NANYANG TECHNOLOGICAL UNIVERSITY

Complexity Institute
Nanyang Technological University

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Complexity Institute

NTU Singapore

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We live in a complex world and are surrounded by complex systems: from a biological cell, made of thousands of different molecules that seamlessly work together, to millions of computer systems that should work together, to our society, a collection of seven billion individuals that try to work and live together.

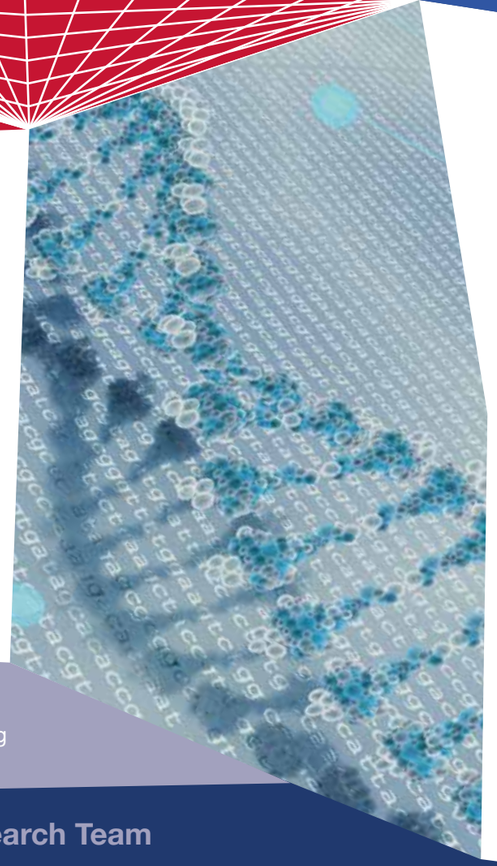
These adaptive complex systems display endless signatures of order, disorder, self-organization and self-annihilation. Handling this complexity is one of the biggest scientific challenges of our time.

In the words of Physicist Heinz Pagels: *'the nations and people who master the new sciences of complexity will become the economic, cultural, and political superpowers of the 21st century.'*

In 2011 Nanyang Technological University (NTU) began to host annual international conferences on complexity, as well as extended campus visits by leading complexity researchers including John Holland, W. Brian Arthur and Geoffrey West. Their presence sparked interest across campus and Singapore.

In April 2014 NTU launched a new Complexity Institute with the goal of catalysing trans-disciplinary research on complex systems across the university.

'I think the next century will be the century of complexity'
- Stephen Hawking



Vision and Mission

The Institute seeks to enhance opportunities for cross-disciplinary research and education in complexity science. The long-term goal is to become Asia's leading Institute for complexity research.

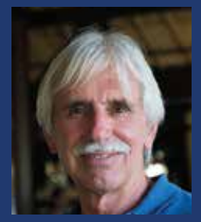
Directors

Professor Peter M.A. Sloot

Peter Sloot is a full professor of Complex Systems Simulations at NTU and Computational Science at University of Amsterdam (UvA) in The Netherlands. He obtained an MSc in Physics & Chemistry from UvA in 1983 and a PhD in Computational Bio-Physics from the Netherlands Cancer Institute and UvA in 1988.

His main interest is in the Foundations of Complex Systems and unravelling the way Nature Processes Information.

Webpage: https://staff.fnwi.uva.nl/p.m.a.sloot/



Professor J. Stephen Lansing

Steve Lansing is a professor of Anthropology in the Asian School of the Environment at NTU, external professor at Santa Fe Institute and senior research fellow at Stockholm Resilience Centre. He received a B.A. with highest honours in the social sciences from Wesleyan in 1972, and completed a doctorate in Anthropology from Michigan at the Institute for Advanced Study in 1977. His current research concerns coupled social-ecological systems.

Webpage: http://www.slansing.org/

Senior Research Team

Associate Professor Andrea Nanetti
School of Art, Design and Media, NTU

Interest: Re-imagine the domain of heritage studies by looking at rich data sets (text, maps, paintings, sculpture, architecture, videos, photographs, etc.) as an integrated whole through the lenses of complexity theory.

Nanyang Assistant Professor Bo An
School of Computer Engineering, NTU

Interest: Computational game theory for analyzing optimal intervention strategies in complex systems. An example is computing optimal intervention mechanisms to combat with criminal networks in consideration of various scheduling constraints and human criminal behaviours.

