Title: Spiking Control Systems

Abstract: Spikes and rhythms organize control and communication in the animal world, in contrast to the bits and clocks of digital technology. As continuous-time signals that can be counted, spikes have a mixed nature. This talk will review ongoing efforts to develop a control theory of spiking systems. The central thesis is that the mixed nature of spiking results from a mixed feedback principle, and that a control theory of mixed feedback can be grounded in the operator theoretic concept of maximal monotonicity. As a nonlinear generalization of passivity, maximal monotonicity acknowledges at once the physics of electrical circuits, the algorithmic tractability of convex optimization, and the feedback control theory of incremental passivity. We discuss the relevance of a theory of spiking control systems in the emerging age of event-based technology.

Biography: Rodolphe Sepulchre is professor of engineering at the KU Leuven (Belgium) and at the University of Cambridge (UK). He is a fellow of IFAC (2020), IEEE (2009), and SIAM (2015). He received the IEEE CSS Antonio Ruberti Young Researcher Prize in 2008 and the IEEE CSS George S. Axelby Outstanding Paper Award in 2020. He was elected at the Royal Academy of Belgium in 2013. He is Editor-in-Chief of IEEE Control Systems. He co-authored the monographs Constructive Nonlinear Control (1997, with M. Jankovic and P. Kokotovic) and Optimization on Matrix Manifolds (2008, with P.-A. Absil and R. Mahony).

His current research interests are focused in nonlinear control, with a focus on the feedback control principles of neuronal circuits. His research is currently funded by the ERC advanced grant Spiky Control (2023-2028).