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Applied Control Technology Consortium

Improving Performance through Understanding and Application of
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E-News December 2005 Edition

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ACTC: A Year in Review

An Update of Progress and Future Activities Within ACTC by Professor Mike Grimble



We have been very busy putting together new training courses that can be provided to members at their company premises. For example, we have just completed the development and delivery of a training course for SEIC which covered an [Introduction to Neural Networks](#) for control, prediction and condition monitoring. We are also well advanced with the development of a new three-day Kalman Filtering training course for Ford in Dearborn, which again involves substantial hands-on exercises with automotive examples used throughout. For this course we will be trialling some new online training material, which will make available to all ACTC members. We can of course adjust the lectures and hands-on material according to the individual company requirements.

We were very pleased with the [Process Control Academy](#) held jointly with Emerson

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Forthcoming ACTC Events

- 20/2/2006, Detroit, USA: ACTC/NI Workshop "Automotive SIG"
- 6-10/3/2006, Amsterdam, The Netherlands: [Alstom/ACTC Rolling Mill Academy 2006](#)
- 4/4/2006, Ross Priory, Loch Lomond, Scotland: ACTC Steering Group Meeting No. 27
- 5-6/4/2006, Glasgow, Scotland: [ACTC/EPSC International Workshop on Nonlinear Control Design for Industrial Applications](#)

Other Events of Interest

- [UKACC Control 2006 Now Open for](#)

Process Management at their premises in Leicester in September. All places on the course were taken, and the

[Paper Submission](#)

feedback from delegates was excellent. We also had considerable success with the week-long [Rolling Mill Academy](#) in Pittsburgh USA, ran jointly with Alstom. Those of you in the metal processing industry will be pleased to know that this series of events is continuing with [the next one being in Amsterdam, 6-10 March 2006](#). The ACTC also organised a [one-day training event at Corus, Port Talbot](#) to both report on the Pittsburgh event and provide an overview of advances of the subject.

Cooperation with the Industrial Control Centre at the University of Strathclyde has mainly been in the areas of benchmarking and in non-linear control for industrial applications. Benchmarking methods are useful to determine whether control loops are performing adequately and even enable economic performance to be assessed and improved. The PROBE benchmarking tool is available to ACTC members to evaluate the benefits of this technique. During next year, a one-day training course will be developed to provide the latest tools to members. This will also be available at company premises. On the subject of nonlinear control there is a [two-day meeting, 5-6 April 2006 in Glasgow](#), where the first day will focus on recent simple design methods for non-linear systems and the second day will be more focused on the scientific advances. This meeting is, of course, free to the ACTC members.

Prior to this meeting, there is an ACTC Steering Committee meeting at Ross Priory on the afternoon of 4th April 2006. Following this there will be a dinner to thank all industrial supporters of both the ACTC and Industrial Control Centre. For those who do not know, Ross Priory is on the banks of Loch Lomond and set in beautiful grounds that include its own gold course and gardens. We are always pleased to receive nominations from companies for members to serve on the Steering Committee. This is one way to ensure the ACTC reflects your own company's interests.

I am pleased to say we had a very successful [meeting in Detroit on Automotive Systems](#) that was held jointly with National Instruments. This event is to be repeated, on 20 February 2006 at General Motors in Detroit, and will focus upon real time control. A [specialist meeting on Power Generation](#) was held at Ferrybridge PowerStation, kindly hosted by George Oluwande of RWE Npower and this covered a very wide range of subjects relevant to the energy and power industries.

For the next year, we will continue to develop in-house training using our ever growing portfolio of course material which is being continually improved by regular use and from feedback from members. Ideas for future training courses is always welcome from members. We are also considering holding a hot strip mill training course jointly with Alstom and we have both aerospace and defence and marine meetings probably to be held at Ministry Of Defence premises in the south of England.

I would like to take this opportunity of wishing you all a Very Happy Festive Season and New Year.

