



The Applied Control Technology Consortium

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ACTC Manager



Presentation Overview

- Objectives of the ACTC
- Areas of expertise
- Our History
- Current Members
- ACTC Services to Members
- Special Interest Groups
- New Initiatives



ACTC Objectives

- **Help industry exploit control technologies**
 - training, case studies and consultancy help
 - *general awareness* programme
 - technology transfer
- **Focus on benefits to industry**



ACTC Areas of Expertise

- **Control Engineering:**
 - simple and advanced techniques
 - simulation and practical
 - Control loop performance assessment and benchmarking
- **System Modelling and system identification**
- **Information Systems**
 - e.g. signal processing, operator systems, condition monitoring, alarm handling, optimisation and scheduling

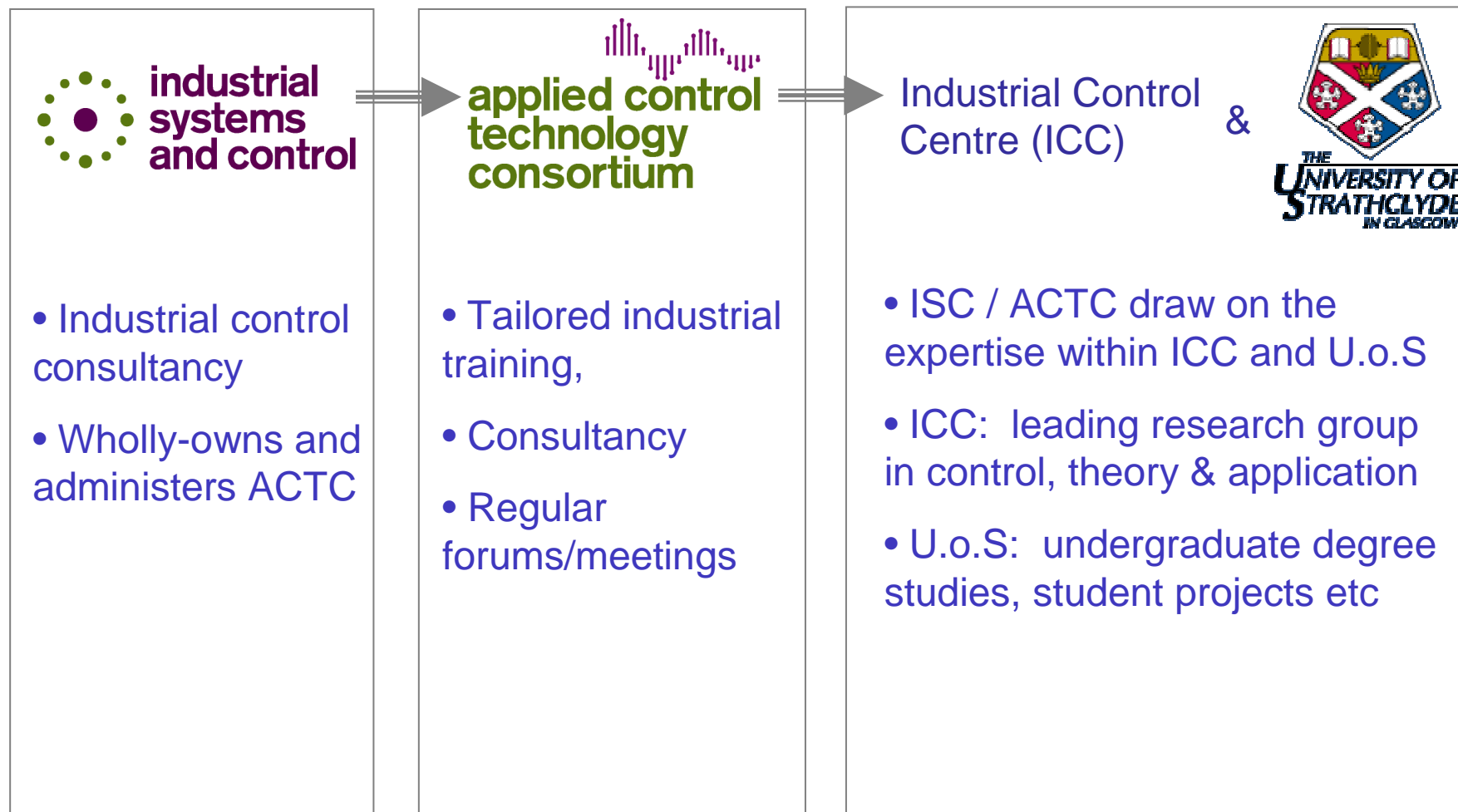


ACTC History

- **Set up in 1990 with initial funding from DTI**
- **Self-financing since 1993**
- **35 member companies**
 - **from blue chip internationals to small high technology firms**
- **London Centre** - Brunel University (1998)
- **Manufacturing Systems Centre** - AJM Consulting, Grimsby (2001)
- **USA Centre** - University of Florida, Gainesville (Dec 2001)
- **“ACTC” Name** - introduced 2004



