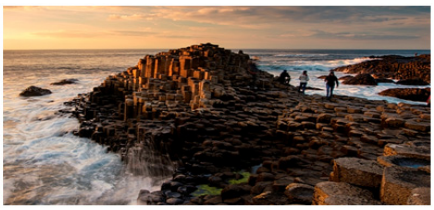
IFAC
INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL

5th IFAC Conference on
Intelligent Control and Automation Sciences
21-23 August 2019, Belfast, Northern Ireland

http://www.qub.ac.uk/**icons2019**

Programme

Wednesday, 21 August 2019

08:30 – 09:15	Registration
09:15 – 09:30	Welcome
09:30 – 10:30	**Plenary talk** by Prof Frank Allgöwer Current trends in model predictive control
10:30 – 10:50	Refreshments
10:50 – 12:10	**Parallel sessions**: 1. Robotics and Autonomous Vehicles 2. Fault Detection, Diagnosis and Fault-Tolerant Control I
12:10 – 13:00	IFAC TC 3.2 Meeting
13:00 – 14:00	Lunch break
14:00 – 15:00	**Tutorial** by Dr Coorous Mohtadi Deep Learning with MATLAB: Real-time object recognition and transfer learning
15:00 – 15:20	Refreshments
15:20 – 17:30	**Special session** (with 10min break): Recent advances in fuzzy model-based design: theory and applications
17:30 – 18:30	Welcome reception

Thursday, 22 August 2019

09:30 – 10:30	**Plenary talk** by Prof Robert Babuska Nonlinear Control Design Through Reinforcement Learning: Challenges and Open Issues
10:30 – 10:50	Refreshments
10:50 – 12:10	**Parallel sessions:** 1. Advanced Manufacturing and Industrial Control 2. Machine Learning and Human-Centric Applications
12:10 – 13:30	Lunch break
13:30 – 14:30	**Plenary talk** by Prof Manuel Giuliani Embodied Cognition for Human-Robot Interaction
14:30 – 15:30	**Poster Session**
15:30 – 16:00	Refreshments
16:00 – 17:20	**Parallel sessions:** 1. Fault Detection, Diagnosis and Fault-tolerant Control II 2. Learning & Control
19.00 – 22.00	Banquet

Friday, 23 August 2019

10:00 – 11:00	**Plenary talk** by Dr Coorous Mohtadi Are you ready for AI? Is AI ready for you?
11:00 – 11:20	Refreshments
11:20 – 12:20	**Parallel sessions:** 1. Modelling and Identification 2. Nonlinear Control and Applications
12:20 – 13:00	Closing and light lunch

Wednesday, 21 August 2019

[Wed 9.15-9.30] Welcome

Chair: Seán McLoone

Welcome and overview of conference

[Wed 9.30-10.30] Plenary by Prof Frank Allgöwer

Chair: Thierry Marie Guerra

Current trends in model predictive control

During the past decades model predictive control (MPC) has become a preferred control strategy for the control of a large number of industrial control problems from distillation control to autonomous driving. Computational issues, application aspects and systems theoretic properties of MPC (like stability and robustness) are rather well understood by now and the theory is well developed even for nonlinear systems. However, during the past couple of years there have been some exciting new trends in MPC that promise to change the field in a lasting way. In this overview presentation we will give an introduction to and an overview over the general field of model predictive control focusing on the new trends.

Most prominently one of those trends concerns the control objective to be achieved. In standard MPC formulations, the considered control objective is typically the stabilization of some (given) setpoint or trajectory to be tracked. In contrast, the main focus in so-called "economic MPC" is on closed-loop performance where the cost to be optimized is directly related to some economic objective. This shift in the typical control task to be solved is especially of interest for many industrial applications like robot control, autonomous mobility, or industrial production processes in the framework of Industry 4.0, and will be discussed in the talk. Secondly, interesting new results for "distributed economic model predictive control" for the control of networks of systems have been developed recently and will be presented in the talk. And, thirdly, the new possibilities arising from data science and learning have also led to exciting new developments in MPC that will also be briefly addressed in this presentation.

