Proposal for Satellite symposium CCS 2018

Title: First findings of the Amsterdam Institute for Advanced Studies

Topic: In 2017, the University of Amsterdam founded its *Institute for Advanced Studies* (IAS; http://ias.uva.nl/), which is intended to offer outstanding researchers a haven - free from constraints of disciplinary boundaries - where they can work collaboratively on complex scientific and societal challenges. The first wave of multidisciplinary research fellows started their work at the IAS in January 2018. This satellite is intended to showcase first findings from this team of researchers in various different disciplines. As the scope of topics studied at IAS is broad, we aim to discuss a wide range of topics, especially well suited to the wide audience present at the conference for complex systems. During the satellite, we will provide information on the IAS, as well as the related complexity institute at the Nanyang Technological University, Singapore.

Program

Part 1

14.30 - 15.00: Wim Hordijk
15.00 - 15:30: Sebastian Poledna
15.30 - 16.00: Rick Quax

Part 2

16.30 - 17.00: Ana Isabel Barros
17.00 - 17.30: Sacha Epskamp
17.30 - 18.00: Siew Ann Cheong
18.00 - 18.30: Claudi Bockting

Speaker: Wim Hordijk

Title: Autocatalytic networks at the basis of life's origin and organization

Abstract:

Life, as a complex system, is more than the sum of its constituent molecules. Living organisms depend on a particular chemical organization, i.e., the ways in which their constituent molecules interact and cooperate with each other. Several abstract models of minimal life, based on this idea of chemical organization, and also in the context of the origin of life, were developed independently already in the 60s and 70s. These models include hypercycles, chemotons, autopoietic systems, (M,R)-systems, and autocatalytic sets. We briefly compare these various models, and then focus more specifically on the concept of autocatalytic sets and its more recent mathematical formalization, RAF theory. We explain the basic ideas, present the main results, and then argue for their relevance to studying the origin and organization of life.

Speaker: Sebastian Poledna

Title: Economic Forecasting with an Agent-based Model

Abstract:

We develop an agent-based model for a small open economy using data from national accounts, input-output tables, government statistics, census data and business demography data. The model incorporates all economic activities (producing and distributive transactions) as classified by the European system of accounts and all economic entities, i.e. all juridical and natural persons, are represented by agents. We show that this model is able to compete with vector autoregressive and dynamic stochastic general equilibrium models in out-of-sample prediction. For the major macroe- conomic aggregates GDP growth, inflation and the main components of GDP – consumption and investment, we show that forecasts of the agent-based model are surprisingly similar to forecasts of a standard dynamic stochastic general equilibrium model. The detailed structure of the agent-based model allows us to break down economic forecasts. Using the agent-based model, we demonstrate the possibility to disaggregate economic forecasts into numerous macroeconomic variables in a stock- flow consistent way according to the conventions of national accounting. Potential applications of this model include economic forecasting, stress test exercises and predicting the effects of changes in monetary, fiscal, or other macroeconomic policies.

Speaker: Rick Quax

Title: Information Processing Features Can Detect Behavioral Regimes of Dynamical Systems

Abstract:

In dynamical systems, local interactions between dynamical units generate correlations which are stored and transmitted throughout the system, generating the macroscopic behavior. However a framework to quantify exactly how these correlations are stored, transmitted, and combined at the microscopic scale is missing. Here we propose to characterize the notion of “information processing” based on all possible Shannon mutual information quantities between a future state and all possible sets of initial states. We apply it to the 256 elementary cellular automata (ECA), which are the simplest possible dynamical systems exhibiting behaviors ranging from simple to complex. Our main finding is that only a few information features are needed for full predictability of the systemic behavior and that the “information synergy” feature is always most predictive. Finally we apply the idea to foreign exchange (FX) and interest-rate swap (IRS) time-series data. We find an effective “slowing down” leading indicator in all three markets for the 2008 financial crisis when applied to the information features, as opposed to using the data itself directly. Our work suggests that the proposed characterization of the local information processing of units may be a promising direction for predicting emergent systemic behaviors.

