



Canadian Association  
of Physicists

Association canadienne  
des physiciens et physiciennes

Contribution ID: 3166 Type: Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)

## (G\*) Inferring gene regulation from static snapshots of gene expression variability

*Tuesday 7 June 2022 10:00 (15 minutes)*

A key challenge of systems biology is to translate cell heterogeneity data obtained from single-cell sequencing or flow cytometry experiments into causal and dynamic interactions. We show how static population snapshots of gene expression reporters can be used to infer causal and dynamic properties of gene regulatory networks without using perturbations. For instance, we derive correlation conditions that detect causal interactions and closed-loop feedback regulation in gene regulatory networks from snapshots of transcript-levels. Furthermore, we show how oscillating transcription rates can be identified from the variability of co-regulated fluorescent proteins with unequal maturation times. Our approach exploits the fact that unequal fluorescent reporters effectively probe their upstream dynamics on separate time-scales such that their correlations implicitly encode information about the temporal dynamics of their upstream regulation. Synthetic genetic circuits provide exciting opportunities to verify these co-variability conditions with well characterized engineered systems. Lastly we report on ongoing experiments where we quantitatively test our theory with variants of a synthetic oscillator, the Repressilator, in single-cells using time-lapse microscopy and microfluidics.

**Authors:** JOLY-SMITH, Euan (Department of Physics, University of Toronto); WANG, Jerry Zitong (Division of Biology and Biological Engineering, California Institute of Technology); PAPAZOTOS, Fotini (Center for Applied Synthetic Biology, Concordia University); ALLARD, Paige (Center for Applied Synthetic Biology, Concordia University); POTVIN-TROTTIER, Laurent (Center for Applied Synthetic Biology, Concordia University); HILFINGER, Andreas (Department of Physics, University of Toronto)

**Presenter:** JOLY-SMITH, Euan (Department of Physics, University of Toronto)

**Session Classification:** T1-1 Advances in Physics in Biology and Medicine Symp.: Protein system dynamics (DPMB) | Symposium sur les progrès en physique dans la biologie et la médecine: dynamique des systèmes de protéines (DPMB)

**Track Classification:** Technical Sessions / Sessions techniques: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)