CPACT News

CENTRE FOR PROCESS ANALYTICS AND CONTROL TECHNOLOGY

December 2016

CPACT TEAM

Natalie Kerr
Administration Manager
CPACT Strathclyde
E: Natalie.kerr@strath.ac.uk
T: 0141 548 4836

Carol Badger (covering)
E: carol.badger@strath.ac.uk

Christine Stevenson
Administrator
CPACT Strathclyde
E:
christine.stevenson@strath.ac.uk

Julian Morris
CPACT Technical Director
E: julian.morris@strath.ac.uk

Inside this issue:

MEMBERSHIP

CPACT is delighted to welcome the Institute of Chemical and Engineering Sciences.

ICES is a national research institute under Singapore's Agency for Science, Technology and Research (A*STAR) with the mandate to establish a strong science base, to develop technology and infrastructure and also to provide highly trained R&D manpower to support future growth of the process industries.

Institute of Chemical and Engineering Sciences
A*STAR

Process technology innovation is a domain to which ICES is committed, with Process Analytical Technology (PAT) and its related technologies forming part of this R&D thrust. PAT is applied in a variety of areas such as crystallization, studying chemical kinetics and thermodynamics, kilo-scale processes, biological systems, inline process monitoring and control.
http://www.a-star.edu.sg/ices/

> *"CPACT membership gives us access to an unparalleled network of expertise in process analytics and control and a forum for discussion with leaders in the field. We look forward to gaining more opportunities for collaboration and better visibility of our work here in Singapore."*
> Paul Sharratt, Head of Process Science and Modelling, ICES

KTN the Knowledge Transfer Network

CPACT partner, Knowledge Transfer Network, has some updates to share:

KTN is the UK's innovation network. Our mission is to deliver economic growth. We connect people to speed up innovation, solve problems and find markets for new ideas. We bring together business, entrepreneurs, academics and funders to develop the new products, processes and services that help create a better society.

Established by Innovate UK to foster better collaboration between science, business, and design, KTN's specialist teams work across all sectors of the economy – from defence and aerospace to the creative industries; the built environment to biotechnology and robotics. KTN's expertise in connecting sectors, disciplines and skills with the right collaborations and business approach is what helps unlock the tremendous hidden value in people and companies.

KTN's relationship with CPACT facilitates communications with a broad range of companies, providing industry with valuable information and ensuring that CPACT is aware of the drivers and needs of companies across the chemistry-using industries.

For more information about CPACT, link to our FACTSHEETS:

CPACT NETWORK

RESEARCH AT CPACT

MEMBERSHIP BENEFITS

CPACT'S ACHIEVEMENTS

BUSINESS BENEFITS OF PROCESS ANALYSIS & CONTROL

NEW FUNDING OPPORTUNITIES

CPACT advances manufacturing excellence to deliver business benefits across all sectors of the processing and manufacturing industries

CPACT initiates leading edge R&D and technology transfer for the exploitation of process analytics and control technologies

CPACT is managed by its industrial and academic partners with support from the Knowledge Transfer Network

BUSINESS IS BASED UPON SUSTAINABLE PROFITABILITY:

PROCESS ANALYSIS AND CONTROL BOOSTS YOUR BOTTOM LINE

www.cpact.com

CPACT

EARLY-STAGE RESEARCHER FEASIBILITY STUDIES

CPACT recently extended its feasibility study programme to encourage early-stage researchers to make research proposals in collaboration with member companies. The first call for proposals resulted in two submissions being approved for £5k under this category.

IMPROVING DECISION MAKING BY INTEGRATING PROCESS EXPERIENCE INTO INDUSTRIAL APPROACHES WITH BAYESIAN STATISTICS
- Newcastle University and Sanofi

EVALUATION OF OPTICAL MEMS-BASED NIR SPECTROMETER FOR SECONDARY PHARMACEUTICAL APPLICATIONS
- University of Strathclyde and GSK

Other proposals received were deemed more suitable for standard CPACT feasibility studies and discussions are taking place to move these forward.