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[New Training on Artificial Neural Networks](#)



Requested by Systems Systems Engineering Innovation Centre (SEIC) at Loughborough, the ACTC has a new training course, Artificial Neural Networks, to augment its already

extensive range of training material.

The course assumes no prior knowledge of the subject. With topics ranging from simple introductory material to more advanced, application oriented material, it looks at how neural networks can be applied for system modelling, control, time series prediction and fault detection. The lectures were complemented by computer based hands-on examples, utilising Matlab and its Neural Network toolbox.

The course was delivered to SEIC during 8-10 November 2005 and was deemed "excellent" by those attending. The full agenda can be found [here \(PDF\)](#).

If your company would like such a course, we can tailor the course to match your requirements. Just get in touch with us.

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Fundamentals of Dynamic Control Using LabVIEW Training at NI, Texas

As requested by National Instruments (Austin, Texas), the ACTC has recently extended its modelling and control design training to take advantage of the Control and Simulation Toolkits available for LabVIEW.



Using computer based hands-on examples developed using LabVIEW and its Simulation and Control Toolkits, this course introduces the concepts of system modelling, identification, classical control design and some of the practical implementation issues often encountered in practice.

The course, delivered by Professor Oscar D. Crisalle (University of Florida) and Dr. Arek Dutka, took place during 12-14 October 2005 at the National Instruments Headquarters in Austin. Excellent feedback was received from the delegates, with all of whom would recommend the course to anyone wanting to improve their knowledge in control engineering.

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ICC Development in Non-linear Generalised Minimum Variance (NGMV) Control

One of the main outcomes of the recent EPSRC Platform Grant Project awarded to the Industrial Control Centre, University of Strathclyde, was the development of the NGMV control law. This is an extension of the Generalised Minimum Variance (GMV) control law used for linear systems, which now can cope with a very wide range of nonlinear systems.

An advantage of the new technique is that the main nonlinear subsystem (which often represents actuators) is represented by a "black box". In other words, conventional nonlinear equations derived from physics are not necessary. This allows any generic nonlinear function to be used, such as data-driven models like a neural network, existing code, look-up tables and/or fuzzy logic. Furthermore the technique is naturally multivariable and the cost functions include dynamic operators.

It has been shown that rate limiting and amplitude limiting constraints can be included in the basic NGMV algorithm, providing a type of optimisation in the presence of hard constraints. For the future, it is proposed that this method be extended to deal with more general constraints. The interesting feature is that this is not within a predictive framework.

[Download a one-page summary \(pdf\)](#) of the work.

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2005 ACTC/Emerson Process Control Academy an Outstanding Success



ACTC is delighted to announce the overwhelming success of its recent Process Control Academy in Leicester, UK.

Organised by the ACTC as part of its leading training and awareness programme, the event enjoyed the support of Emerson Process Management. It took place over a three-day period and was a showcase of the latest techniques and application stories for the very best in industrial control.

Companies attending this event came from a myriad of industries, including Corus, BP and Lever Faberge amongst many other distinguished companies. For delegates, an encouraging factor was the high quality of speakers presenting at the Process Control Academy. In conjunction with industry relevance, feedback stating the event was good value for money was noted. Mid-event, the delegates enjoyed a Process Academy dinner: a relaxing, informal affair, providing an opportunity to network with other attendees and colleagues.

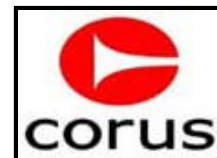
Andrew Buchanan, Managing Director of ISC/ACTC, stated "we are astounded at the level of interest shown in this event and were disappointed that we had to turn down so many companies and interested parties due to number restrictions within the venue. We've received so much positive feedback on the event that we are planning to hold another Process Control Academy in the near future. We'll release the details as soon as a suitable date is agreed upon."

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Gauge and Shape Control for Cold Rolling, Corus, Port Talbot

The ACTC delivered a training course on Gauge and Shape Control for Cold Rolling on 22 September 2005 at Corus, Port Talbot.

