Welcome to a Festive ACT Club News

Forthcoming Events for ACT Club Members

16th ACT Club Plenary Meeting on "Modelling, Simulation & Control Design Tools"

A request we sometimes receive from members is guidance when selecting the most appropriate simulation or control design software. These products are continually evolving and it is difficult to keep abreast of all their new features and capabilities. Therefore we have decided that the next ACT Club Plenary meeting will look at recent developments with these packages and also present the views of end users. The latest versions of products such as Matlab and $MATRIX_X$ will be available for you to try.

We are hoping to hold this event at Cambridge Control Ltd sometime during March 1998. The exact format of the day is still to be confirmed, you will hear more about this after the New Year.

If you would like to make a presentation or have a specific topic that you would like to see addressed then please contact Andy Clegg.

Steering Group Meeting

A Steering Group meeting is expected to be held at the same time as the above Plenary meeting. Details of the meeting will be passed to Steering Committee members when finalised.

Expert Systems Training Courses

You should by now have received details of the latest ACT Club event which is a one day training course on Expert Systems. This is being held at two different locations; the first is at our premises here in Glasgow on the 9th December, with the second being held at Salford on the 12th December.

This course is designed to give you an introduction to knowledge engineering and in particular the features and benefits of real-time intelligent systems. The course is being run jointly with COGSYS Ltd, whose software will be used throughout the course.

Technical Meeting on Expert Systems

This is scheduled for sometime next year and will be held at British Gas Research in Loughborough. We will confirm details as soon as they are available.

Training Courses on Hot and Cold Rolling Processes

Additional events for the future include a series of specialised training courses on metal rolling processes. These prestigious events will be aimed at those companies interested in this particular application, but could also be of value to any company trying to gain an appreciation of practical robust control systems design. Both hot and cold rolling mill courses are planned

These courses will be organised jointly by the ACT Club and the University of Strathclyde, with strong support from CEGELEC. They are expected to commence mid-1998 and Club members will be able to send two delegates free of charge with additional places being substantially discounted.

All of us here at the ACT Club would like to extend our warmest wishes for the festive period.

Have a Merry Christmas and a Prosperous New Year

Initiatives in Predictive Control

Seminar on "Theory and Practice of Predictive Control"

Predictive control has established itself as a very useful technique within the process control industry. The recent ACT Club Seminar on this subject, held at the Oxford University on the 20th November, was tremendously successful.

The focus of the day was on those technologies that have found application, as well as techniques that are emerging from academia. Predictive control was the subject of an ACT Club meeting held in 1995, again at Oxford University, and this years event hopefully demonstrated what progress has been made since then.

The seminar opened with an overview of Model Based Predictive Control (MBPC) given by Dr. Basil Kouvaritakis of Oxford University. Theoretical presentations then followed from Dr. Anthony Rossiter of Loughborough University, and Mark Cannon and Rob Bowyer of Oxford University.

After lunch a lively presentation was given by Atique Malik of Air Products and Chemicals Inc. (USA) covering the application of predictive control to chemical process. Other applications that were discussed included power generation, aircraft landing gear and plasma generation.

Two predictive control software tools were then described, the first produced by Oxford University and the second from the ACT Club which is described in more detail below.

Dr. Mike Oglesby of ICI Technology and Geoff Lewis of Predictive Control Ltd. concluded the day with insights into their own experiences of what predictive control can offer industry today and what needs to be done to widen its applicability.

Forthcoming ACT Club Predictive Control Toolbox for Matlab

The first demonstration of the new ACT Club Predictive Control Toolbox was given at the Oxford University meeting on Predictive Control. Many of the delegates commented upon the professional quality of the package and its potential usefulness within their companies.

