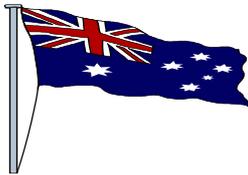


The ACT Club News

Professor Goodwin Visits the Industrial Control Centre

Since the mid seventies Professor Graham Goodwin of the University of Newcastle (Australia) has been one of the major pioneers in the areas of filtering and prediction. His book "Adaptive Filtering, Prediction and Control" is one of the main references in control and signal processing. The Industrial Control Centre and ACT Club Engineers had the great opportunity to listen to his distinguished lecture on the fundamental design trade-offs in filtering, prediction and smoothing.



Professor Goodwin also gave an in-depth demonstration of the UNAC system that was developed in the University of Newcastle by his team of researchers and is now a commercial product sold through CICS Automation. CICS has a similar structure as ISC in bridging research and industry. The UNAC system is primarily a platform for the industrial design and implementation of advanced and classical controllers. The system has been successfully used in the steel, petrochemical, mining and paper industries. If you would like further details of the system please contact us at the address given at the bottom of the back page.

**Scottish Nuclear Holds the
First Energy and Oil SIG
Meeting**

The first Energy and Oil SIG meeting was kindly hosted by John Richards at SNL's sumptuous offices in East Kilbride. The meeting was attended by:

John Richards	Scottish Nuclear
John Tedd	Scottish Power
David Hoult	Rolls Royce & Assoc
George Oluwande	National Power
Phil Fedenczuk	BP Oil
Brian Keenan	BNFL
Mike Grimble	ACT Club
Jim Hamilton	ACT Club
Diyar Abdulkadar	ACT Club
Andrew Sherlock	Strathclyde University

Each member briefly described their involvement in advanced control and their companies' views and future strategies. The companies that were present at the meeting were particularly interested in investigating the application of predictive control techniques to the optimisation of processes, and most of them were involved in ongoing projects involving predictive control. An update on three ACT Club case studies was also presented. The three were the BP Oil, Marathon Oil and Scottish Nuclear case studies. These studies are all concerned with the application of predictive control techniques to improve plant performance and they attracted an enthusiastic interest.

Two important issues were concluded at the meeting, the first was to arrange a case study in which all the well known predictive control packages (DMC, CONNOISSEUR and SCAP) are used and their advantages demonstrated. The Club is now looking for a member company who is willing to propose a case study and give access to Club engineers to try these techniques on a particular process. The second was to organize Special Interest Groups based upon areas of application rather than industry. The two areas that have attracted considerable attention are predictive control and expert systems.

Any member who wishes more information or would like to contribute to these activities should contact us, particularly if they wish to undertake a joint case study with the Club in investigating the predictive control systems.

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- ③ EC Framework IV Proposals
- ④ Case Studies Progress

ACT CASE STUDIES

Since the last newsletter the Club has undertaken a new case study with British Steel. The Study is concerned with the collector main pressure in three batteries of coke ovens. The three pressure loops form a three-input three-output multivariable problem with a degree of coupling between them. Disturbances to the system are caused mainly by the feed of coal to the individual ovens. British steel have designed and implemented PID decoupling strategies which rely on identified first order process models with dead time. The method works very well by greatly reducing the interaction in the loops, however performance deteriorates over time due to process variations and external disturbances. This problem forms an ideal platform to demonstrate the advantages of advanced multivariable design techniques. The work thus far has concentrated on multivariable H_{∞} control, to improve the robustness of the controller. In the simulation tests, the performance of the advanced multivariable controller showed improvements on the decoupled PID controller, particularly when the system deviates substantially from its model parameters, thus emphasising the robustness properties of H_{∞} . However the H_{∞} controller did not improve on the PID decouplers when the identified model exactly matches the process.

In the BP case study a Generalised Predictive Controller (GPC), based on the state space approach to GPC, has been tried on-line at BP Oil refineries in Grangemouth for the control of the furnace temperature in a Hydrogen reformer. The GPC controller was coded by BP engineers in their Honeywell TDC 3000 DCS system and the initial results showed improvement on the Honeywell PID controller. A Club engineer will work alongside BP engineers on-site to further enhance the performance of the GPC controller.

The British Aerospace case study on control systems for safety critical applications is near its completion and Club members should receive a detailed report of the study shortly. The scope for more work on this study is extensive and the SIG members must decide priorities. If there is a significant interest from the aerospace SIG members and other Club members then more work will be undertaken in this study.

The next meeting of the SIG will be held at BAe Warton after presentations by Professor Dino Houpis and Captain Steve Rasmussen of the US Air force. The date is 23 August 1995. This event is an addition to the workshop at Strathclyde, details of which follow.