Corus in the UK requested the ACTC organise and deliver the one-day course which covered several key lectures from the 2005 Rolling Mill Academy that was held in Pittsburgh. The course was supported by lecturers from Alstom (whom, to quote one Corus delegate, gave "the best lecture on shape control I have heard").



The course attracted 22 delegates from 4 different Corus sites throughout the UK. Judging by the questions and discussions, everybody got a lot out of the day.

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ACTC Helps Trim pH Calibrations

The ACTC was asked by one of its member companies, a leading pharmaceutical producer, to provide help investigating a potential discrepancy between on-line pH measurements and sampled laboratory pH measurements, used on a number of large fermentation vessels.

The difference between online and laboratory readings often resulted in a re-calibration procedure being instigated on the perceived erroneous online pH probes. This placed a significant and continuing burden on instrument technician support for the process.

The ACTC engineers worked closely with the plant engineers and technicians to devise and carry-out a series of tests to pin-point if (and more importantly where) a discrepancy was arising. The tests quantified the size of various known effects on pH (e.g. exposure to air, ambient temperature), while investigating other

previously unknown effects.

The main discrepancy was identified and immediate changes to Ways of Working, and standard operating procedures were made. Once confidence in the on-line measurements was established and the procedures fully implemented, the following benefits were reported:

- time spent trimming probes reduced by 70%
- less time spent on laboratory sampling
- more accurately informed operation and maintenance decisions

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Report Available: "Optimising Petrochemical and Process Plant Using New Performance Assessment and Benchmarking Tools"

Produced by Industrial Control Centre, University of Strathclyde, as an outcome of an EPSRC funded project, this project final report covers:

- Data-Driven Algorithms for Performance Assessment and Condition Monitoring of Control Loops
- MIMO GPC/LQGPC Benchmarking Algorithms
- Restricted Structure Controller Design and Benchmarking
- Economic Assessment and Loop Prioritization
- Nonlinear GMV Control Design and Benchmarking
- Numerical Algorithms and Software Implementations

Key project deliverables included two software toolboxes, Benchmarking Toolbox and the NGMV Design Toolbox (containing numerical benchmarking algorithms, a tutorial and a number of examples). The toolboxes were created using MATLAB Release 14 and will soon be available from the project website. The MIMO version of the routines requires Polynomial Toolbox (<http://www.polyx.com/frm-main-download.htm>), though the SISO routines do not have this restriction.

[Download the full report \(PDF\)](#).

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New ACTC Members

During this year we have had several companies become members of the ACTC. For some it is a new experience and we look forward to introducing them to the benefits of membership, for others it is a chance to renew our acquaintance with them:

- Rolls Royce Marine (Fife) - design and manufacturers of ship stabilisation systems
- Shell UK Exploration & Production (Aberdeen) - offshore oil and gas production
- BAE Systems SEIC (Loughborough) - a joint venture between BAE Systems and Loughborough University, for a centre of excellence in all areas of Systems Engineering.

- Jaguar / Land Rover (Coventry) - automotive design
- Perceptive Engineering Ltd. (Manchester) - vendor of advanced process control and condition monitoring systems into the process industries

A full list of ACTC members can be found [here](#). If you would like to know more about the benefits of ACTC membership, please just [contact us](#)

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Other Events of Interest

UKACC Control 2006 Now Open for Paper Submission

The next UKACC Control Conference, supported by IEE, IMechE and InstMC, will be held in Universities of Strathclyde and Glasgow, 30 August to 1 September 2006.



The paper submission site is now open and the ACTC members will get special discount for attending the Conference. The three Institutions (IEE, IMechE and InstMC) are organising Industrial Session on Thursday 31 August 2006. This includes a mini-symposium to be organised by Prof. Robert Sutton on behalf of IMechE, on advances in marine control systems. For further information and contributions on this contact Bob at R.Sutton@plymouth.ac.uk.

For more information on the conference, contact Dr Reza Katebi at r.katebi@eee.strath.ac.uk.

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