ISC / ACTC / ICC / University of Strathclyde

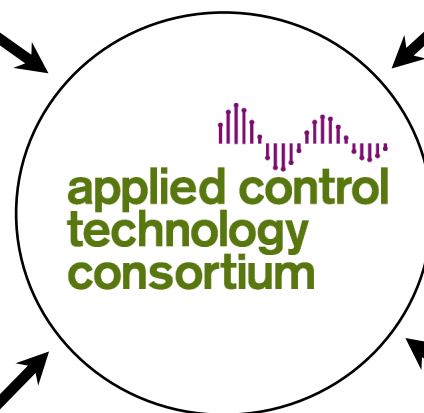




Wider ACTC Links



Industrial Control Centre



- University of Michigan
- University of Aalborg
- Loughborough University
- University of Cambridge
- University of Glasgow
- University of Hull
- University of Liverpool
- University of Oxford
- University of Paisley
- University of Plymouth
- University of Sheffield
- University of Warwick
- University of Manchester - UMIST

Other Universities

AJM
Consulting
ACT Manufacturing Systems Centre

 **industrial systems and control**



New ACTC Members

2001

- Visteon
- Pechiney/Rhenalu (FRANCE)
- Huntsman Tioxide
- Avecia
- Caledonian Paper
- Performance Improvements Ltd
- Shell Expro

2002

- SimCar.com (USA)
- National Instruments (UK)
- Jaguar Cars
- Boeing (USA)
- General Electric (USA)
- Innogy
- BP, Sunbury
- Coherent Ltd.
- PolyX (CZECH REPUBLIC)

2003

- Ricardo MTC Ltd.
- Innoval Technology Ltd.
- Ford Motor Company (UK)
- National Instruments (Corporate)

2004

- Emerson Process Management
- Ford Motor Company (USA)
- John Wiley & Sons Ltd.
- Marathon Oil
- Total Oil

2005

- Rolls Royce Marine, Fife
- Shell UK Exploration & Production, Aberdeen
- BAE Systems SEIC, Loughborough
- Jaguar / Land Rover
- Perceptive Engineering Ltd.

2006

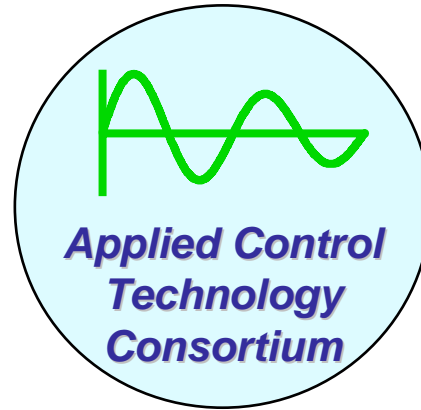
- Lyondell, Grimsby
- Yorkshire Water
- Lloyds Register, London
- Scottish Power
- DaimlerChrysler (USA)
- BAE Systems Land Systems
- Axeon Technologies Ltd.
- Boeing (USA)

2007

- Adept Scientific
- Corus
- Ricardo Inc, USA



ACTC Members





ACTC Services and Deliverables

- Regular technical events:
 - Technical workshops (*bi-monthly*)
 - Scheduled basic training courses (*bi-monthly*)
 - Week long open training courses
- Annual tailored training course - at company premises
- Case Studies and Consultancy help
- Special Interest Groups:
 - Marine, Energy & Oil, Metals, Automotive and Aerospace & Defence



ACTC Services and Deliverables

- **Reports:**
 - **Case Study Reports, Technical Reports & Educational Notes**
- **ACTC's own software toolboxes**
- **Access to commercial control design packages**
- **Reference library and Internet site**
- **Regular mailings and newsletters**
- **Industrial forum**