Plenary Meeting Highlights Club Activities on New Control Techniques

At the last plenary meeting which was held on 23 March the attendees were introduced to some of the areas of control that the Club has not addressed in detail before. This is one of the services that the Club provide to the members where the benefits of new control techniques are demonstrated. At the plenary meeting the in-house research on Variable Structure Control was described by Dr. Andrzej Bartoszewica and a presentation was given on neural networks developments at Strathclyde University by Professor Douglas McGregor. Research from the Process Engineering Department on fuzzy control was also described by Dr. Bruce Postlethwaite. Professor Mike Grimble gave a lecture on the benefits of feedforward control. This appears to be a subject which has not received the same amount of attention as feedback control design but in some cases it offers substantial benefits. He described how to obtain an optimal feedforward control solutions using the H_2 and H_{∞} methods and compared it to the classical frequency domain techniques. A simple introductory report is available on this subject from the Club Manager Mr. Jim Hamilton and a MATLAB toolbox will soon be available for club members.



Two Volume Set of Books to be Won

A two volume set of optimal control and stochastic estimation : theory and applications by Mike Grimble and Mike Johnson, published by John Wiley can be won by Club members by the simple expedient of proposing potential companies and contact names who might join the Club. The books will be awarded to the winner who will be announced at the next plenary meeting. Please note that you can nominate other divisions of your own company who can take advantage of our group membership scheme.



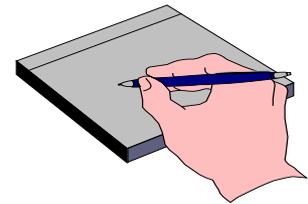
Club Involvement with EC Framework IV Research Proposals

The ACT Club in association with the Industrial Control Centre and other European partners have submitted two European Community proposals.

If the proposals are successful then the generic results of the proposal will be disseminated to the members and there will also be opportunities for case studies as part of assessment stages of the projects. One project is mainly concerned with applying a new generation adaptive predictive control technology to processes. This project is undertaken with the Spanish company SCAP Europa who has already developed the necessary platform (hardware and software) to make the integration of new control methodologies to existing systems and processes straight forward. Another proposal is concerned with the integration of discrete and dynamic simulation tools. A hybrid system of this nature would more accurately model the total supply chain dynamics and offer important advantages over existing systems in overall business optimisation, logistics and scheduling.

ADVERTISE IN ACT NEWS..!!

Members and Non-members can now advertise their products, services and any additional information in the newsletter if they wish to do so. The charge for members will be £200 per page and will be reduced according to size. The charge will be doubled for Non-members. Any income generated from this will be used to supplement Club activities.



DTI Carrier Technology Program

The ACT Club and the ICC have joined forces with ERA and submitted an application for DTI Funding to train SME's in the application of advanced control technology. The ACT Club would be responsible for setting up a demonstrator study based on a genetic application within a particular industry. The feedback so far is that the DTI are still considering the funding but it may be under a different scheme heading.

ACT Club Technical Director Attends the IFAC Conference on Marine Applications

The third IFAC Workshop on Marine Systems was held at the University of Trondheim in Norway and this was a very appropriate venue considering their contribution in the control of ship systems. Unfortunately, Professor Jens Balchan who has been referred to as the father of control in Scandinavia was ill and could not open the event. However, Professor Thor Fossen (NTH Norway) and Professor Mogens Blanke (Chairman of the IFAC Working Group on Marine Systems) opened the meeting and set the scene of the very intensive three days of talks.

It is not surprising that the event reflected the huge interest in ship systems related to oil production. The design of ship positioning systems were the four main themes of the event.

The group at Trondheim have particularly contributed to the design of ship positioning systems and there were a number of sessions on this subject. Johannessen (Norway) used the structural singular value to analyse the robustness of dynamic ship positioning systems very effectively. He was particularly concerned with the performance under changing sea state conditions. Sorensen (ABB Industria AS) considered the design of a commercial system for both dynamic positioning and floating production systems. He noted that a future research area was likely to be integration of the power management system with the ship positioning controls. The relationship between observer based positioning systems and classical design was considered by Sha of Sintef. He noted that the frequency response characteristics can be very similar but there are considerable differences in the ease of tuning such systems.

There was a lot of interest in roll stabilisation systems. Blanke (Aalborg, Denmark) considered a multi-objective H-infinity solution to the rudder roll stabilization problem. He presented a novel approach at H-infinity design for this type of problem. It was very nice to see a very realistic application study described by Sharif (U.K.) concerning experimental results for a fin/rudder roll stabilisation system obtained from sea trials. The benefits that combined fin and rudder roll stabilisation provides were clearly evident.