The new package has been produced as a Matlab toolbox and has evolved from work carried out on previous industrial control projects. The purpose of the toolbox is to provide a user-friendly environment for the design of Generalised Predictive Controllers (GPC) and Linear Quadratic Gaussian Predictive Controllers (LQGPC). The toolbox interfaces to existing linear and non-linear plant models through Simulink. The controller parameters are accessed through easy-to-use dialogue boxes. Consequently, this package is useful for predictive control novices as the underlying algorithms are hidden from the user. For the more advanced user these algorithms are accessible and can be modified as desired.

The toolbox includes the following features:

- full graphical user interface driven toolbox
- user-defined plant models which can be linear, linearised or non-linear
- user-defined plant inputs and reference signals
- controller synthesis for constrained and unconstrained, GPC and LQGPC algorithms
- a block library so that the user can "drag and drop" his or her models directly into the toolbox
- saving data to workspace variables
- graphing data for analysis
- access to the Kalman filter used within the GPC algorithm
- built-in non-linear gas turbine demonstration example
- printed and on-line user guide
- written for Matlab v4.2 and Simulink v1.3 and operates under Windows 95 and Windows 3.1 operating systems

The toolbox is currently being extended to work with the latest versions of Matlab and Simulink, and also under the UNIX operating system. Anyone wishing to obtain a pre-release version, when available, please contact Andy Clegg.

This package will be the subject of a full one day training event that will be held sometime next year.
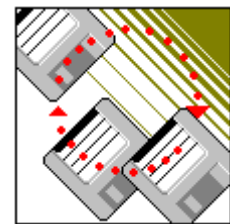
ACT Club 4DoF Non-linear Ship Model

A new toolbox has been developed by the ACT Club for the Marine SIG. The package is a 4DoF non-linear dynamic ship model and is built using SystemBuild, the graphical modelling part of MATRIX$_X$. It was launched at the recent Marine SIG meeting, held at Lloyd's Register of Shipping in Croydon, and will be used by both the members and the Club for future Marine SIG studies.

The present model is for a high speed container ship, though other ship models will be developed. We have received many ideas for future enhancements to create a truly useful and generic model.

If you would like a copy of this package then please get in touch at the usual address.

ACT Club Reports

"Comparison of the Design of a Marine Autopilot using H_∞ Design and Quantitative Feedback Theory"

During the Autumn the latest ACT Club Technical Report was distributed to Club members. The report was presented to the Marine Special Interest Group and describes a comparison of ship autopilots designed using H_∞ and Quantitative Feedback Theory (QFT).

The use of QFT is becoming increasingly popular as it is based on classical frequency domain control design methods. The solutions can be made robust to parameter variations and model uncertainties. This report was produced for the Marine SIG but should be of general interest to everybody.

"An Introduction to Discrete Event Simulation"

The most recent of our reports to be issued is an Educational Note that introduces the ideas and capabilities of discrete event simulation. Such simulations are ideal for modelling systems where specific events govern the system behaviour, for example automotive assembly lines, deliveries of goods in a distribution centre and scheduled maintenance.

Once a discrete event model has been built, the effect of various "what-if" scenarios on the system can be investigated. This can be used to optimise throughput or investigate the effect of new plant. The report contains several examples of real systems that have been modelled and used to improve system schedules, remove bottle-necks, asses the impact of new plant and optimise resources.

The following reports are currently being completed for the ACT Club:

- Educational Note introducing Fault Monitoring, Diagnosis and Control
- Educational Note on Quantitative Feedback Theory (QFT).
- Technical Report on QFT applied to Ship Rudder Roll Stabilisation
- Technical Report on QFT applied to an Aerospace Application
- Technical Report on Genetic Algorithms for Choosing Weights in Optimal Control Problems
- Technical Report on Auto-tuning of PID Controllers
- Technical Report on Design Methodologies for Handling Parametric Uncertainties
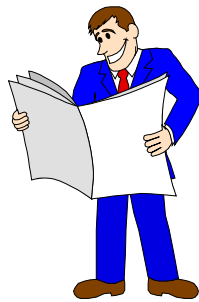
ACT Club Case Studies

"Expert System Based Training Simulator : Picrite Process" for Royal Ordnance

The above Case Study report has now been completed and distributed to all ACT Club members. The objective of the Case Study was to look at the feasibility of an operator training simulator that uses an expert system incorporating "Best Operator Practice" rules coupled to a model of Royal Ordnance's Picrite process.

