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: Energy maximising control for wave energy systems:

An extremum seeking problem?

Speaker: Professor John Ringwood, Maynooth University, Ireland

Time: December 19, 2022 (4pm UTC)

Abstract: Wave energy systems represent another category of renewable energy system with a control objective of energy maximisation. Typically, data-driven methods, including extremum-seeking control, have found good application for renewable energy systems, especially for solar PV and wind systems. For these applications, the objective function (energy converted) is directly measurable and relatively immediate control action can be taken. In wave energy systems, due to the stochastic nature of the excitation force (described by a wave spectrum), an integration interval, consisting of a significant number of pseudo wave cycles, must be employed to get a reasonable statistical measure of the converted energy, precluding the use of control action of a wave-by-wave or intra-wave basis. Nevertheless, model-based techniques, which operate on an intra-wave basis, have been shown to be clearly superior to controllers which operate on an 'average' wave, or wave spectrum, basis.

Despite these difficulties, there is considerable motivation to employ data-driven control techniques in the wave energy application. Physics-based hydrodynamic models, employed in model-based control designs, present a significant fidelity challenge, particularly those which might lend themselves to real-time control application, while the sensitivity properties (to modelling errors) of wave energy control systems have been shown to be challenging. This webinar will articulate the control problem for wave energy systems, focussing on aspects that both encourage use of, but also present challenges to, data-driven control, such as extremum seeking. One mitigating factor, perhaps favouring a data-driven control solution, is the presence of persistent excitation, which may preclude the requirement for additional perturbation typically associated with extremum-seeking techniques.

In the discussion period, the speaker would be more than grateful for suggestions from experts in the data-driven control community as to how this problem might be effectively approached!

Bio: John Ringwood received the HonsDipEE from TU Dublin, the BSc(Eng) in electrical engineering from Trinity College Dublin (both in 1981), and the PhD in control systems from Strathclyde University (1984). He subsequently received an MA in music technology from Maynooth University in 2005. He spent 15 years in Dublin City University as a member of academic staff in the School of Electronic Engineering, with concurrent terms as a visiting academic in Massey University and the University of Auckland. He joined Maynooth University in 2000, as chair professor and founding head of the Dept. of Electronic Engineering and built the Dept. from a greenfield site, also serving as Dean of Engineering from 2001 to 2006. He is currently Professor of Electronic Engineering and Director of the Centre for Ocean Energy Research in Maynooth University. He is Associate Editor for IEEE Trans. on Sustainable Energy and the Journal of Ocean Engineering and Marine Energy, and Deputy Subject Editor for IET RPG. John received the 2016 IEEE Control Systems Magazine Outstanding Paper Award and was awarded Chevalier des Palmes Academiques by the French Government in 2017 for his contribution to ocean energy research. In addition to over 400 peer-reviewed publications, he is co-author of the book Hydrodynamic Control of Wave Energy Devices (with Umesh Korde) and holds 3 patents. His commercialization activities, which include the spin-out company Wave Venture, has been recognized by Enterprise Ireland (2008 Industrial Technologies Commercialization Award) and Maynooth University (2013 Commercialisation Award). His research interests are in control systems, ocean and renewable energy, and biomedical engineering

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