[Wed 10:50-12:10] Regular Session 1: Robotics and Autonomous Vehicles

Chair: Miguel Bernal; Co-Chair: Wasif Naeem

1. Jorge Luis Alvarez,Juan Carlos Arceo,Carlos Armenta,Jimmy Lauber, Miguel Bernal, An Extension of Computed-Torque Control for Parallel Robots in Ankle Reeducation
2. Antal Hiba, Rita Aleksziev, Koppány Pázmán, Peter Bauer, András Benczúr, Akos Zarandy, Bálint Daróczy, The applicability of on-line contextual calibration to a neural network based monocular collision avoidance system on a UAV (ID: 32)
3. Faheem Rehman, Giles Thomas, Enrico Anderlini, Centralized Control System Design for Underwater Transportation using two Hovering Autonomous Vehicles (HAUVs) (ID: 58)
4. Shane Trimble, Wasif Naeem, Seán McLoone, Slip signal analysis on a Baxter robot (ID: 59)

[Wed 10:50-12:10] Regular Session 2: Fault Detection, Diagnosis and Fault-Tolerant Control I

Chair: Antonio Ruano; Co-chair: Nikolaos Athanasopoulos

1. Ahmed Al-Ajeli, David Parker, On-line monitoring for diagnosis of violations of constraints in Petri net models (ID: 9)
2. Denis Kirchhübel, Morten Lind, Ole Ravn, Toward Comprehensive Decision Support Using Multilevel Flow Modeling (ID: 12)
3. Christopher Reinartz, Denis Kirchhübel, Ole Ravn, Morten Lind, Generation of Signed Directed Graphs Using Functional Models (ID: 13)
4. Mert Ergurtuna, Ebru Aydin Gol, An Efficient Formula Synthesis Method with Past Signal Temporal Logic (ID: 53)

[Wed 14.00-15.00] Tutorial by Dr Coorous Mohtadi

Chair: Pantelis Sopasakis

Deep Learning with MATLAB: Real-time object recognition and transfer learning

Deep learning can achieve state-of-the-art accuracy for many tasks considered algorithmically unsolvable using traditional machine learning, including classifying objects in a scene or recognizing optimal paths in an environment. This presentation demonstrates a practical approach to the domain of deep learning and enables discovery of new MATLAB® features that simplify these tasks and eliminate the low-level programming. Use of pre-trained networks and transfer learning is discussed. The tools enable swift transition from prototype to production, build and train neural networks and automatically convert a model to CUDA® to run natively on GPUs.

[Wed 15.20-17.30] Special Session: Recent advances in fuzzy model-based design: theory & applications
[Chairs: Jimmy Lauber and Kevin Guelton

1. Djamel Eddine Chouaib Belkhiat, Dalel Jabri, Kevin Guelton, Noureddine Manamanni, Issam Chekakta, Asynchronous Switched Observers Design for Switched Takagi-Sugeno Systems Subject to Output Disturbances (ID: 23)
2. Carlos Ariño, Antonio Sala, Minimal Controllable Set for Takagi-Sugeno Fuzzy Systems with disturbances (ID: 29)
3. Guoxi Feng, Thierry Marie Guerra, Anh-Tu Nguyen, Lucian Busoniu, Sami Mohammad, Robust Observer-Based Tracking Control Design for Power-Assisted Wheelchairs (ID: 43)
4. Thierry Marie Guerra, Mathias Blandeau, Juntao Pan, Anh-Tu Nguyen, Practical approach of input delay nonlinear systems: Application to spinal cord injury sitting stability (ID: 44)
5. Yosr Garbouj, Thach Ngoc Dinh, Talel Zouari, Moufida Ksouri, Tarek Raïssi, Interval estimation of switched Takagi-Sugeno systems with unmeasurable premise variables (ID: 46)
6. Thierry Marie Guerra, Anh-Tu Nguyen, Michael Defoort, Control of SISO non-affine-in-control discrete-time systems using Takagi-Sugeno models (ID: 54)

