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Applied Control Technology Consortium

Improving Performance through Understanding and Application of
Control Technologies

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A Review of ACTC Activities



by
**Professor
Mike
Grimble**

You may like
to know

about some of the activities and initiatives that have taken place in the last few months. I will first mention that we have recently participated in a European Union Framework 7 launch meeting in Brussels. In fact, I presented one of the motivational talks at the event that focused upon the control of networks, wireless networking, embedded systems, and complexity. It was an excellent venue to meet other potential project proposers and to explore ideas. A typical project will be 4 million euros and it must contain the right mixture of both project partners and technical areas.

Anyone interested in exploring the potential funding available may contact me for further details.

The ACTC is continuing to develop its training courses and of course this is driven by the needs of the members. For example, we have recently put together a relatively short course on

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Forthcoming ACTC Events

- 29-30 August 2007: [Mathematics for Engineers](#), Glasgow
- 5 Sept 2007 (5pm - 7pm): [ACTC Steering Group Meeting No.28](#), Cathedral House Hotel, Glasgow
- 5 - 7 Sept: [University of Strathclyde "Advances in Real-Time Control of Nonlinear Systems"](#), Court Senate/Suite, Collins Building, University of Glasgow
- 5 - 9 Nov: [International Rolling Mill Academy - Advanced Control](#), Glasgow, UK

Other Events of Interest

- 17-18 September 2007: [Advances in Process Control Conference \(APC8\)](#), York, UK
- 16 October 2007: [IET Industrial Networking and Wireless Communications in Control](#), ,

Neural Networks for Chrysler in Detroit. As you know, a large part of all of the courses involves hands-on sessions and these are tailored to the particular company's interest such as the flight controls examples for Boeing in Seattle.

In addition to the basic training courses that can be presented at company premises, we have also been developing the various academies on rolling mills and process control working with Converteam at Rugby or Emerson at Leicester and Stockport. Members do of course receive two free places but the attendance is much wider and it is valuable to demonstrate to non-members the type of course material that can be provided. We have a [Advanced Control Rolling Mill Academy](#) being held at Strathclyde 5-9 November this year, and we are planning next year's Process Control Academy. In addition, the one day or two day training courses that introduce control and related areas have been very successful. Companies seems to like the opportunity of sending engineers away for a few days training and this is often provided in a very personal and supportive environment.

The Industrial Control Centres work on nonlinear systems has fed into the nonlinear control-training course that was presented very successfully at Ford late last year. The centre has recently been awarded two new EPSRC projects concerning biological systems and health care. The initial study will concentrate on the modelling of immune system response. At the same time, the department has appointed two new Lecturers with interests in biological systems and of course more traditional areas of advanced control theory.

We are currently planning a three-day meeting 5-7 September on [Real Time Control of Nonlinear Systems](#). The first day is sponsored by National Instruments and will involve the more practical aspects of real-time control implementation and technology. The second day will be aimed at industry and introduce practical methods of solving problems of the control of nonlinear systems. The final day is more concerned with new developments in the subject than the theory of nonlinear systems.

Finally, I am pleased to announce that Dr. Andrew Clegg has been appointed to the board of ISC Ltd. with a new role to stimulate consulting projects, however, he will retain an interest in the ACTC and you will meet him at future events. I am, also very pleased to say that Dr. Arek Dutka who has been leading our work on automotive systems will take over the management of the ACTC activities.

May I wish you a happy summer period.

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Advances in Process and Condition Monitoring for the Offshore Oil Industry



applications.

University of Warwick, UK

- 5-6 November 2007: [IEEE IAS-CSS 2nd Seminar for Advanced Industrial Control Applications \(SAICA 2007\)](#), Madrid, Spain
- 6 December 2007: [IET Control and Automation TPN, Power Generation Control](#), Birmingham, UK

Opening the event was Dan Benson (Tracerco) who described his company's gamma-radiation sensing technologies, which are used for non-invasive investigations of pipe fouling and internal damage to vessels that would otherwise require a complete shutdown of the process. The technology is also being used for online measurements, such as density profiles in separator vessels and multi-phase "slug" measurements. Robin Brooks (Curvaceous) presented the use of Geometric Process Modelling for assessing plant operation without resorting to a conventional math model. This presents an intuitive display for operators, who can see dynamically changing bounds for good process operation and also what moves are required when these bounds are exceeded.

