposes of this research program are firstly to design and build a computer-controlled experimental apparatus for xerographic characterisation, and secondly to carry out measurements on the charge acceptance, photoinduced discharge, dark decay and residual voltages [10].

- *Corrosion Fatigue of Duplex Stainless Steel.*

An investigation into the effect of metallurgical structure on corrosion fatigue crack propagation rates in duplex stainless steel. A correlation with potentio dynamic characteristics in acid and neutral medial will be sought.

- *The Effect of Surface Condition on the Stress Corrosion Susceptibility of α-brass and Al–Zn–Mg Alloys.*

The project considers the effectiveness of various surface treatments, in particular the role of anodisation on the incidence of stress corrosion cracking (SCC) in susceptible alloys. The alloy systems chosen are known to undergo SCC by an anodic dissolution mechanism, and a hydrogen embrittlement mechanism respectively.

Computer Aided Design and Manufacture

- *Document Image Processing (a Teaching Company Scheme with Synergy UK Ltd).*

The availability of CD-ROMs, image processing and high throughput microprocessors has opened up the possibilities for document image processing (DIP). This enables images of documents to be stored, retrieved and manipulated, rather than just text. New techniques of image reduction and reconstruction, file organisation and searching are required, and optimised for DIP systems. This project will investigate the opportunities created by object orientation programming techniques, graphical user interface (GUI) and optical character recognition (OCR) combinations and strategies to provide DIP systems with a user acceptable speed and accuracy.

- *A Novel Sensor for Welding Inspection.*

Optical fibres with specifically configured tactile pins and a computer controlled robot arm can be combined as an integrated part of a sensing system for welding inspection. The object of this project is to develop a prototype tactile sensing system offering improvements over conventional welding inspection techniques [11, 12].

- *Characteristics and Modelling of Small-Batch Manufacturing Systems.*

Little work has been directed at the basic problem of modelling existing small-batch manufacturing systems. The main objectives of the project are

(1) to gain a better understanding of small-batch manufacturing systems;
(2) to identify common problem areas and inefficiencies;
(3) to orchestrate a series of system modelling exercises with the aim of identifying common methodological and technological parameters of the small-batch system in order to devise a common strategy for modelling [13].

POSTGRADUATE STUDENT TRAINING

Postgraduate students who have obtained their first degree from other institutions are recommended to attend selected lectures from the final year options offered to our undergraduate students. For example, students involved with solid state electronic projects may attend some of the lectures from the microelectronic design and technology option and/or the advanced electronic devices optoin. Students who are working on research projects in control, may attend selected lectures from the power electronics and systems option and/or the control and instrumentation option. Other forms of training and collabortive activities include:

- Attendance of the School Open Lecture Programme where industrial or academic speakers discuss a specific subect of interest to staff and students.
- Attendance of IEE and IMechE Colloquia, Short Courses and Seminars relevant to the student research programme.
- Attendance and participation at the School Research Seminars.
- Attendance at relevant conferences and seminars such as those organised by the Institution of Electrical Engineers, Institute of Physics, and Institute of Measurement and Control.
- Occasional visits to research laboratories of other institutions and companies interested in our projects.

STUDENTS' PROGRESS ASSESSMENT

The progress of students during the first year is assessed vigorously to ensure that the student is learning the pattern of work that is appropriate to the project. By the end of the first year the student should have a good idea of what the end purpose of his research is to be. Students are recommended to keep a systematic record of their theoretical and experimental work, such as literature survey, design and building of new apparatus, practical results, etc. A systematic approach to the project helps the student to focus on the work and when required, to write up progress reports. Without systematic records, the students will have considerable difficulties when it comes to a final writing-up. We have a framework to enable the supervisor and the student to assess the suitability of the student for the project undertaken during the early part of the first year. Students meet the supervisor on a regular basis. To deal with the day-to-day matters relating to the work during the first few months, the student has weekly contact with the supervisor as well as a formal monthly meeting, when the student and supervisor discuss the work in more detail. For the project supported by industrial organisations, regular progress meetings will be arranged between the student, academic supervisors and industrial supervisor. For these meetings, the student is expected to prepare a progress report in advance and make a presentation of the work done at the meeting.

At the beginning of the second year, students should know what they intend to do with a thorough background knowledge and some primary results. Student progress is assessed similarly but with less informal contacts. The monthly meetings remain, as in the first year. It is also expected that during the second year, students should present one or two papers at the School Research Seminars. It is in the second year and the early portion of the third year that the supervisors insist students should obtain the bulk of results which would appear in their thesis. In the final year, meetings will be less frequent to let the students concentrate on finalising their research and prepare their thesis. However, during this year, at least one major paper should be presented at a conference.

CONCLUSIONS

The School of Engineering at the University of Greenwich continues to attract outside support for its R&D projects. Research areas in energy, power electronics, control and instrumentation, solid state electronics, engineering materials and computer-aided design and manufacturing have been strengthened by the SERC, DIT and industry. Staff are active outside the university as committee members of various institutions including the IEE and the Institute of Measurement and Control. The range of research and development activities undertaken was described in this paper. The progamme of postgraduate student training and progress assessment was also discussed.

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