Alain Goriely, University of Oxford

Title: The arrival time problem and its applications to the brain.

Abstract: Many physical, epidemiological, or physiological dynamical processes on networks support front-like propagation, where an initial localised perturbation grows and systematically invades all nodes in the network. A key question is then to extract estimates for the dynamics. In particular, if a single node is seeded at a small concentration, when will other nodes reach the same initial concentration? Here, motivated by the study of toxic protein propagation in neurodegenerative diseases, we present and compare three different estimates for the arrival time in order of increasing analytical complexity: the linear arrival time, obtained by linearizing the underlying system; the Lambert time, obtained by considering the interaction of two nodes; and the nonlinear arrival time, obtained by asymptotic techniques. We use the classic Fisher-Kolmogorov-Petrovsky-Piskunov equation as a paradigm for the dynamics and show that each method provides different insight and time estimates. Further, we show that the nonlinear asymptotic method also gives an approximate solution valid in the entire domain and the correct ordering of arrival regions over large regions of parameters and initial conditions