[Wed 17.30-18.30] Welcome Reception: Venue: Isdell Courtyard, Riddell Hall

Thursday, 22 August 2019

[Thu 9.30-10.30] Plenary by Prof Robert Babuska
Chair: Seán McLoone

Nonlinear Control Design Through Reinforcement Learning: Challenges and Open Issues

Reinforcement Learning (RL) algorithms provide a way to optimally solve dynamic decision-making and control problems. Recent progress in deep learning has enabled RL to scale to problems that were previously intractable. Notable examples include complex board games, such as Go, or tasks with high-dimension visual inputs, such as video games or robots learning directly from camera inputs. The ability to learn control policies from scratch is an undisputable advantage of RL, especially for problems where it is difficult or impossible to design a controller in advance, for instance because one cannot rely on a mathematical model of the system to be controlled. However, for RL to become a standard control design tool, many challenges need to be addressed. For instance, approaches based on deep neural networks suffer from the lack of reproducibility, caused by nondeterminism during the training process. In addition, the interpolation and extrapolation properties of the function approximators involved in RL may adversely affect the control performance and thorough comparisons with alternative control design methods are lacking. The focus of this talk is on the use of reinforcement learning as a tool for feedback control design to improve the closed-loop performance of nonlinear systems. We will address the aspects of value function and policy approximation, using methods ranging from standard basis function approximators, through deep neural networks to our new work showing how to incorporate analytical models generated by means of symbolic regression. The talk will include examples of nonlinear control problems that can be successfully solved by reinforcement learning as well as by alternative methods and will illustrate some of the challenges this exciting field of research is currently facing.

[Thu 10.50-12.10] Regular Session 3: Advanced Manufacturing and Industrial Control
Chair: Juš Kocijan; Co-chair: Thierry Marie Guerra

1. Ricardo Massao Kagami, Gilberto Reynoso-Meza, Eduardo Alves Portela Santos, Roberto Zanetti Freire, Control of a Refrigeration System Benchmark Problem: An Approach based on COR Metaheuristic Algorithm and TOPSIS Method (ID: 19)
2. Oliver Tate, David Cheneler, C. James Taylor, A thermal-electrical analogy model of a four-floor building with occupancy estimation for heating system control (ID: 26)
3. Yousaf Alarfaj, A Practical Example Of Fractional Order Generalised Predictive Control: Forced Ventilation In A Micro-Climate Test Chamber (ID: 35)
4. Linn Danielsen Evjemo, Geir Langelandsvik, Jan Tommy Gravdahl, Wire Arc Additive Manufacturing by Robot Manipulator: Towards Creating Complex Geometries (ID: 49)

[Thu 10.50-12.10] Regular Session 4: Machine Learning and Human-Centric Applications
Chair: Miquel Angel Piera Eroles; Co-chair: Keum-Shik Hong

1. Matija Perne, Martin Stepancic, Boštjan Grašič, Handling Big Datasets in Gaussian Processes for Statistical Wind Vector Prediction (ID: 16)
2. Gian Antonio Susto, Leonardo Vettore, Giuliano Zambonin, Fabio Altinier, Daniele Beninato, Terenzio Girotto,

Mirco Rampazzo, Alessandro Beghi, A Machine Learning-based Soft Sensor for Laundry Load Fabric Typology Estimation in Household Washer-Dryers (ID: 33)

3. Miquel Piera Eroles, A socio-technical holistic agent based model to assess cockpit decision supporting tools performance variability (ID: 40)
4. Nicolò Bargellesi, Mattia Carletti, Angelo Cenedese, Gian Antonio Susto, Matteo Terzi, A Random Forest-based Approach for Hand Gesture Recognition with Wireless Wearable Motion Capture Sensors (ID: 62)

[Thu 13.30-14.30] Plenary by Prof Manuel Giuliani

Chair: Kang Li

Embodied Cognition for Human-Robot Interaction

In the next decades robots will be used more and more in new application areas such us households, assisted living homes, and public spaces. Furthermore, more collaborative robots will be used professionally in the future, for example by workers on factory floors and by operators in extreme and hazardous environments. This means that there will be a growing user base of people who will interact with robots on a regular basis, who have not been trained to use robots and who do not have the technical background to know how robotics technology works.

