Applied Mathematics Seminar

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

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Domino effects on networks of bistable oscillatory nodes

Multistability has been identified as a key mechanism in a diverse range of brain functions at different spatial scales. It is well known that the addition of noise in a multistable system can induce random transitions between states. In a network, the presence of coupling introduces dependence between nodes leading to sequences of noise-induced transitions in a so-called domino effect. The timing and order of these domino cascades are emergent properties of the network. Analysis of the transient dynamics responsible for these transitions is crucial to understand the drivers of neurological disorders such as epilepsy.

We consider a general model of coupled bi-stable oscillators. Each node has two stable states; oscillating (active) and non-oscillating (quiescent). Escape from the quiescent state is driven by additive noise and we assume the timescale of transitions back again is long enough to be ignored. Escapes are affected by changes in node dynamics, coupling strength and synchronisation. Using numerical and theoretical techniques we explore the interplay between synchronisation and noise-induced escape. We consider amplitude and phase-amplitude coupled motifs. In particular, we find and investigate examples of three node symmetric networks where sequences of noise-induced escapes are associated with various types of partial synchrony during the sequence.

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