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IEEE CAS Distinguished Lecture

Neuromorphic Dynamics of Chua Corsage Memristor

Professor HERBERT H.C. IU

The University of Western Australia

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Time: 10:00 am to 11:00 am (AWST)
Venue: Murdoch University, 360.3.025 (see https://maps.murdoch.edu.au/?sharepoi=360)
Cost: Free (IEEE and Non-IEEE members)
RSVP: Email hai.wang@murdoch.edu.au

**** This seminar is co-organised by IEEE Circuits and Systems Society Western Australia Chapter and Murdoch University School of Engineering and Energy****

Abstract:

Neuromorphic computing can solve computationally hard problems with energy efficiencies unattainable for von Neumann architectures. A locally-active memristor, which possesses the capability to amplify infinitesimal fluctuations in energy and can be used to generate neuromorphic behaviors, is a natural candidate for constructing an electronic equivalent of biological neurons. In this talk, we first look at the signature of Edge of Chaos in a memristor. Then we identify some unknown neuromorphic dynamics of the Chua corsage memristor (CCM), and show that the CCM, when biased at the edge of chaos domain, can exhibit rich dynamics of biological neurons. Using Chua's theories of local activity and edge of chaos, we demonstrate that under the destabilizing of the input voltage and the circuit parameters (inductance or capacitance), two CCM-based circuits can produce thirteen types of neuromorphic behaviors either on, or near the edge of chaos domain via supercritical or subcritical Hopf bifurcation. In addition, we give the conditions to test the edge of chaos of the CCM and the CCM-based circuit only by using the poles and the zero of their admittance functions.

Biography

HERBERT H.C. IU (S'98--M'00--SM'06) received the B.Eng. (Hons) degree in electrical and electronic engineering from the University of Hong Kong, Hong Kong, in 1997. He received the Ph.D. degree from the Hong Kong Polytechnic University, Hong Kong, in 2000.

In 2002, he joined the School of Electrical, Electronic and Computer Engineering, The University of Western Australia as a Lecturer. He is currently a Professor at the same school. His research interests include power electronics, renewable energy, nonlinear dynamics, current sensing techniques, and memristive systems. He has published over 300 papers in these areas. He has won two *IET Premium Awards* in 2012 and 2014. In 2014, he also won the UWA Vice-Chancellor's Mid-Career Research Award. He received the *2023 IEEE Transactions on Circuits and Systems Guillemin-Cauer Best Paper Award*, *2021 IEEE Journal of Emerging and Selected Topics in Power Electronics* Prize Paper Award, *2019 IEEE Transactions on Very Large Scale Integration Systems* Prize Paper Award, and the Best Paper Award of *2019 IEEE International Conference on Artificial Intelligence Circuits and Systems*. He currently serves as the Editor-in-Chief for *IEEE Journal on Selected and Emerging Topics in Circuits and Systems*, Associate Editor for *IEEE Transactions on Circuits and Systems II, IEEE Transactions on Power Electronics*, *IEEE Journal of Emerging and Selected Topics on Power Electronics*, and *IEEE Transactions on Smart Grid.* He was appointed as IEEE CASS Distinguished Lecturer for 2023-24. He is a co-editor of *Control of Chaos in Nonlinear Circuits and Systems* (Singapore: World Scientific, 2009) and a co-author of *Development of Memristor Based Circuits* (Singapore: World Scientific, 2013).