Recent Meetings

- **5 July 2007: Advances in Process and Condition Monitoring in the Offshore Oil Industry, University of Aberdeen**
- **6-8 Feb 2007: ACTC / Emerson Process Control Academy 2006, Stockport**
- **19 March 2007: Automotive Control SIG Meeting, NI(USA), Detroit**
- **31 Aug 2006: Control 2006 Industry Session “Advances in Predictive Control”, Glasgow [ACTC Organised]**
- **13 July 2006: “Managing Alarms and Abnormal Situations in the Process Industries”, CATCH, Grimsby**
- **5-6 April 2006: ACTC/EPSRC International Workshop on Nonlinear Control Design for Industrial Applications, University of Strathclyde, Glasgow**
- **4 April 2006: ACTC Steering Group Meeting No. 27, Ross Priory, Loch Lomond**
- **20 Feb 2006: ACTC/NI Workshop “Advances in Real Time Control for Automotive Systems, General Motors University, Detroit, USA**





Forthcoming Meetings

- **5 Sept 2007 (5pm-7pm): ACTC Steering Group Meeting No. 28, Cathedral House Hotel, Glasgow**
- **6-7 Sept 2007: ACTC / University of Strathclyde “Advances in Real-Time Control of Nonlinear Systems”, Glasgow**
- **Date TBC: Automotive SIG Meeting,**



Training Courses

- Ranging from basic loop tuning to advanced control techniques
- Either:
 - Customised training given at company premises
 - Scheduled Training Courses **NEW INITIATIVE**
 - our five most popular and general courses
 - centrally held at Strathclyde University, scheduled regularly
 - allows access to training for 1-2 staff from each companies





Forthcoming Training Courses

- **Scheduled Courses:**
- **Customised training at company premises:**
 - **Ricardo, USA (Sept'07)**
"Control Fundamentals for Automotive Applications"
 - **Boeing, USA (Sept'07)**
Title TBC
 - **Ford Motor Co., Detroit, USA (December 2007)**
"Title TBC"
 - **National Instruments, Austin, USA (Date TBC)**
"Control Fundamentals and Overview of Advanced Control"
 - **DaimlerChrysler (USA), Detroit, USA (Date TBC)**
"Modelling, Simulation & Control for Automotive Applications"
 - **DaimlerChrysler (USA), Detroit, USA (Date TBC)**
"Introduction to Neural Networks"

Recent Training Courses

- 17-19 July 2007: "Control Fundamentals for Automotive Applications" Ford Motor Co., Detroit, USA
- 23-24 May 2007 : Control Fundamentals (Part 1: Theory) (2 days)
- 16 May 2007: "Process Control for Process and Chemical Engineers" CATCH, Stallingborough
- 22-23 March 2007 - Control Fundamentals for Power Generation, RWE Npower, Swindon
- 20-23 March 2007 and 26-29 March 2007: "Control Fundamentals and Intro to Neural Networks" Chrysler, Detroit, USA
- 8-9 March 2007 - Control Fundamentals for Power Generation, Scottish Power
- 5 March 2007 – Introduction to Process Control, Scottish Power
- 21 Feb 2007 - Nonlinear MPC for Reheat Furnace Challenge, Corus, Rotherham
- 5 - 7 Dec 2006: "Control Fundamentals for Aerospace Applications" Boeing, Seattle, USA
- 28 - 30 Nov 2006: "Nonlinear Control for Automotive Applications" Ford Motor Co., Detroit, USA
- 15 Nov 2006: "Introduction to Kalman Filtering", SELEX-SAS, Edinburgh (held at Strathclyde University)
- 1-2 Nov 2006: Control Fundamentals (Part 1: Theory) (2 days)
- 27 - 28 Sept 2006: "Overview of Advanced Control for Automotive Applications", Jaguar, Coventry

New Initiatives with Training

- **New material:**
 - **Neural Networks for Modelling, Control and Fault Detection – 3 day course**
 - **Introduction to Kalman Filtering – 3 day course**
 - **Fuzzy Logic and Fuzzy Control – 1 day course**
 - **Overview of Advanced Control – 1 day course**
 - **Improvements to Control Fundamentals Theory (part 1) course, including new Automotive and Aerospace examples**
- **Online refresher material:**
 - **State Space and Transfer Function System Representation**
 - **Introduction to Kalman Filtering**



Case Studies

- **Typically 3 man weeks duration**
 - can be longer if linked into an academic project
- **Impartial advice**
- **Initial on-site meeting to identify the needs**
- **Results and reporting**
 - potential cost benefits and improvements identified
- **Assistance with implementation possible**



Marine Related Case Studies

- **Control of a Gas Turbine Engine**
Rolls Royce (CS01/1992)
- **Design of Robust Ship Positioning Systems: Advantages of Feedforward/ Feedback Control**
Marine SIG (CS07/1995)
- **Classical versus Modern Control Design Methods for Safety Critical Control Engineering Practice**
British Aerospace (CS08/1995)
- **Control of a High Resolution Laser Scanner**
Barr & Stroud (CS15/1996)
- **Implementation Problems and Design of Ship Autopilots**
Marine SIG (CS16/1996)
- **Advanced and Classical Control of Non-linear Ship Positioning Systems**
Marine SIG (CS17/1996)
- **Study on Effect of Rudder Slew Rate on Roll Stabilisation**
MoD(N) (CS27/2004)