The trainee interacts with the simulator via a "soft desk" which graphically represents the effects of his actions on this difficult to control process. Various fault scenarios can be set up and the trainee's actions are compared against the best practice rules. The Case Study proved very successful and is currently being extended through a full commercial project with Royal Ordnance.

If your company would like any additional copies of this report then please get in touch. For more information on this Case Study please contact Eric Georgin (*email: georgin@isc.eee.strath.ac.uk*)

"Control of Supply Chain Dynamics" for Unilever Research

Unilever have had a long interest in Supply Chain Dynamics and have just proposed this Case Study for the ACT Club to undertake over the next few months.

The supply chain from factory to distribution centre to supermarket and subsequent orders in the reverse direction, yields a feedback loop which is poorly understood and controlled. Consequently very high inventories are maintained to meet the orders. Huge savings are possible if these stock levels can be reduced, which makes supply chain dynamics of great interest to many companies.

The ACT Club will investigate the current research being carried out in this area and also future potential development directions. This will be summarised in a report including:

- Summary of previous research work
- Modelling the supply chain
- Potential control engineering solutions
- Recommendations for short term research
- Long term strategic research

If you have any comments about The ACT Club News, then please pass them to Andy Clegg.

CONFERENCE NEWS

Control of Industrial Systems

The first conference on the "*Control of Industrial Systems*", organised by the International Federation of Automatic Control, was held at Belfort, France, 20-22 May 1997. An unusual feature of the programme was the emphasis on plenary sessions. The first plenary was by Eugeniy Pyatnitskiy (Institute of Control Science, Russian Academy of Sciences). His talk on the control by multiarm robot manipulators was based on a combination of rigorous theory and good engineering intuition. The plenary presentation by Prof. Ioan Landau (Grenoble) on the R-S-T digital controller was particularly clear and all embracing. Prof. Landau has much practical applications experience and his film of different applications, including zinc galvanising, was impressive. He discussed the importance of closed-loop identification and the different margins that can be used, including the relatively unknown delay margin. His philosophy of a well defined methodology, for both design and implementation, was well received.

The plenary presentation by Prof. Ted Davison (University of Toronto) was a typical tour de force. His objective was to design a controller based on very little a-priori plant knowledge. He proposed two basic solutions, neither of which relied on mathematical models, rather using adaptive control or controller tuning approaches. Both methods used a sequence of linear time invariant controllers that were applied to the plant via a switching device. This device chose which gain matrices to apply from a finite dictionary of elements. When the intelligent controller could not cope with any unexpected conditions, it would disconnect itself from the plant (assuming an open-loop stable plant). One of the examples he provided was

a 2x2 square system and he reversed the outputs to see if the controller could still cope with the condition. He also disconnected one of the leads to the actuators. Reasonable results were obtained even under these extreme situations. He observed that if a model was employed, a more favourable solution could always be obtained, but such a model-based solution would fail when any unexpected changes occurred. His demonstrations using models of a large Canadian space structure was impressive. This seems a technique with a very wide range of potential applications and one that is worthy of much greater development.

There seemed to be an unusual number of papers on power systems and one of the most enlightening was that by Prof. Mania Pavella (University of Leige, Belgium). She noted that of all the complex power station phenomena, stability is the most intricate to understand and to handle. She added that transient stability is the condition that imposes the most stringent plant requirements. Her main conclusion was that it was necessary to generate an integrated approach for effective transient stability assessment, using numerical, direct and automatic learning methods. It was also noted that what might be termed "intelligent modelling" had, in a very short time, contributed significantly to effective tools for this purpose.