SUPPORT FOR BID WRITING

CPACT, the Centre for Process Analytics and Control Technology, is an industry / academic consortium dedicated to the development and application of process analytics and control technology.

Many of the national and international calls for research proposals, such as innovate UK, BIS and Horizon 2020, involve considerable time and effort on the behalf of industrial and academic partners, at a very early stage of the bid process. Often, the deadline for submission to calls is extremely short, which challenges the resource availability to complete them.

CPACT wishes to remove barriers to participation in these calls, to increase the research effort in process analytics and control technology. To that end CPACT is offering funds to support the utilisation of professional bid writing, to ease the strain on potential partners and improve the chance of successful application.

For stage one applications, this will normally be limited to a contribution to costs of £1k.
Applications should be for projects with themes in areas of interest to CPACT members: http://www.cpact.com/research/projects/current
In the first instance, interest should be directed to admin@cpact.com

SUPPORT FOR STUDENTSHIPS

CPACT is keen to encourage and enable researchers to leverage university/ CASE/industrial funding to support PhD studentships in areas of interest to CPACT members.

To that end, CPACT is offering 5 x £10k bursaries , offered as a contribution to the costs of PhD studentships.

If you are interested in this funding, please contact us for further information and application guidelines: admin@cpact.com

CPACT EVENTS

FORTHCOMING EVENTS

13 December 2016

CPACT Steering Committee
University of Strathclyde
09:00-16:00

17-19 January 2017

Process Spectroscopy Course
Clairet Scientific Ltd.
Northampton
Details:
http://www.cpact.com/events/courses/20170117_process_spectroscopy_course

8 March 2017

CPACT Research Day
Syngenta,
Jealott's Hill, Bracknell
09:30-16:30

9 March 2017

CPACT IMB Meeting
Syngenta,
Jealott's Hill, Bracknell
09:30-16:30

10-12 May 2017

EuroPACT 2017
Potsdam, Berlin
Details:
http://dechema.de/en/europact17.html

4-5 October 2017

Special 20th Anniversary Research Day and Dinner
University of Strathclyde

www.cpact.com

CPACT

RESEARCH DAY—September 2016

Another successful Research Day was held at University of Strathclyde on 14 September. Attendees commented on the high quality and broad range of both company and academic presentations which, together with networking opportunities, made the day a great success.

Many thanks to all the presenters for their interesting talks. Presentations have also been uploaded to the CPACT members pages of the website for those who were unable to join us. www.cpact.com

The next Research Day is planned for 8th March 2017 and will be hosted by member company Syngenta at their Jealott's Hill site. Presentation contributions are invited—please contact us at admin@cpact.com if you would like to participate.

PROCESS SPECTROSCOPY COURSE
17-19 January 2017
Clairet Scientific, Northampton

CLAIRET SCIENTIFIC LIMITED

Process Analysis is an integral part of process optimisation, process control and performance monitoring. Rapid analytical measurements are increasingly required in industry to monitor progress of a reaction, know when the end-point of a process has been reached, check reaction kinetics, detect impurities or control blending, granulation, etc. All these activities and many more require timely qualitative and quantitative information. This can often be provided through at-line, on-line, in-line or non-invasive application of molecular spectroscopy techniques. The course provides an introduction to molecular spectroscopy through a series of presentations and practical exercises/demonstrations on process spectroscopy techniques, including NIR, MIR, UV-visible, Raman spectrometries. Developments in complementary process analysis procedures based on light induced fluorescence spectrometry, mass spectrometry, NMR spectroscopy and acoustic measurements will also be described. Emphasis will be given to the practical application of spectroscopy to process analysis.