Researchers in Embodied Cognition for Human-Robot Interaction are investigating in the necessary cognitive skills for robots to interact with humans in a natural and socially appropriate way. The research in this field has two parts to it. On one hand, there is the technical challenge of designing complex robot architectures that combine software components for multimodal input recognition, decision making, and multimodal output generation with appropriate robot hardware. On the other hand, there is the challenge to study the human factors of human-robot interaction. What appearance should a robot have to support a given task? Should the robot show social behaviour when interacting with humans? How do humans perceive working together with robots depending on task context and application area?

In this talk, I will give an overview of past and present research in Embodied Cognition for Human-Robot Interaction, showing its relevance to different application areas such us manufacturing, social interaction, and nuclear decommissioning. I will also attempt to look into the future of the field and discuss research questions that still need to be addressed.

[Thu 14.30-16.00] Poster Session (including coffee-break from 15.30-16.00)

Chair: Ahmad Elkhateb

1. Marek Dlapa, Application of the Robust Control Toolbox for Time Delay Systems with Parametric and Periodic Uncertainties Using SSV to Uncertain Time Delay System with Astatism (ID: 2)
2. Pedro Constantino, Prodromos Daoutidis, A Control Perspective on the Evolution of Biological Modularity (ID: 14)
3. David Ismael Vázquez, Alan Tapia, Adolfo Soto-Cota, Miguel Bernal, Stability analysis of 2-sliding mode algorithms via convex optimisation (ID: 30)
4. Mustapha Oudani, Modelling the Incomplete Intermodal Location Problem (ID: 31)
5. Zhilin Hu, Kezhi Li, Shuang Cong, Yaru Tang, Reconstructing Pure 14-Qubit Quantum States in Three Hours Using Compressive Sensing (ID: 37)
6. Alvaro Hernandez, Antonio Ruano, Jesús Ureña, Maria da Graça Ruano, J. Jesus Garcia Dominguez, Applications of NILM Techniques to Energy Management and Assisted Living (ID: 38)
7. So-Hyeon Yoo, Keum-Shik Hong, Diagnostic Mild Cognitive Impairment via Task Relevant Hemodynamic Response (ID: 41)
8. Aziz Hraiba, Achraf Touil, Ahmed Mousrij, Hybrid Two-Stage Eagle Strategy for Reliability Analysis (ID: 55)*
9. Saso Blazic, Igor Skrjanc, Design of Experiments as a Prerequisite for Development of Fuzzy Models? (ID: 56)
10. Achraf Touil, Abdelwahed Echchatbi, Abdelkabir Charkaoui, Ahmed Mousrij, Uncertain Chance-Constrained Model for Energy Consumption in the Permutation Flow Shop (ID: 61)*

[Thu 16.00-17.20] Regular Session 5: Fault Detection, Diagnosis and Fault-tolerant Control II

Chair: Adrian Gambier; Co-chair: Gian Antonio Susto

1. Ruben Morales-Menendez, Israel Benjamin Ruiz Quinde, Antonio Vallejo, Jorge Chuya Sumba, Luis Enrique Escajeda Ochoa , Bearing Fault Diagnosis based on Optimal Time-Frequency Representation Method (ID: 17)
2. Himanshukumar Patel, Vipul Shah, Passive Fault-Tolerant Tracking for Nonlinear System with intermittent Fault and Time Delay (ID: 22)
3. Ruben Morales-Menendez, Luis Enrique Escajeda Ochoa, Israel Benjamin Ruiz Quinde, Jorge Chuya Sumba, Antonio Vallejo, New Approach based on Autoencoders to Monitor a Tool Wear Condition in HSM (ID: 36)
4. Tommaso Barbariol, Enrico Feltresi, Gian Antonio Susto, Machine Learning approaches for Anomaly Detection in Multiphase Flow Meters (ID: 39)

