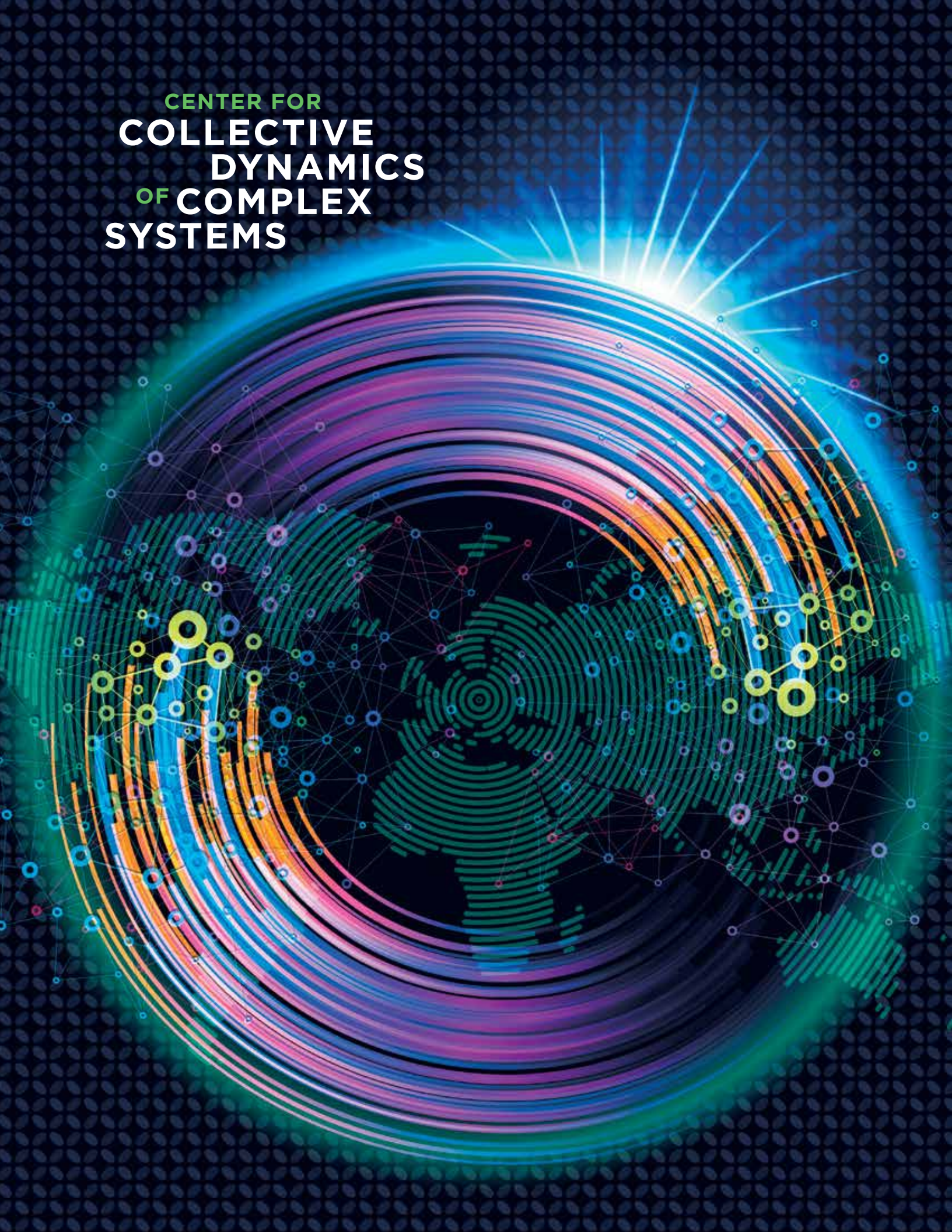


CENTER FOR
COLLECTIVE
DYNAMICS
OF COMPLEX
SYSTEMS



IT'S ALL ABOUT NETWORKS

SEE THE WORLD AS INTERCONNECTED WEBS OF AGENTS

Complex systems are networks of a large number of dynamic components, or agents, that interact with each other and evolve through self-organization. Complex systems are everywhere, ranging from gene regulatory networks in a cell to food webs in an ecosystem, and from an individual human brain to the Internet and social media, among thousands of other examples. At the Center for Collective Dynamics of Complex Systems at Binghamton University (CoCo), we study how all the different pieces of life work together and against each other, all at the same time.

OVERVIEW

The Center for Collective Dynamics of Complex Systems (CoCo) is an interdisciplinary Organized Research Center (ORC) at Binghamton University that studies structural and dynamic properties of various complex systems to obtain general, cross-disciplinary implications and applications.

CoCo's goals are to:

1. advance our understanding about the collective dynamics of physical, biological, social and engineered complex systems through scientific research,
2. promote interdisciplinary collaboration among faculty and students in different schools and departments, and
3. translate the understanding to products and processes which will improve the well-being of people at regional, state, national and global scales.