Model reference adaptive control has not found wide application in Europe but Lauvdal described a globally stable ship autopilot used yaw angle measurements. The autopilot control problem is in fact minimum phase and it is therefore particularly suitable for application of model reference adaptive control methods. There is increased interest in high position track keeping controllers for commercial ships now that very exact measurements of position are available.

Holzhter (Hamburg Polytechnic) described their operating experience with such a system. A theoretical analysis of this problem taking into account the nonlinearities in the system was considered by Marriot Paulsen who used Lyapunov stability theory.

Major Publishers Donate Books to the Club

Wiley and Springer-Verlag have donated an excellent selection of references in control and systems engineering to the Advanced Control Technology Club to add to our list of books. These books can be borrowed from the Club for temporary periods if any of the members would like to do so, and the borrower holds full responsibility for the book. The titles of the donated books are:

SPRINGER-VERLAG BOOKS

- **Intelligent Manufacturing**, W.A. Gruver and J.C. Boudreaux
- **Modern Manufacturing**, M.Z. Zaremba and B Prasad
- **Modelling and Advanced Control for Process Industries**, M Rao, Q Xia and Y Ying
- **Nonlinear Process Control**, P Lee
- **Parallel Processing for Jet Engine Control**, H.A Thomson
- **Intelligent Seam Tracking for Robotics Welding**, N Nayak & A Ray
- **Automatic Supervision in Manufacturing**, Y Ito
- **CO₂ Laser Cutting**, J Powell
- **Expert Aided Control System Design**, C Tebbutt
- **A Systems Approach to AMT Development**, D.R. Towill and J.E. Cherrington
- **Advanced Fixture Design for FMS**, A. Nee, K Whybrew and S Kumar
- **Interactive Learning Control for Deterministic Systems**, K Moore
- **Modelling and Simulation of Power Generation Plants**, A.Ordys, A Pike, M Johnson, R Katebi and M Grimble
- **Microcomputer-Based Adaptive Control Applied to Thyristor-Driven DC-Motors**, U Keuchel and R Stephen
- **Robust Multivariable Flight Control**, R Adams, J Buffington, A Sparks and S Banda
- **Parallel Processing for Jet Engine Control**, H Thomson
- **Laser Material Processing**, W Steen

JOHN WILEY BOOKS

- **Guidance and Control of Ocean Vehicles**, Thor I Fossen
- **Engineering Management : A New Approach**, Patrick. D.T. O'Connor

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- **The Analytical and Numerical Solution of Electric and Magnetic Fields**, K Binns, P Lawrenson and C Trowbridge
- **Self-Tuning Control for Two Dimensional Processes**, W.P. Heath
- **Self-Tuning Systems (Control and Signal Processing)**, P.E. Wellstead and M.B. Zarrop

PRENTICE-HALL BOOKS

- **Matlab Tools for Control System Analysis and Design**, D Hanselman and B Kuo
- **Digital Control System Analysis and Design**, C Philips and H Nagle
- **Automatic Control Systems**, B Kuo
- **Neurofuzzy Adaptive Modelling & Control**, M Brown and C Harris
- **Nonlinear Control of Robotic Systems for Environmental Waste and Restoration**, M Bridges and Z Qu
- **Discrete Time Control Systems**, K Ogata

G2 Centre of Excellence

ACT has the opportunity to become an affiliated member of the GENSYM G2/ORSI EXAD Centre of Excellence. This has been set up in partnership between ISC and Scomag with the ICC, AI and Computer Science Departments of Strathclyde University. The COE has the full development licences for both G2 and EXAD. G2 is the "de facto" standard for expert systems with over 3000 licences world wide and covering a wide range of applications from control to scheduling. EXAD is a user friendly front end to G2 enhancing the graphics and has specific menus for the food, metal, etc industries.

The ACT via ISC can offer to carry out studies using G2 and EXAD to demonstrate the power and cost benefit of the software. This is a cost effective method of 'Trying' before 'Buying'.

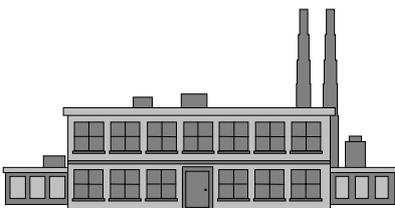


The Oxford Meeting on Predictive Control for Industrial Users.