[Thu 16.00-17.20 Regular Session 6: Learning & Control
Chair: Lucian Busoniu; Co-chair: Daniel Görges

1. Daniel Görges, Distributed Adaptive Linear Quadratic Control using Distributed Reinforcement Learning (ID: 47)
2. Eduard Alibekov, Jiri Kubalik, Robert Babuska, Proxy Functions for Approximate Reinforcement Learning (ID: 48)
3. Cees Verdier, Robert Babuska, Barys Shyrokau, Manuel Mazo Jr, Near Optimal Control With Reachability and Safety Guarantees (ID: 51)
4. Jan Hauser, Daniel Pachner, Vladimir Havlena, Gaussian Process Based Model-free Control with Q-Learning (ID: 52)

[Thu 19.00-22.00] Banquet: Venue: Belfast City Hall

Friday, 23 August 2019

[Fri 10.00-11.00] Plenary by Coorous Mohtadi
Chair: Wasif Naeem

Are you ready for AI? Is AI ready for you?

AI, or Artificial Intelligence, is powering a massive shift in the roles that computers play in our personal and professional lives. Most technical organizations expect to gain or strengthen their competitive advantage through the use of AI. But are you in a position to fulfil that expectation, to transform your research, your products, or your business using AI?

We look at the some of the techniques that compose AI (deep learning, computer vision, robotics, and more), enabling you to identify opportunities to leverage it in your work. You will also learn how MATLAB® and Simulink® are giving engineers and scientists AI capabilities that were previously available only to highly-specialized software developers and data scientists.

[Fri 11.20-12.20] Regular Session 7: System Identification
Chair: Antonio Vallejo; Co-chair: Naohisa Otsuka

1. Roberto Saco, Subspace Identification of an Inverted Pendulum on a Cart using State Variables Transformation (ID: 27)
2. Naohisa Otsuka, Daiki Kakehi, Interval Switched Positive Observers for Continuous-Time Switched Positive Systems under Arbitrary Switching (ID: 28)
3. Li Zhang, Kang Li, Dajun Du, A sparse least squares support vector machine used for SOC estimation of Li-ion Batteries (ID: 60)

[Fri 11.20-12.20] Regular Session 8: Nonlinear Control and Applications
Chair: Saso Blazic; Co-chair: Dajun Du

1. Yuehua Song, Dajun Du, Huiyu Zhou, Minrui Fei, Sliding mode variable structure control for inverted pendulum visual servo systems (ID: 24)
2. Lucian Busoniu, Jamal Daafouz, Irinel Constantin Morarescu, Near-optimal control of nonlinear systems with simultaneous controlled and random switches (ID: 25)
3. Adrian Gambier, Evolutionary multiobjective optimization with fractional order integral objectives for the pitch control system design of wind turbines (ID: 42)

[Fri 12.20-13.00] Closing and Light Lunch:

ICONS 2019 is using the guidebook Conference App which can be downloaded from either the Apple App Store, Google Play, by visiting the website https://guidebook.com/getit/, or by scanning the QR code. Delegates attending the conference will be emailed further instructions on how to access the conference guide using this App.

We gratefully acknowledge the generous support of our sponsors:

QUEEN'S UNIVERSITY BELFAST

visit Belfast

iAMS
CENTRE FOR INTELLIGENT AUTONOMOUS MANUFACTURING SYSTEMS

BELFAST CITY COUNCIL

ELSEVIER

MATLAB