Filled with a diverse mix of active faculty members and graduate students, CoCo officially became a University ORC in July 2015, but had informally produced new interdisciplinary research projects since 2007.

RESEARCH FOCI

SOCIAL DYNAMICS

Utilizing and extending computational agent-based modeling, evolutionary theory, game theory, cognitive science/psychology, and network theory to model, analyze and design policy for social systems. Research topics include: modeling of socio-economical dynamics of the Greater Binghamton area; leadership, team performance and organizational decision making; and evolution of cooperative/ competitive strategies in social systems.

NETWORK DYNAMICS

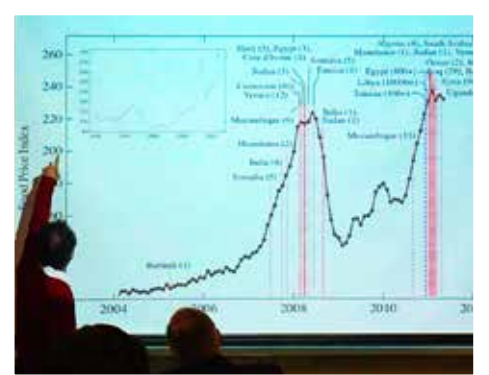
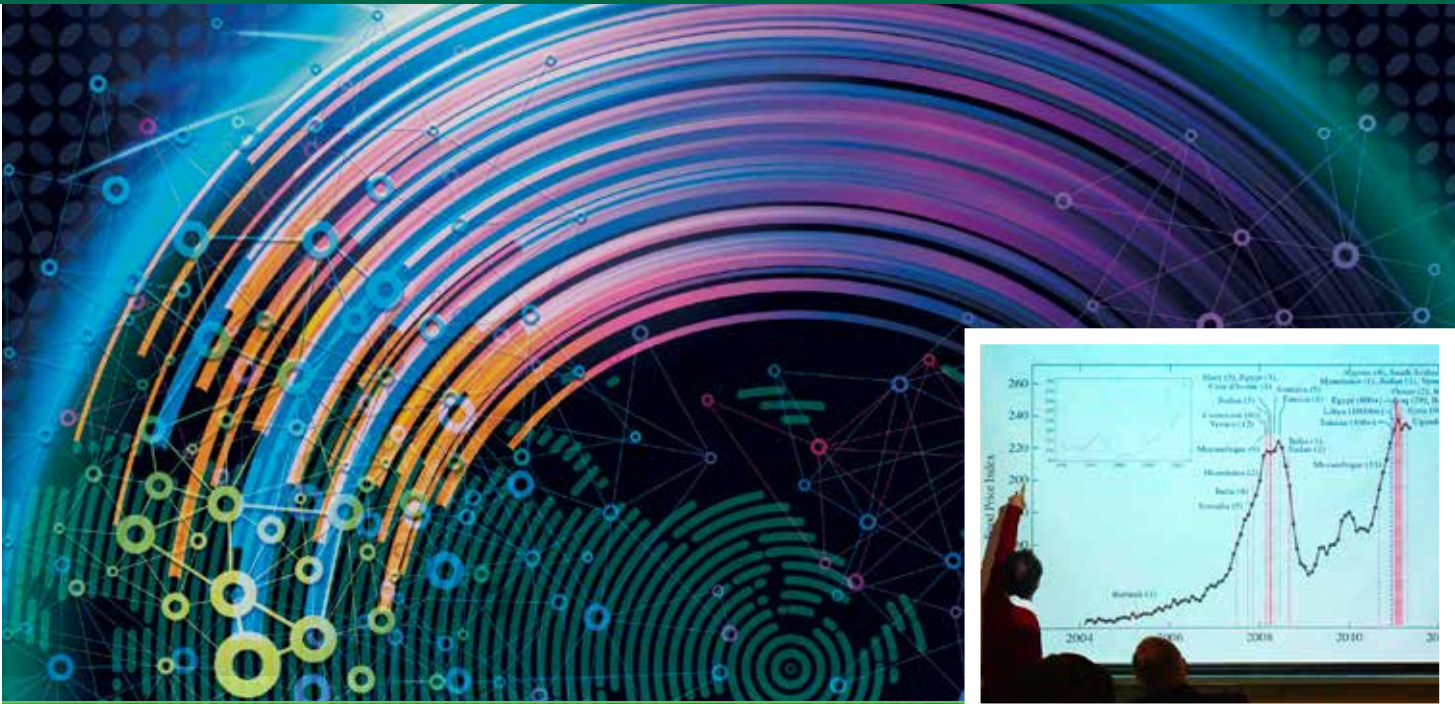
Utilizing and extending network theory to explore the connectivity between elements, growth and self-

organization, and dynamical evolution of complex networks. Research topics include: modeling power grids as multiplex networks; distributed control mechanisms for adaptive networks; and application of network analysis to psychological data.

