Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **3090** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Random Asymmetric Markov Models

Monday 6 June 2022 11:15 (15 minutes)

Biological systems need to react to stimuli over a broad spectrum of timescales. If and how this ability can emerge without external fine-tuning is a puzzle. This problem has been considered in discrete Markovian systems where results from random matrix theory could be leveraged. Indeed, generic large transition matrices are governed by universal results, which predict the absence of long timescales unless fine-tuned. Previous work has considered an ensemble of transition matrices and motivated a temperature-like variable that controls the dynamic range of matrix elements. Findings were applied to fMRI data from 820 human subjects scanned at wakeful rest. The data was quantitatively understood in terms of the random model, and brain activity was shown to lie close to a phase transition when engaged in unconstrained, task-free cognition –supporting the brain criticality hypothesis in this context. In this work, the model is advanced in order to discuss the effect of matrix asymmetry, which controls entropy production, on the previous results. We introduce a new parameter that controls the asymmetry of these discrete Markovian systems and show that when varied over an appropriate scale this factor is able to collapse Shannon entropy measures. This collapse indicates that structure emerges over a dynamic range of both temperatures and asymmetry, and allows a phase diagram of temperature in discrete Markovian systems to be produced.

Primary author: MOSAM, Faheem (Ryerson University)

Co-author: Dr DE GIULI, Eric (Ryerson)

Presenter: MOSAM, Faheem (Ryerson University)

Session Classification: M1-8 Statistical physics and biology (DCMMP) | Physique statistique et biologie (DPMCM)

Track Classification: Technical Sessions / Sessions techniques: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)