This was the first such event organised by IFAC and it was a great success and the organisers are to be congratulated on a format which should be repeated.

American Control Conference

The 1997 ACC was held in Albuquerque, New Mexico in June and attracted over 960 registered participants. One of the major awards of the ACC, the Richard E. Bellman Control Heritage Award, was given to Prof. Rudolf E. Kalman. The Education Award was received by Prof. William R. Perkins, of the University of Illinois, who has made significant contributions to the organisation of the American Automatic Control Council.

The Technical Programme was interesting and the highlight was the Plenary presentation given by Prof. Graham Goodwin (University of Newcastle). His talk concerned defining the performance envelope of industrial control systems. To illustrate this he presented a number of applications and cited problems in control that had generic implications.

Several papers challenged accepted wisdom. For example one of the contributions was titled "*When is a Linear Robust Regulator Optimal ?*". Its seemed that many authors were repeating the questions raised by Howard Rosenbrock, many years ago regarding the real significance of optimality. Most of the researchers in optimal systems do not regard optimality as being of central importance. It is often the case that optimal control is simply used to generate a convenient solution that meet specifications based on classical design requirements.

Symbolic manipulation languages have been available for some time but have not found much use in the control community. This situation is changing since both Mathematica and Maple had stands at the conference and new initiatives in control engineering. The "Control Systems Professional" toolbox has only recently been launched by Mathematica. Maple, developed by the University of Waterloo, was also demonstrated to good effect. These symbolic manipulation tools are fundamentally different to products like Matlab or MATRIX$_X$ and are

increasingly finding use by academic and industrial engineers alike.

CONFERENCE NEWS (cont.)

Young (Seoul National University) described a state-space minimax generalised predictive controller. Although the idea of merging predictive control concepts with H_∞ minimisation is not new, the state space approach was innovative. It certainly has much academic potential but whether this approach has practical relevance still has to be determined. However, the basic idea of trying to couple the robustness of H_∞ with the valuable practical properties of long range predictive control laws seems valuable.

A very controversial but interesting contribution was made by Zane Gastineau (Southern Methodist University) entitled "*Catastrophes in Modern Optimal Controllers*". His thesis was that it is necessary to de-gain optimal controllers to improve robustness. He supported these ideas with a mathematical theorem that was thought provoking. By trying to achieve the ultimate in performance the author suggested that robustness was often sacrificed. A wide debate ensued after this presentation.

Romeo Ortega (University de Compiegne, France) presented a very well attended tutorial on "*Passivity Based Control of General Non-linear Systems*". Although this topic is mainly of mathematical interest at the present time, it may have a role in specific engineering applications. One such application described by Erling Johanneseen (Norwegian University of Science & Technology) was in the offshore oil industry.

Gregory Walsh (University of Maryland) gave a very interesting presentation on the cost effective operation of blast furnaces. This was followed by Mohamed Abdelrahman (Idaho State University) speaking about robust control of cupola iron furnaces. Both of these contributions offered practical and valuable results. Kenneth Kalnitsky (Bethlehem Steel Corporation) described an extension

of the work on disturbance rejection controllers, pioneered by Davison, applied to continuous casting. Hearns (Strathclyde) described the use of H_∞ robust design in the control of hot strip fishing mills. This was only one of the many industrial application sessions that attracted both academic and industrial participants.