Professor David Clarke, who introduced Generalised Predictive Control, kindly hosted the ACT Club Symposium on Predictive Control for Industrial Users at Oxford University. The Club was also delighted to have Professor Eduardo Mosca of the University of Florence in Italy who has worked on Predictive Control for many years to give a presentation on new developments in the area. Professor Clarke's presentation gave an excellent overview of the predictive control and was well received by the Club members. There was also presentations by leading industrialist from Cambridge Control Ltd and Predictive Control Ltd. Cambridge Control markets the DMC package which was developed by engineers from Shell Oil Company using Predictive Control techniques. Dr Steve Williams, the Managing Director of Cambridge Control, gave a presentation on DMC and DMO which is an optimisation package working at a supervisory level. Darren Lewis of Predictive Control gave a presentation and demonstration of their CONNOISSEUR package which has been widely used in the UK.

There was also demonstrations of the SCAP Optimisation System which is a total DCS System based on the Adaptive Predictive Control technology. The system is developed in Spain and has recently been introduced in the British Market. Oxford University researchers demonstrated software tools with which constrained GPC controllers are developed and analysed.

The day proved to be very successful and the feedback from the members was positive.



Fault Detection and Condition Monitoring Symposium

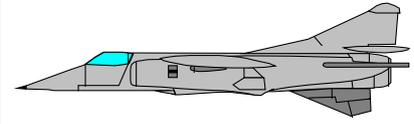
The ACT Club symposium on Fault Detection and Condition Monitoring was held at the University of Strathclyde and had the usual blend of theory and practice. Professor Ron Patten of Hull University, who is a leading authority in the area, gave a stimulating presentation on the state of the art model based fault detection and isolation and a detailed report on the technique was provided. He also said that industry and academia view fault detection and condition monitoring separately. Whilst in academia the subject is viewed as a branch of control engineering without much emphasis on the importance of the subject to industry, in industry the subject is completely separate from control engineering and is essential to the safe and efficient operation of processes.

Professor Jim McDonald of Strathclyde University gave a presentation on the use of artificial intelligence, in particular expert systems, in alarm handling and fault diagnosis in the power supply industry. Industrial contributions to the symposium were made by British Gas who described their COAS system (Condition and Operation Advisory System) which is used in the supervision of the complex gas transportation network. Lloyd's Register gave a presentation on the application of fault detection techniques in diesel engines. British Steel gave a presentation on on-line determination of stopper sensitivity in casting machines and Scomag described their DMS system. The symposium attracted more than twenty five people and the open session, as usual, was stimulating and informative. Copies of the presentation have been sent to all members.

Distinguished Invitees to Give a One Day Workshop on QFT

The ACT club has much pleasure in announcing the one day workshop on Quantitative Feedback Theory (QFT) to be held at the University of Strathclyde on 28 July 1995. The workshop will be given by Professor Dino Houppis of the Air Force Institute of Technology at Wright Patterson Air Force Base, USA, and Captain Rasmussen of the United States Air Force. Professor Houppis is a leading exponent in QFT developments and has worked closely with Professor Horowitz the originator of QFT. He also has developed very sophisticated tools. In addition to the morning lectures there will a demonstration of multivariable QFT control design package.

The QFT technology has recently attracted much interest particularly from the aerospace industry for its robustness qualities. However the theory of QFT can be used in many industrial applications that are multivariable in nature and characterised by uncertainties.



New Chairman for the Steering Committee

After one year as the Chairman of the Steering Committee Patrick Holmes has decided to resign due to increased responsibilities at British Gas. The ACT Club would like to thank Patrick for his efforts and enthusiasm in the effective running of the Club. At the last Steering Committee meeting George Oluwande of National Power was elected as a successor to Patrick. George whose critical input at Plenary and Steering Committee Meetings always ensure enthusiastic discussions, can only enhance the efficient running of the ACT Club.

The Advanced Control Technology Club is professionally managed by Industrial Systems and Control Limited, a company formed by the Industrial Control Centre at the University of Strathclyde. It was formed in response to demand from industry to provide a means to transfer modern control technology into industrial applications.

The Club can call upon an unrivaled source of expertise within both ISC Ltd and the Industrial Control Centre, where a large number of researchers are studying advanced control, both blue-sky and applied research towards post graduate degrees. This includes a large number of foreign researchers who are undertaking research at the University largely because of the reputation of Professor Mike Grimble, the Technical Director of the ACT Club. ISC also has a complement of highly qualified engineers with substantial industrial experience in the field of advance control.

If you would like further details of the Club, in the first instance contact Dr Stephen Forrest at the ACT Club, which is located at :

**50 George Street
Glasgow, G1 1QE
Tel : 0141 553 1111**

Fax : 0141 553 1232