A few places are still available for the course. For further details:
http://www.cpact.com/events/courses/20170117_process_spectroscopy_course

EuroPACT—10-12 May 2017
Potsdam, Berlin

europact 2017

EuroPACT 2017 is the fourth European Conference on Process Analytics and Control Technology

The conference will cover new technologies in process analytics, the implementation of these technologies in various fields and the transformation of data into knowledge. The conference will be supported by an exhibition of instrumentation, applications and data evaluation tools.

EUROPACT 2017 provides a meeting and a discussion forum for scientists and users of process analytics from academia and industry. The conference programme will include plenary lectures and discussion during poster sessions.

For further details: http://dechema.de/en/europact17.html

SPECIAL EVENT FOR CPACT'S 20TH ANNIVERSARY!

RESEARCH DAY AND CELEBRATION DINNER—4-5 October 2017

Next July CPACT will celebrate 20 years since its beginning in 1997 which probably makes it the longest running UK-based centre of its type! We are delighted to announce that it has been decided to hold a special event to recognise our successes and achievements.

The research event will run over two full days, and hopes to portray a glimpse of CPACT from a past, present and future perspective.

There will also be a celebration dinner in the evening of 4th October at the Corinthian Club in Glasgow.

Webinars are a huge benefit of CPACT membership — they are excellent training resources for companies and best of all they are free!

Recent Webinars and company benefits

Participation in CPACT webinars is free of charge for members making it an excellent training resource and benefit. Additionally, all webinars are now recorded and can be accessed from the CPACT website (www.cpact.com members area).

- ATR FTIR Spectroscopic Imaging led by Sergei Kazarian and Andrew Ewing, Imperial College London (8 July 2016)
- Lyophilised Product Monitoring led by Fabien Chauchard, Indatech (11 October 2016)
- Hybrid Modelling led by Julian Morris and Jie Zhang (1 December 2016)

Upcoming Webinars

MINDFUL ORGANISING FOR ORGANISATIONAL SAFETY AND RESILIENCE: 8 DECEMBER 2016 AT 15:00 (GMT)
Matthew Linsley, University of Newcastle
Using international case studies, this 1 hour webinar introduces participants to **High Reliability Organisation (HRO)** theory and practice by providing an awareness of the **5 pillars of effective mindfulness**. Effective mindfulness enables not just containment after an incident, but anticipation pre-event.

1763 AND ALL THAT OR A BRIEF INTRODUCTION TO BAYES: 26 JANUARY 2017 AT 15:00 (GMT)
Malcolm Farrow, University of Newcastle
There are a number of different theories, or paradigms, of statistical inference. The main division is between the "frequentist" paradigm, which is the approach most commonly taught to students in the UK, and the Bayesian paradigm. The Bayesian approach has grown greatly in popularity in recent years, especially since computational advances, starting around 1990, have made complicated analyses relatively straightforward. Nevertheless the approach remains unfamiliar to many. This talk will give an introduction to Bayesian inference, starting from the Bayesian, or subjectivist, interpretation of probability. Some simple examples will be illustrated in detail and some more advanced topics and applications briefly introduced.

One of the advantages of the Bayesian approach is that probability under the Bayesian interpretation provides a unified means of handling uncertainty, in inference and decision making, and we can move seamlessly between the two. It also provides a means of incorporating information from different sources. One of the main arguments in favour of the Bayesian approach is its relationship to rational decision making. Arguments against are usually concerned with the need to start with a prior probability distribution which is criticised by some. This criticism will be addressed.

ONLINE ELEMENTAL ANALYSIS: 9 FEBRUARY 2017 AT 15:00 (GMT)
Philip Martin, University of Manchester

STATISTICAL ANALYSIS METHODS WEBINAR SERIES:
A series of four webinars commencing on 2nd March 2017 and continuing on 16th, 23rd and 30th March.