The conference was enhanced by several specialist tutorial workshops on a range of topics. One of particular interest was on Fault Detection and Diagnosis Methods. This was Chaired by Prof. Rolf Isermann (Darmstadt) who provided an excellent introduction to the subject, using both theory and application examples. Observer based fault monitoring methods using linear and non-linear estimation were described by Prof. Paul Frank (Duisburg). This method uses an observer or Kalman filter to estimate the fault. However, the main problem with an observer based scheme is one of choosing a suitable feedback gain matrix such that the residual changes due to faults are large, compared to those caused by disturbances or other uncertainties. Parameter estimation methods for fault detection, where the system parameters are estimated using traditional identification techniques, were also described. Intelligent control approaches to fault monitoring and diagnosis were also discussed, including neural network and fuzzy methods. The need to combine techniques to solve such problems was also highlighted, involving a combination of model based and knowledge based methods. The applications described by Isermann's group looked promising and included automobile and electric drive fault detection.

Workshops are growing both in number and in scope and their tutorial nature seems to be of interest to both researchers and engineers alike. The American Control Conference continues to be the prime

forum for researchers involved in the interface between academia and industry.

Maritime Defence Conference, Greenwich

Many of the major Maritime Defence Contractors were represented at the above event which was held on the 8-10 October. Prof. Mike Grimble presented a paper at the conference session on re-configurable control. System reconfiguration arising from faults has, in the past, been realised using adhock procedures. However, in recent years the aerospace industry has pioneered a more rigorous treatment of the subject. The current ideas seem well suited to applications in marine systems, nuclear power plants and critical petrochemical and chemical processes.

IFAC Workshop on Adaptive Control and Signal Processing

26th - 28th August, 1998
University of Strathclyde,
Glasgow, Scotland, UK

First Call for Papers

This IFAC workshop will present the state-of-the-art in adaptive control and advanced signal processing. It will explore current theoretical developments as well as the latest applications to engineering problems. The workshop will have an informal atmosphere in which to discuss and present papers describing the most recent research in these areas. Invited papers will be given by leading international experts.

For more information please contact:
Mike Grimble or Mike Johnson
Industrial Control Centre
email: acsp98@eee.strath.ac.uk

Funding for Training, Travel and R&D

The ACT Club maintains a watching brief on the various organisations that award funds to companies for the purposes of training and research and development.

A few of the more relevant awards that have appeared recently are described below. I hope that you find these of interest.

Scottish Technology Fund

The £2 million Scottish Technology Fund is a key part of an action plan designed to ensure that many more Scots firms are given the chance to cash in on academic research by helping them launch new products and inventions into the commercial world.

Until now a funding gap has meant that much of the high technology research carried out by Scottish universities has been wasted and that Scots businesses were losing out. This was the conclusion of a year long enquiry carried out by Scottish Enterprise and the Royal Society of Edinburgh. The study identified the lack of cash for research and development work as a major barrier for new technology firms.

Start-up funding, known as "seed capital", will be made available for businesses which show high growth potential in new technology areas, such as biotechnology, software and electronics.

Full details of the scheme can be obtained from:

Scottish Technology Fund
Scottish Enterprise
tel.: 0141 248 2700

EU Support for Learning & Training for Industry

How does flexible working help your organisation to compete effectively?

Many workers need to adapt to changing environments through learning and re-training. But did you know that Europe is providing a total of 25 MECU (£17M) funding to support, identify and develop computer based tools, processes and application environments to meet these needs ?

Your company can seek a share of this support from a new part of the well-known ESPRIT Programme: "*Learning & Training for Industry*" (L&TI). Full details are published as part of the 10th Call for Proposals which opened on the 16th September 1997. This is under the continuous submission scheme and proposals may be submitted anytime up to 17th March 1998.

More details are available on the World Wide Web at :
http://www.cordis.lu/esprit/src/ learners.htm

The Royal Academy of Engineering "Schemes of Support for Professional Engineers"

Professional Engineering Development Awards

This scheme offers financial assistance to companies to meet the cost of professional development programmes which are linked to the company's business plan. The activities supported are selected by the company and can include short courses in both management and technology subjects, training required

by new legislation and technical foreign language training.

The Panasonic Trust

The Panasonic Trust provides grants to suitable qualified applicants to undertake courses to retrain in new engineering technologies. Preference will be given to applicants wishing to enrol on part-time modular masters courses.

