Invitation

You are cordially invited to the public defense to obtain the academic degree of

DOCTOR OF ECONOMICS and PHYSICS

by Fatemeh Zarei
(a.k.a Avin)

**The impact of social network structure, collaboration costs, and bursty activation
on opinion dynamics and innovation via agent-based modeling**

Supervisors:
Prof. dr. Luis E. C. Rocha – Prof. dr. Koen Schoors – Prof. dr. Jan Ryckebusch

Monday, 6 January 2025 at 16h00
In the Faculty Board Room, Campus Tweekerken, Tweekerkenstraat 2, 9000 Ghent
Please confirm your attendance no later than 18 December by email to Fatemeh.Zarei@ugent.be

EXAMINATION BOARD

Prof. dr. Dirk Van den Poel
Chair – Ghent University

Prof. dr. Luis E. C. Rocha
Supervisor – Ghent University

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Abstract

This dissertation delves into the intricate relationships between social network structures, collaboration costs, and bursty activation patterns, investigating their combined effects on opinion dynamics and innovation through agent-based modeling. The research adopts an interdisciplinary framework that integrates insights from complex systems theory, network science, and computational modeling to address critical questions in social and economic dynamics.

Study 1 examines the impact of bursty communication on opinion dynamics within structured social networks. This study introduces a novel temporal version of the opinion dynamic model, showing that bursty activation not only slows stabilization but also enhances diversity by promoting multi-partisan opinion clusters across network types. The findings highlight the significance of temporal interaction patterns in fostering opinion diversity and mitigating polarization.

Study 2 focuses on the role of social network heterogeneity in individual and group innovation processes. It employs a mechanistic model to explore how structural diversity facilitates the evolution of complex technologies through self-creation and social learning. Results reveal a paradox: while local network heterogeneity benefits individuals by exposing them to diverse knowledge, it simultaneously limits overall group innovation due to imbalances in resource distribution and collaboration dynamics.

Study 3 addresses the cost-benefit dynamics of collaboration within social networks, incorporating financing constraints into innovation processes. This study develops an extended agent-based model to analyze the interplay between collaboration costs and benefits, revealing optimal conditions for supporting innovation through equitable resource allocation. Findings emphasize the importance of strategic investments in collaboration to maximize innovative outcomes.

In summary, this dissertation advances the theoretical and practical understanding of how opinion dynamics and innovation emerge within complex social systems. It provides actionable insights for decision-makers, researchers, and organizations aiming to utilize social network structures and temporal dynamics to drive innovation and manage societal challenges.

Curriculum vitae

Fatemeh Zarei holds a Master of Science in Statistical Physics and Complex Systems (2019) from Sharif University of Technology and a Bachelor of Science in Physics (2016) from Ferdowsi University of Mashhad. In October 2020, she joined the Complex Systems Group at Ghent University as a PhD researcher, working within the Faculty of Economics, Department of Economics, and the Faculty of Physics, Department of Physics and Astronomy.

Study 1 of her dissertation is published in Scientific Reports (https://www.nature.com/articles/s41598-024-52458-w), while Study 2 is published in Journal of Physics: Complexity (https://iopscience.iop.org/article/10.1088/2632-072X/ac9447/meta). Study 3 is currently a working paper. Fatemeh has presented her research at several international conferences, including the BeNet Conference (2021, Namur, Belgium), the Complex Networks Conference (2021, Madrid, Spain), the IC2S2 Conference (2023, Chicago, USA, virtual), and the NetSci Conference (2023, Vienna, Austria).