A new three-phase motor condition monitoring device was presented by Andy Bates (Artesis). Sophisticated pattern recognition techniques are used to determine a whole range of possible conditions from just current and voltage measurements. Conventionally this would require machine-mounted vibration and acoustic sensors, but the use of just current and voltage means the device can be mounted remote from the motor, making it ideal for applications where access is difficult. Mike Grimble (Strathclyde University) presented some research where aging effects in a nuclear reactor can be extracted from operating data using a variety of signal processing algorithms. The event was concluded by Dave Gill (Emerson Process Management) who presented some of Emerson's new technologies for improving process operation and maintenance.

This event showed that condition monitoring is a very diverse subject area and that the vast amount of data that is now available coupled with novel sensing techniques, can be used to better predict fault conditions as algorithms are reaching a state of maturity.

As usual, ACTC members can download the presentations from the members download area of the ACTC website

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Case Study on Nonlinear Predictive Control for Reheat Furnaces

A very interesting case study has recently been completed on evaluating the performance of nonlinear predictive controls for reheat furnaces. Two types of nonlinear control were utilised, one based on linearisation around a trajectory and the second based upon the nonlinear generalised minimum variance control concept described at the Process Control Academy in February this year. The linearisation around a trajectory method involves predictive control of a nonlinear model with input and output constraints. It does take a long time to compute (more than a couple of hours for the simulation) but looks to be feasible within the 60 seconds sample time posed in the problem. The NGMV solution was much faster and only had marginally worse performance for the scenarios posed.

Presentations were given to Corus engineers from both the Netherlands and from the Rotherham research laboratories, at which detailed discussions took place. Members may like to know that this proved an excellent way of evaluating new control techniques through realistic application simulations, well defined scenarios and comparing the performance against classical and other solutions. It is hoped that a joint publication with Corus will stem from this work and the results are likely to be demonstrated at one of the future ACTC training events.

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NEW training course: "Mathematics for Engineers":

As a recognition of a demand for re-fresher of the fundamental skills we decided to develop a new training course. The Mathematics for Engineers is aimed as a refresher of the mathematics knowledge gained at University/College. The

selection of subjects supported by practical engineering examples will provide enhanced understanding of the typical engineering problems that require high level of mathematical skills. The course is suitable for engineers, academics and students who, from a non-mathematical background, are currently practising in a field of engineering or science and wish to update or refresh their mathematical knowledge.

The first Mathematics for Engineers course will be held on 29th - 30th August in Glasgow. For more information about registration for the course please go to <http://www.isc-ltd.com/training/EngMaths/meet070829.html>

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ACTC Member Training Courses

Over recent months the ACTC has been very busy with training courses for our member companies:

- **Chrysler (USA) - "Control Fundamentals and Introduction to Neural Networks"**. These two separate subjects were presented to DaimlerChrysler and the course was attended by about 20 delegates each. The three day training course on Control Fundamentals was followed by a one day introduction to Neural Networks. The same training program was repeated for another 20 delegates in the following week.
- **RWE Npower and Scottish Power - "Control Fundamentals for Power Generation"**. This three-day course was a run for both Scottish Power (10 delegates) and RWE Npower (12 delegates), and benefited from new hands-on examples on a coal-fired boiler control problem.
- **Corus - "Nonlinear MPC for Reheat Furnace Challenge"**. Presented training on MPC and Nonlinear MPC and findings from case study work. See above article.
- **ConocoPhillips and Scheduled Training, CATCH - "Process Control for Process & Chemical Engineers"**. This one day course was presented to 17 delegates at Conoco's Humberbank Refinery. The agenda concentrated on the fundamental control problems and solutions encountered in the process industry, but aimed at non-control specialists such as chemical engineers. The course was repeated on the following day for other companies in the area (8 delegates).
- **Scheduled Training, Glasgow - "Control Fundamentals 1 : Theory"**. This popular scheduled training course attracted 7 delegates from a variety of companies, looking to improve their understanding of basic concepts of control theory.