The Sir Angus Paton Bursary

A scholarship is available to suitably qualified engineers who enrol on a full-time masters course related to the environment at selected universities.

The Sir Henry Royce Bursaries

This scheme provides bursaries for suitably qualified engineers to undertake part-time modular masters related to automotive engineering.

International Travel Grants

Open to chartered engineers of any age working within UK industry, International Travel Grants are provided to help engineering researchers in the UK make study visits overseas.

For full details of these awards please contact:

Ian Bowbrick
The Royal Academy of Engineering
29 Great Peter Street
Westminster
London
SW1P 3LW
tel.: 0171 222 2688
email: bowbricki@raeng.co.uk

ACT Club Services and Deliverables to Members

The ACT Club provides its members with access to a very wide range of control technologies. This is accomplished through the various services that are listed below and which are *FREE* to members of the ACT Club.

- Regular Plenary meetings, training courses and awareness days on both basic and advanced subjects. *Typically 2-3 per annum, held centrally*.
- An annual training course at the company premises. This can be selected from our standard range covering virtually all topics in control, or tailored to meet your exact requirements. *Typically 1-2 days duration.*
- Case Studies proposed by members are undertaken to investigate the usefulness of new technologies. *Typically 3-4 case studies are undertaken per annum.*
- Special Interest Groups (SIGs) that focus our efforts onto particular sectors of industry. *Typically 1-2 meetings per annum*.
- Annual visits to provide consultancy advice at company premises.
- Instant access to consultants is available over the telephone, fax or email.
- The ACT Club's own range of user friendly software packages and toolboxes designed to make advanced control more accessible.
- Access to commercial software and hardware rapid prototyping systems.
- Detailed technical reports and easy to understand educational notes.
- Regular conference reports from most of the major events world wide on latest technology and results.
- Regular mailings and newsletters.

Case Studies

Case Studies investigate the applicability of advanced control technologies to specific industrial problems as proposed by the ACT Club members. These studies usually take the form of a 1-3 month study, which can be either simulation based or use real hardware to interface directly to the members plant.

The following Case Studies have been carried out and the associated reports can be made available to Club members.

ROLLS ROYCE: Control of a Gas Turbine Engine (*CS01/1992*)

BRITISH GAS: Self Tuning Control of a Furnace Temperature (*CS02/1992*)

BRITISH AEROSPACE: Pitch Control of a Generic Canard Delta Aircraft (*CS03/1992*)

BRITISH STEEL: Control of Reheat Furnace (*CS04/1993*)

BRITISH STEEL: Gauge Control for Cold Rolling (*CS05/1993*)

ROCHE PRODUCTS: Non-linear Model Based Control for pH (*CS06/1993*)

MARINE SIG: Design of Robust Ship Positioning Systems and Advantages of Feedforward/ Feedback Control (*CS07/1995*)

BRITISH AEROSPACE: Classical versus Modern Control Design Methods for Safety Critical Control Engineering Practice (*CS08/1995*)

BRITISH STEEL: Multivariable Decoupling Control of Collector Main Pressure on Coke Ovens (*CS09/1995*)

ROCHE PRODUCTS: Roche Vitamin C Modelling Report (*CS10/1995*)

BRITISH GAS: British Gas Maintenance Reduction (*CS11/1996*)

BRITISH PETROLEUM: Introduction to Predictive Control with Application to a Hydrogen Reformer (*CS12/1996*)

T&N TECHNOLOGY: Gauge Control of Cold Rolling Mill (*CS13/1996*)

ROYAL ORDNANCE: An Operational Planning Tool for the Royal Ordnance Nitro-Cellulose Process (*CS14/1995*)

BARR & STROUD: Control of a High Resolution Laser Scanner (*CS15/1996*)

MARINE SIG: Implementation Problems and Design of Ship Autopilots (*CS16/1996*)

