

Online Seminar Series for IFAC TC 1.2 Adaptive & Learning Systems

Organizers: **Tiago Roux Oliveira**, State University of Rio de Janeiro – UERJ, TC 1.2 Chair
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Details of the Seminar

Title: Iterative Learning and Repetitive Control — A Status Report

Speaker: Prof. **Eric Rogers**, University of Southampton

Time: **November 26, 2025 (03:00pm GMT)**



Abstract: Iterative learning control (ILC) applies to systems that repeatedly perform the same finite-duration task. A particular example is a gantry robot executing a pick-and-place task, where the sequence of operation is i) collect the payload from a specified position, ii) transfer it over a finite duration, iii) place the payload at a specified location or onto a moving conveyor under synchronization, iv) return to the starting location, and v) repeat i)-iv) as many times as required or until a stop for, e.g., maintenance is required. Once an execution is complete, all generated information is available for potential use in updating the control input for the subsequent execution, which is computed when the robot returns to its starting location. The resetting action is not necessary for the application of ILC; it is enough that there is a stoppage time between one execution and the start of the next. Consequently, ILC can be applied to batch processing. The basic control setup involves specifying a reference signal to represent the ideal response on each execution. Then the design problem can be formulated as minimizing the sequence whose entries are the errors between the reference and the output on the corresponding execution number. Repetitive Control (RC) has been developed for applications where the reference trajectory is periodic and there is no stoppage time between successive executions. Although there is some evidence to the contrary, research on ILC and RC began in earnest in the mid-to-late 1980s. Since then, many approaches to design have been developed for both linear and nonlinear dynamics. This presentation will focus on the development of algorithms that have been followed through to experimental testing and application. Some ideas for possible future research will also be discussed.

Bio: Eric Rogers has been a professor of control systems theory and design in the School of Electronics and Computer Science at the University of Southampton, UK, since April 1999. He is originally from Northern Ireland and received his postgraduate master's and PhD degrees (supervised by David H. Owens) in control systems from the University of Sheffield, UK. He also earned a DSc degree for a thesis based on published research from Queen's University, Belfast, UK. In 2017, he was awarded the Doctor Honoris Causa degree by the University of Zielona Gora, Poland, where he had conducted joint research since 1996 with Professor Krzysztof Galkowski, who passed away in 2023, and his group (which continues with members of the group). In research, he has focused on iterative learning control since the early 1990s. He is a co-author, with Notker Amann and David Owens, of the first paper on the norm-optimal approach to design, a key method in iterative learning control design that has seen numerous applications in laboratory testbeds and industrial settings. He has also been an extensive contributor to the development of a 2D systems/repetitive process approach to iterative learning control for linear and nonlinear systems, collaborating with Zielona Gora, Pavel Pakshin, and co-workers from Nizhny Novgorod, Russia. Unlike all other 2D control systems research, this research has been followed through to experimental validation, including, more recently, systems with saturating actuators. In another strand of research, his group has collaborated with healthcare professionals to use iterative learning control algorithms to regulate the assistive stimulation applied to patients' muscles during robotic-assisted upper limb stroke rehabilitation, supported by clinical trial results. An early output from this ongoing research was awarded the 2013 IEEE Control Systems Best Paper Award. Other research interests include multidimensional systems theory, long-range autonomy for AUVs, and flow control. He is currently the editor-in-chief of the International Journal of Control. He has an extensive record of service to the organisation, including national and international conferences, most recently as general co-chair of the 8th IEEE Conference on Control Technology and Applications (CCTA) 2024, held in Newcastle-upon-Tyne, UK. He regularly serves on funding panels for grant awarding bodies in the UK and elsewhere.

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