Recent Case Studies

- **Applying LabVIEW to Automotive Powertrain Control – Optimal Control of a TIVCT Engine – Visteon / NI (CS28/2005)**
- **Study on Effect of Rudder Slew Rate on Roll Stabilisation – MoD(N) (CS27/2004)**
- **Kalman Filter Based Sensor Fusion – BAE SYSTEMS SSD (CS26/2002)**
- **Fault Diagnosis of a Simulated Industrial Gas Turbine using Identification Techniques - Alstom Energy (CS25/2002)**
- **Integrating Pro/ENGINEER and MATLAB with ADAMS - Thales Optronics, (CS23/2001)**
- **H_{∞} Control for a Servo System - BAE Systems Electro-Optics (CS22/2001)**
- **Human Operator Error Handling Methods for Complex Systems: A State-of-the-art Survey - The National Grid Company (CS21/2001)**





Consultancy Help

- ◆ Pharmaceuticals company – 70% reduction in pH sensor maintenance
- ◆ BAE Systems - investigation into ADAMS
- ◆ Omron - application of advanced control in a PLC
- ◆ Avecia - control loop investigation
- ◆ British Energy - advice on Instrumentation Project
- ◆ Pilkington Glass - continued help with automation project
- ◆ Corus Group – Predictive Control study for Rolling Mills
- ◆ Kodak – on-site visits and advice (Ron Leigh)
- ◆ NNC - interfacing Matlab/Simulink with other packages
- ◆ Alcan - review of rolling mill model



ACTC Library

- **Case Study Reports**
- **Technical Reports**
- **Educational Notes**
- **Books, conference proceedings and papers for loan**



Recent Reports

Educational Notes:

- What is Control Engineering and Why is it Critically Important (*EN13/2006*)
- Diophantine Equations and their Application to Solving Control Problems (*EN12/2002*)
- The Riccati Equation & Optimal Control (*EN11/2002*)

Technical Reports:

- Carbon Emission Control in Coal-Fired Power Plants: Recent Development (*TR20/2006*)
- Subspace Identification Methods (*TR19/2003*)
- A Design Methodology for Handling Parametric Uncertainty (*TR18/2001*)
- Design of l1 Optimal Controllers for Practical Problems: A Tutorial (*TR14_v2/2001*)



Software Toolboxes

- **PROBE - Control Loop Benchmarking and Performance Assessment**
- **Kalman Filter Toolbox (Matlab/Simulink)**
- **Genetic Algorithms for System Identification (Matlab)**
- **Model Based Predictive Control Toolbox (Matlab)**
- **6 DoF Non-linear Ship Modelling Package (Matlab/Simulink)**
- **Easy-Kit - GUI design tool for LQG, H_2 & H_∞ control (Matlab)**
- **... and others on Self-tuning Control, H_2 Control Design and Multivariable Robust Control as well as many process and system models**

Commercial Tools

- **RapidMVC – *Model Based Predictive Control package***
- **LabVIEW RT with PXI and Fieldpoint – *software and hardware for Real-Time Control***
- **MATRIX_x and SystemBuild - *simulation package***
- **Matlab and Simulink - *simulation package***
- **UNAC - *simulation and real time realisation***
- **AVDS - *Aviator Visual Design Simulator***
- **Beacon - *tool for automatic generation of embedded software***





Special Interest Groups

- **SIGs already established In:**
 - **Marine Systems - very successful**
 - **Power and Energy - being established currently**
 - **Metal Processing - through annual training course**
 - **Aerospace and Defence**
 - **Automotive **NEW INITIATIVE****
- **New SIGs to be established in:**
 - **Food**



Our Internet Site

- general ACTC information
- on-line meeting registration
- Control Engineering resource centre
- member-only area:
 - downloadable reports, software and meeting presentations





What the ACTC offers you !

- Keeping your company up to date with the latest developments in control
- Staff building skills and therefore value
- Ability to nominate case studies of several weeks duration
- Regular scheduled training courses at Strathclyde
- Training courses for engineering staff at Company premises
- Consultancy advice and help on urgent problems
- Fast access and help to find information on problem areas
- User friendly software tools and training courses for use
- Attendance at plenary meetings for senior managers and workshops



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