FOR FURTHER DETAILS AND UPDATES VISIT: www.cpact.com

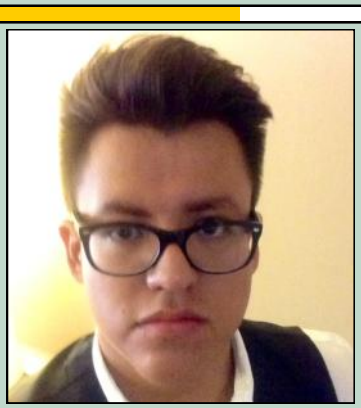
PEOPLE: RESEARCHERS

Atakan Sahin joined University of Strathclyde as a Marie Curie Early Stage Researcher in July 2016. He has background on optimization, time series modelling, control systems and computational intelligence methods, especially on Fuzzy Logic.

Currently, he is working under the supervision of the multidisciplinary team of Prof. Julian Morris, Dr. Alison Nordon and Dr. Jianzhu Pan from University of Strathclyde.

His research interests are based on dynamic model based process performance monitoring for life sciences. His project will seek to develop new dynamic statistical bio-process performance monitoring methodologies and algorithms. He hopes to develop new tools based on Canonical Variate Analysis state space models and Gaussian Process Regression models for nonlinear processes.

Atakan Sahin
University of Strathclyde



Ricardo Suarez-Heredia
University College London

Ricardo Suarez-Heredia joined as PhD researcher in Biochemical Engineering at University College London (UCL) in April 2016.

Ricardo's current research is focused on the development of a combined mathematical and experimental platform for the design and optimisation of metabolically balanced nutrient supplementation strategies in semi-continuous mammalian cell cultures.

The proposed approach combines extensive wet lab experimentation with state-of-the-art model based techniques in Process Systems Engineering (model-based optimisation and model analysis techniques) and Systems Biology (Flux Balance Analysis, Flux Variability Analysis, Randomised sampling) for the development of robust, highly-predictive mathematical models for Chinese Hamster Ovary (CHO) cell cultures. This in vitro – in silico methodology enables a quantitative representation of genotype-phenotype relationships underlying cellular functions under a wide variety of bioprocessing conditions, offering insights for designing CHO cell based processes with increased monoclonal antibody yields.

Maximilian Lularevic began his PhD at University College London in September 2015. His research topic is: A combined multi-scale modelling and experimental investigation of the effects of Lactate metabolism on mammalian cell bioprocessing.

A key metabolic effect observed in high cell density mammalian bioprocesses is the shift in lactate metabolism which is commonly observed during the later stages of batch and fed-batch cultures. This metabolic shift (from secretion to consumption) is not well understood and experimentation alone has not been able to fully explain it.

The aim of this project is to combine state-of-the-art constraint based modelling techniques combined with wet-lab experimentation in order to gain further insights into the underlying metabolic effects that cause this shift on lactate metabolism and their impact on culture performance. With the obtained knowledge it is hoped to optimize current practices in mammalian bioprocessing.

Maximilian Lularevic
University College London

Puneet Mishra
University of Strathclyde

Puneet Mishra joined the University of Strathclyde in May 2016 as a Marie Curie Early Stage Researcher under the MODLIFE (Advancing Modelling for Process-Product Innovation, Optimization, Monitoring and Control in Life Science Industries) project funded through Horizon 2020.

Puneet's current research under the project aims to improve the development and monitoring of processes in the life science and biotechnology industries. He will be working towards evaluation of optical, acoustic and imaging techniques for in situ measurement of critical quality and performance attributes for a range of processes, including the production of oleochemicals, structured emulsified products and multi component pharmaceutical systems.

Furthermore, he will be working towards multi block modelling and Bayesian data-integration methodologies for the fusion of data from different spectroscopic techniques along with the monitored process measurements. Finally, he will work towards the development of miniature fibre-probe analysers for optimized high resolution multi-spectral process control.

PEOPLE: CPACT TEAM

We are delighted to welcome **Florian Zehentbauer** who joined CPACT in November as a Research Associate in Process Analysis. He is based at University of Strathclyde and will be the contact for companies who wish to discuss potential feasibility studies.