MARINE SIG: Advanced and Classical Control of Non-linear Ship Positioning Systems (*CS17/1996*)

ROYAL ORDNANCE: Expert System Based Training Simulator : Picrite Process Application (*CS18/1997*)

SCOTTISH NUCLEAR: Control Room Alarm Analysis Toolkit (*On Going*)

UNILEVER RESEARCH: Control of Supply Chain Dynamics (*On Going*)

Technical Reports

Technical Reports provide a detailed theoretical description of specific advanced control techniques. These notes are written to be a concise and complete source of information that any engineer working in that particular field will find invaluable.

The following list gives all the ACT Club Technical Reports:

Application of Expert Systems in Industrial control *(ACT Report 1/1990)*

A Tutorial of Polynomial LQG/H_∞ Optimal Control for Industrial Users *(ACT Report 2/1990)*

A Tutorial of Digital LQG and H_∞ Self-Tuning Control for Industrial Applications *(ACT Report 3/1990)*

µ-Analysis and Synthesis (An overview of an Optimisation - Based Methodology for Multivariable Control Design) *(ACT Club Report 4/1990)*

Weighting Functions in H_∞ Control *(ACT Report 5/1991)*

Introduction to Non-linear Self Tuning Control *(ACT Report 6/1992)*

An Introduction to the Control of Non-linear Processes *(ACT Report 7/1993)*

Mathematical Notations and Glossary *(TR07/1993)*

On the Performance of Generic Model Control *(TR09/1993)*

An introduction to Neural Networks *(TR10/1994)*
Long Range Predictive Control: A Review *(TR11/1994)*

Introduction to the Benefits of Controller with Several Degrees of Freedom and the Use of Feedforward Control *(TR12/1995)*

Applications of Fuzzy Logic Control *(TR13/1995)*

Tutorial Introduction to l_1 Analysis and Synthesis *(TR14/1996)*

Comparison of the Design of a Marine Autopilot using H_∞ Design and Quantitative Feedback Theory *(TR15/1997)*

Educational Notes

Educational Notes are a simple introduction to the various control subject areas that are becoming increasingly prominent and relevant to industry. These introductory texts are aimed at engineers with no prior knowledge of the subject described and provide a basic understanding of the techniques involved.

The following list gives all the ACT Club Educational Notes:

What is H_∞ Optimal Control ? *(EN01/1990)*

What is Robustness ? *(EN02/1990)*

Typical Robust Control Design Problems ? *(EN03/1990)*

What is Self-Tuning Control ? *(EN04/1990)*

A Note on Smith Predictor for the Control Process Plants with Significant Transport Delays *(EN05/1993)*

Tutorial on Variable Structure Control for Industrial Users *(EN06/1995)*

Simple Introduction to Kalman Filtering *(EN07/1996)*

An Introduction to Discrete Event Simulation *(EN08/1997)*

ACT Club Software

The software packages listed below provide intuitive user friendly tools for many of the common control design laws. Comprehensive manuals and examples are provided and complementary training courses often exists.

EASY_KIT Toolbox for MATLAB

Self-Tuning Control Software

Nonlinear Self-Tuning Control Software

Multivariable Robust Control Toolbox for MATLAB

Robust H_2 Feedback/Feedforward Control Design Toolbox for MATLAB (Polynomial Approach)

H_∞ Robust Control Toolbox for MATLAB

4 DoF Non-linear Ship Modelling Package for MATRIX$_X$

If you require more copies of **The ACT Club News**, then please complete the form below and return by to Andy Clegg at 50 George Street, Glasgow, G1 1QE. *tel.*: (+44) 0141 553 1111, *fax*: (+44) 0141 553 1232, *email*: actclub@isc.eee.strath.ac.uk.

Please send _____ more copies of this newsletter.

Name: _____

Company: _____

THE ADVANCED CONTROL TECHNOLOGY CLUB