Dr Christopher Monterola
Institute of High Performance Computing

Interest: Urban dynamics and the interplay between social and infrastructural systems for urban mobility.

Assistant Professor Cheong Siew Ann
School of Physical and Mathematical Sciences, NTU

Interest: Develop data analysis methods and models to understanding the dynamics of complex systems e.g. biological macromolecules, brain, earthquakes, financial markets and infectious diseases.

Current Research Foci

1. Cities and Sustainability
2. Critical Transitions and Regime Shifts
3. Evolution of Signalling Systems
4. Theoretical Foundations of Complex Systems

Interdisciplinary Graduate School PhD Programme

Through NTU's Interdisciplinary Graduate School, Complexity Institute offers Doctor of Philosophy programmes and scholarships currently in these areas:

- Critical Transitions in Man-Made and Natural Systems
- Foundations of Complex Systems
- Urban Adaptive Dynamics
- Dynamics of Pattern Formation in Biofilms
- Large Scale Complex Adaptive Systems
- Health Systems Complexity

Fellowship Program

We invite applications for visiting research fellowships at the Complexity Institute. A completed doctorate or equivalent is required by the application deadline, and visiting research fellowships are awarded for 1 month up to two semesters. We seek a mix of junior and senior scientists tackling fundamental questions in the sciences of complexity. Topics of particular interest include, but are not limited to, cities, theory of complex systems, and coupled human-ecological systems. Collaborative research projects are encouraged, and ongoing affiliation with the Institute after the fellowship year is desirable. Funding for stipends is individually negotiated, taking into account the applicant's base salary and the level of sabbatical or other grant support he or she may bring. Travel, accommodation and a research stipend are included.

Winter-School on Complexity Science

This annual introductory course in complexity science is held on NTU campus. It is a joint project of Complexity Institute and Warwick University.

Renowned local and overseas experts:

- Teach basic aspects of complexity and complex systems, answering the question "What makes a system complex?" and cover topics on nonlinearity, order disorder and chaos, emergence and complex adaptive systems.
- Introduce methods to study the behaviour of complex systems: models and simulation tools that will be introduced include complex networks, agent based models, evolutionary algorithms, game theory.
- Provide insights into how complexity manifests itself in real life: politic & governance, complexity thinking in decision support, eco-systems socio-systems & their interactions, cities, spreading phenomena (e.g. rumours and epidemics), economics and entrepreneurship.

Past lecturers and tutors: Brian W. Arthur, Geoff West, John Holland, Chris Barrett, Colm Connaughton, Steve Lansing, Peter Sloot, Han Jing, Mike Lees, Georgios Christopoulos, Adrian Kuah, Justin Ruths, Markus Karner, C. Jason Woodard, Chew Lock Yue, Cheong Siew Ann and Xiao Gaoxi.

Associate Professor Gaoxi Xiao
School of Electrical and Electronic Engineering, NTU

Interest: Understand how ideas/diseases/ viruses may propagate in adaptive complex systems or multiple interconnected systems and the control and protection of complex systems.

Dr Karinh Eurenius
Singapore Center of Environmental Life Science s Engineering, NTU

Interest: Decipher abundant, environmentally friendly & low cost materials for energy storage while focusing on structural effects in relation to the conduction features of novel complex nano-engineered biofilm hybrids.

Associate Professor Haibin Su
School of Materials Science and Engineering, NTU

Interest: Development & application of theoretical & computational physical science. That is quantum-mechanical & classical simulations and modeling of the structural, kinetic and dynamic properties of complex functional systems, especially emergent collective properties at multiple spatial and temporal scales.

Professor Law Sia Kit
Division of Molecular Genetics & Cell Biology School of Biological Sciences, NTU

Interest: How organs and organelles can maintain the shapes and remain functional in the complexity of biological growth.

Associate Professor Jing Han,
Academy of Mathematics and Systems Science, Chinese Academy Science

Interest: Multi-agent systems, intervention of collective behavior and co-evolution.

Associate Professor Lock Yue Chew
School of Physical and Mathematical Sciences, NTU

Interest: Uncover the organizing principles of complex systems based on the approach of statistical and nonlinear physics.