Florian Zehentbauer
CPACT Research Associate

After receiving his degree in Chemical and Bioengineering from the University of Erlangen-Nuremberg in 2010, Florian joined the Materials and Chemical Engineering Research Group at the University of Aberdeen as a Postgraduate Research student. During his PhD he applied spectroscopic techniques such as Raman and infrared (MIR, NIR) spectroscopy in the characterisation of process unit operations as well as the physico-chemical behaviour of single and multiphase process fluids.

In 2014 Florian relocated to the University of Bremen where he continued his work as a Research Associate within the institute for engineering thermodynamics before receiving his PhD in Engineering from the University of Aberdeen in 2015.

After his graduation Florian remained involved in several research projects within the institute for engineering thermodynamics at the University of Bremen while acting as a visiting researcher until he joined CPACT.

Jaclyn Dunn
GSK

We would also like to wish **Jaclyn Dunn** every success in her new role at GSK and thank her for her valuable contribution to CPACT over the past two years. Jaclyn has moved to GSK at Stevenage as Scientific Investigator, New Analytical Technologies & Control, R&D Platform Technology & Science.

Although she will be missed at Strathclyde, we are pleased that she has moved to a member company and is already involved with a possible new CPACT feasibility study, this time from the industry side! So not so much a loss as a gain for CPACT and a good success story of how CPACT's talent pool move on to further careers within the network.

Natalie Kerr

Lastly, but definitely not least, we're delighted to welcome CPACT's Administration Manager, Natalie Kerr, back from maternity leave on 1st December. Natalie's son, Jaxon, was born in January 2016 and she has enjoyed a busy year in her new role as a mum.

Carol Badger, who was part of the CPACT team in the early years, has been covering the role during Natalie's absence. *"It has been good to be back and part of this special network once again. Hope to see many more familiar faces at the 20th anniversary celebrations next year!"*

Carol Badger

LIGHT INDUCED FLUORESCENCE AS A PAT TOOL

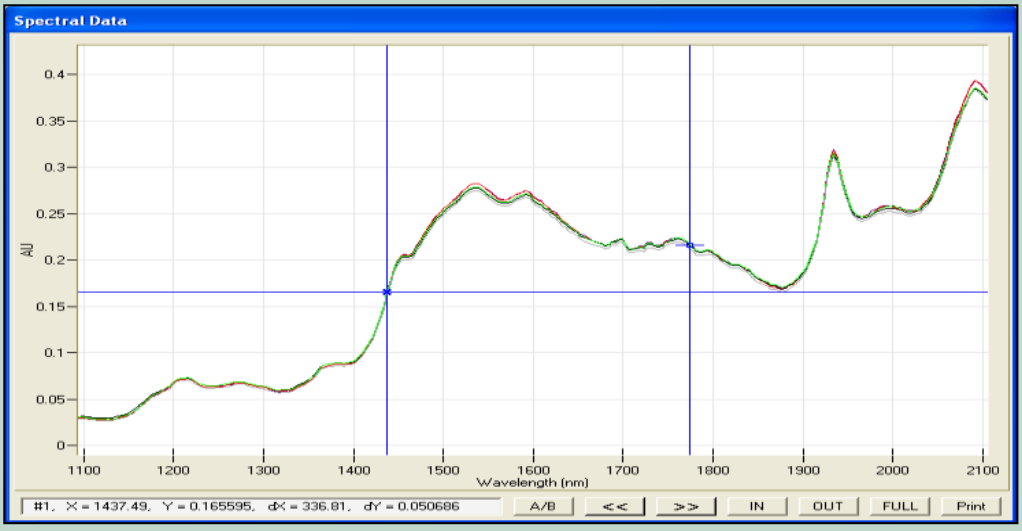
John Andrews
Clairet Scientific Ltd.