If you would like to know more about the above and other ACTC training courses, then [get in touch](#).



Details of our [standard courses](#), including agendas



The list of [courses](#) delivered to ACTC members, as well as centrally held "scheduled" courses which all ACTC member companies can access



Download the [ACTC Training Brochure](#) which contains the same information that can be found on the [ACTC web-site](#)

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15th IEEE Mediterranean Conference on Control and Automation (MED'07)

The Mediterranean Control Conference started some years ago and this year it was held in the historic city of Athens during June.

Professor Mike Grimble gave the first plenary of the conference entitled: Why Industry Needs Improved and Practical Nonlinear Control: A Challenge For Today to about 300 attendees. In fact this meeting was the most successful of these annual events in terms of numbers attending and the excellent technical programme. There were six parallel sessions and poster sessions and the event reflected the changing nature of control engineering. That is, topics such as wireless control systems, hybrid systems theory and intelligent transportation systems were covered. One of the most unusual round table sessions was on Automation in the Ancient Mediterranean World.

In addition to the strong technical meeting, there was an excellent social programme with conference receptions and banquets most evenings. It provided an intimate atmosphere for technical discussions and confirms the belief that sometimes the smallest events can be better for interaction and networking.

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45th IEEE Conference on Decision and Control, San Diego, USA



The 45th IEEE Conference on Decision and Control was held in San Diego, California, during December 2006. San Diego is California's second largest city and even in winter time is blessed with an ideal climate.

Professor Stephen Yurkovich (Ohio State University) presented a plenary talk entitled: Calibrating the Control Engineer. His talk was focussed on rather unusual topics exploring what happens to the control engineer once he leaves the comfort of academia and is faced with the real problems experienced in industry. It was illustrated with numerous applications from the automotive, paper and process industries

Professor Frank Allgöwer (University of Stuttgart) gave a much more academic and theoretical talk entitled: The Continuing Joy of Dissipation Inequalities. This is a very useful concept in the analysis and design of nonlinear control systems and Frank was able to enthuse the audience but whether they were joyful at the end is for others to judge.

Another very theoretical talk, but one which had real practical value, was that by Professor Arthur J. Krener (University of California at Davis) who discussed model reduction for both linear and nonlinear control systems. This was in fact the most prestigious of all the plenary talks since it was entitled: The Bode Lecture. With the increasing importance of analysing and designing nonlinear systems, the subject of model reduction figures largely. To generate practical controllers for implementation in industry reasonably low order designs are often imperative. Professor Krener's presentation included something for all, ranging from an excellent historical introduction to information on algorithms for practical application.

As with most CDC conferences the event was preceded by a number of one or two day workshops. The workshop on Model Predictive Control for Fast Nonlinear Systems covered existing approaches, future challenges and various areas of applications. The workshop was run by Rolf Findeisen (University of Stuttgart) and it was very well attended. Other workshops included Air Traffic Management and Hybrid Systems.

This particular CDC conference was extremely well attended and it had a large number of so called interactive sessions. In old terminology these were conventional poster sessions. They seem to work very well with many delegates walking around and interacting with the speakers but it is still questionable whether this as useful as having a formal lecture. Nevertheless, with the balance of regular presentations and interactive sessions they maintained, it seems to

have been a successful formula.

The range of topics covered within the event reveal the changing face of control engineering moving away from regulating loops and onwards towards more difficult problems of system integrity, system management, system co-ordination and health monitoring.

There was a good exhibition of software tools, hardware, books and journal. The wireless internet provided was extremely reliable and seemed to work anywhere within the conference areas. This was therefore a very successful conference which will encourage submissions for the next event to be held in New Orleans during December of this year.

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