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Ultra low power cytomimetic VLSI circuits: Synthesis method & proof-of-concept results

The physics-dictated sub-threshold operation of MOS transistors can lead to ultra-low-power designs but is also governed by a challenging exponential characteristic. This talk will elucidate how to view such a non-linearity as an asset and how to exploit it by treating it as a powerful computational primitive which can lead to the systematic realisation of non-linear dynamics dictated by biology. We will present a method for the systematic implementation of ultra low power microelectronic circuits aimed at computing nonlinear cellular and molecular dynamics. Several examples of systematic computation of non-linear cellular and molecular dynamics by means of ultra-low-power microelectronic cytomimetic circuits will be elaborated: Glycolytic oscillations, nonlinear intracellular calcium oscillations and a gene-protein regulatory system model. Proof-of-concept results from a 1 microwatt cytomimetic prototype chip emulating the complex non-linear mammalian cell cycle dynamics will be reported.

Biography

Emmanuel Mic. Drakakis received the BSc degree (1st Class Honours) in Physics and the MPhil degree (1st Class Honours) in Electronic Physics and Radioelectrology from Aristotle University of Thessaloniki, Macedonia, Greece, and the PhD degree in Analogue IC design from the Department of Electrical and Electronic Engineering at Imperial College London, U.K. under the supervision of Dr. Alison Payne. Currently he is Reader in Bio-Circuits and Systems in the Department of Bioengineering at Imperial College London. In the Department of Bioengineering he has founded the Bioinspired VLSI Circuits and Systems Group whose research focuses on "Circuits for and from Biology". He has authored or co-authored many (more than 120) peer-reviewed journal and conference papers and several book chapters. He has received many prizes for research excellence and is involved in several cross-disciplinary research projects. In the past he has served as Guest Ass. Editor for IET El. Letters and as Subject Editor for the International Journal of Electronics – Taylor & Francis. He has also served as an Associate Editor in IEEE publications, including TCAS1 and TCAS2. He is currently an Associate Editor for IEEE Transactions on Biomedical Circuits and Systems and an Associate Editor for Frontiers in Neuromorphic Engineering.

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