LIF can be a much more sensitive technique than NIR and Raman

The most common spectroscopic techniques for PAT are NIR and Raman, however, both of these techniques have a lower limit of quantitation of the order of a few hundred ppm (except in some cases where long pathlength NIR measurements are possible, on clear liquids for example.) Light Induced Fluorescence (LIF) can be a much more sensitive technique. Where the analyte of interest is fluorescent and needs to be measured in a matrix which is either non-fluorescing or where fluoresence is not excited by the same wavelength, LIF is ideal.

The availability of LEDs of specific wavelengths in the UV or Visible provides a readily available monochromatic excitation source, more rugged and better suited to PAT than the conventional lamp and monochromator source arrangement used in laboratory instruments. Several LEDS can be installed in a single instrument to provide a range of selectable excitation wavelengths. A rugged monolithic diode array UV-Vis spectrograph is used for detection and analysis of the fluorescence signal.

One example of the use of LIF is for monitoring the blending of low concentrations of active pharmaceutical ingredients (API's) with excipients. Caffeine provides a good model compound for illustrating this type of application. The NIR spectra of a series of low concentrations of caffeine are shown below:



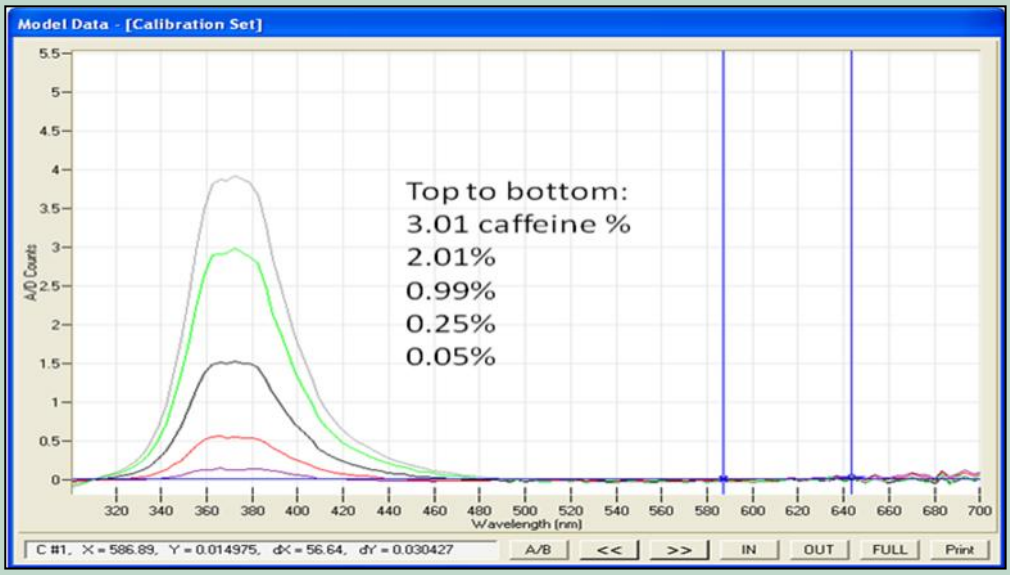
The excipients have strong NIR spectra, masking the changes in caffeine concentrations and limiting the sensitivity and accuracy of quantitation for an NIR method.

Continued/...

LIGHT INDUCED FLUORESCENCE AS A PAT TOOL
.../Continued

Whilst not so universally applicable as NIR and Raman, LIF is a very useful addition to the PAT spectroscopy toolbox

However, caffeine fluoresces strongly under UV excitation while the excipients do not, producing a strong clear signal for analysis at concentrations as low as 0.05%, shown below:



The single peak in the fluorescence spectrum due to caffeine, with no interference from other components is ideally suited for univariate quantitative or qualitative analysis.

Whilst not so universally applicable as NIR and Raman, LIF is a very useful addition to the PAT spectroscopy toolbox.

LIF systems are manufactured by Prozess Technology and available from Clairet Scientific. They can be configured either with a probe or with a large area head designed to measure through a window (shown right). A variety of enclosures for lab or process applications including IP65 and ATEX are available.

For rotating bin blender applications optional battery powered operation and wireless communications are available.