SWARM DYNAMICS

Investigating collective behavior and pattern formation in massive populations of biological or biomimetic autonomous agents. Research topics include: theoretical investigation of morphogenetic collective systems; design and evaluation of hierarchical heterogeneous particle swarm optimization; and automated model construction of biological collectives.





NEWS HIGHLIGHTS

COCO HOLDS KICK-OFF CEREMONY

Statistics and calculus help us understand our world in important ways, but scientists need new tools to make sense of increasingly complex and interconnected networks. That was the central theme on Oct. 22, 2015, as Binghamton University celebrated the launch of the Center for Collective Dynamics of Complex Systems.

“Increasingly we have global transportation, global communication ... and that means we have things that propagate across the world,” Yaneer Bar-Yam, president of the New England Complex Systems Institute, told dozens of faculty, students and administrators who gathered for the event. The study of complex systems can reveal trends, help forecast and avert crises and identify connections between seemingly unrelated phenomena.

Read more: bit.ly/28NyOum

FRAMEWORK FOR TEACHING NETWORKS DEVELOPED

A framework co-developed by a Binghamton University researcher (tinyurl.com/networkliteracy) could help future scientists improve their understanding of all types of networks, from social media channels to beehives.

CoCo Director Hiroki Sayama co-led a team of over 30 network science researchers, educators, teachers and students to set up a framework that any school can adapt to teach students the concept of a network from the ground up.

“The concept of networks is truly interdisciplinary and knowing about general properties of networks allows students to see common patterns across disciplines, and thereby transcend disciplinary boundaries,” Sayama said. “It would be wonderful to see students studying various subjects — languages, history, social phenomena, biological organisms, engineered products, the Internet — all from a common lens of networks.”

Read more: bit.ly/28MciXI

OTHER SELECT PROJECTS

RESEARCH

- Robustness and adaptation in morphogenetic collective systems
- Complexity measures and concept learning
- Network analysis of brain dynamics and emotional transitions
- Evolutionary perspective on collective decision making
- Modeling and predicting state-topology coevolution of complex adaptive networks
- Making complexity accessible using 3D printing

EDUCATION

- Teaching social complexity and multidisciplinary team building
- Advanced Certificate Program in Complex Systems Science and Engineering (binghamton.edu/cx)
- NetSci High educational outreach program (tinyurl.com/netscihigh)
- Open SUNY Textbook on complex systems modeling and analysis (tinyurl.com/imacsbook)



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Assistant Professor, School of Management

Gregory Strauss

Assistant Professor, Department of Psychology

Francis Yammarino

Distinguished Professor, School of Management

Ziang (John) Zhang

Assistant Professor, Department of Electrical and Computer Engineering

For a full list of participating faculty members, see the CoCo website.

BINGHAMTON UNIVERSITY AT A GLANCE

- Founded: 1946
- Highly selective, mid-size public university
- One of four research university centers within the State University of New York (SUNY) system
- Total enrollment: 16,000+
- Graduate students: 3,200+
- Academic colleges: 7
- Specialized research centers: 30+
- Master's programs: 60+
- Doctoral programs: 30+
- Accelerated degree programs: 50+
- Certificate programs: 20+
- Students of color: 29%
- International students: 16%
- Students come from all 50 U.S. states and 100+ countries

ACADEMIC EXCELLENCE

- *Kiplinger's Personal Finance* ranks Binghamton University number 4 in value for out-of-state students and number 15 overall among the nation's public colleges
- *U.S. News & World Report* consistently ranks Binghamton University among the top 50 public universities
- The Princeton Review: Best Value Colleges for 2014 ranks Binghamton University the number 10 best value for public universities based on academics, cost of attendance and financial aid
- *Fiske Guide to Colleges* rates Binghamton University a best buy and one of the premier public universities in the Northeast: "With a four-year graduation rate that is among the highest of any public university, Binghamton has a reputation for an excellent education at a reasonable price"

GREAT LOCATION

Located in the high-tech heart of New York state, the University sits on 930 acres in a beautiful hillside setting. Greater Binghamton is a friendly, affordable and safe community only hours from major metropolitan areas such as New York City, Boston, Philadelphia and Washington, D.C. A number of bus companies serve the area, including the Broome County Transit and Binghamton University's OCC Transport buses that offer transportation between home and campus, as well as to area businesses and downtown Binghamton free of charge.

GET INVOLVED

Website: coco.binghamton.edu

Email list: COCO-ML@listserv.binghamton.edu

Facebook: facebook.com/BinghamtonCoCo

Twitter: [@BinghamtonCoCo](https://twitter.com/BinghamtonCoCo)

CoCo Seminar Series (vimeo.com/user4630872) is a long-running interdisciplinary seminar series that hosts research talks on a wide variety of topics related to complex systems. Seminars are open to anyone. Contact CoCo directors if you are interested in participating and/or presenting.

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