Speaker: Ana Isabel Barros & Tom van Engers

Title: Networks of crime and terrorism

Abstract:

Crime and terrorism take a heavy toll on society and there is still little consensus on how to fight these phenomena most effectively. In fact the dynamics in criminal and terrorist networks show many characteristics of complex adaptive systems. Drawing on expertise from a range of disciplines, from criminology and law to sociology, computational science, operational analysis, we are starting to understand the patterns behind criminal and terrorist activity by disentangling the complexity of the 'system' in the research program Networks of Crime and terrorism at IAS. In particular we aim at achieving a better understanding of the underlying mechanisms of these systems and developing models that can help to assess the effect of current intervention strategies and - together with law enforcement agencies - explore potential new approaches in a fully multi-disciplinary setting.

Speaker: Sacha Epskamp

Title: Intermediate Stable States in Substance Use

Abstract:

Substance dependence can be viewed of as a complex dynamical system with alternative stable states, demarcated by critical transitions. Prior work focuses on modeling only a zero-use and abuse stable state, and intervention and prevention strategies typically aim at the zero-use state. For a large majority of people (especially youth), however, this prevention strategy tends to fail. We propose to model substance use instead as a dynamical system with three modes: zero-use, recreational use, and abuse. The intermediate stable state in substance use may be more stable than the zero-use state and a better target for interventions. We investigate the intermediate stable state in in three ways: (1) by reviewing existing studies on recreational use, (2) by investigating empirical data of lifetime usage of alcohol, nicotine and marijuana, and (3) by modeling substance use as a dynamical system with three stable states.

Speaker: Siew Ann Cheong

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Title: Accelerating the Transition From Scientific Knowledge to Technological Innovation

Abstract:
Starting with Gallileo, Newton, and Maxwell in the 16th, 17th, and 18th centuries, scientists have amassed a vast knowledge of science. We now understand pretty well our universe, our planet, life on Earth, and our bodies. But do we know how our knowledge of science grows and evolves? Reflecting on the scientific enterprise, Karl Popper clarified the logic behind coming up with hypotheses, design experiments to test these hypotheses, refine our hypotheses, and test again. In Popper's view, scientific progress is incremental, and the nature of our knowledge is tentative. Studying the birth of special relativity and quantum physics, Thomas Kuhn believed that scientific truth is a social construct born of consensus between scientists. Whenever scientists change their mind, dropping an old theory for a new one, we see a paradigm shift. In this talk, I will describe our attempts to better understand scientific knowledge evolution, by using what the American Physical Society publication data sets (consisting of about 500,000 publications between 1893 and 2013) tells us. By constructing year-to-year bibliographic coupling networks (BCNs), we show that the BCN communities represent research topics that can be treated as mesoscopic units of knowledge. We then visualize how these knowledge units evolve from year to year largely as a Popperian process dominated by weak mixing between topics, but interrupted infrequently by strongly-mixing Kuhnian processes where two or more knowledge units merge to become one, or where one knowledge unit split into two or more knowledge units. We show that these Kuhnian processes strongly impact our knowledge of the topics involved, and so these can be considered paradigm shifts at scales smaller than the special relativity or quantum physics revolutions. I then go on to describe ongoing work to combine bibliographic analysis with linguistic analysis of the APS publication data, to understand how scientific concepts evolve through Popperian and Kuhnian changes in the citation structure, as well as to identify features in the citation structure that allow us to most accuratey predict Kuhnian processes. Finally, I describe work that we have just started, to understand how scientific knowledge becomes technological innovations, by tracking how scientific papers are cited by patents, for the case study of graphene.

Reference

W. Liu, A. Nanetti, and S. A. Cheong, "Knowledge evolution in physics research: An analysis of bibliographic coupling networks", PLoS ONE, vol. 12, no. 9, 0184821, 18 Sep 2017.

Speaker: Claudi Bockting

Collaborators:
Peter Sloot, Denny Borsboom

Title: No health without mental health: understanding the onset of common mental health disorders

Abstract:
Common mental health disorders (depressive and anxiety disorders) are a worldwide epidemic and there is no evidence that the epidemic is subsiding. Depression is a major contributor to the overall global burden of disease (WHO). Globally, more than 300 million people suffer from depression. Psychological and pharmacological treatments are effective treatments but only for half of treated patients. Further, relapse rates in depression after remission are unacceptably high. Evidence for leading theories that explain the onset and maintenance of depression is fragmented. Whereas, depression is seen as a disorder that is caused by interplay of mental-, biological, stress related- and societal factors that can change over time characterised by large individual differences. One of the main research challenges is to understand the causal interplay between these factors in order to explore new targets for prevention and treatment. In this talk a multidisciplinary project will be presented on how complexity modelling tools successfully can be applied and explored to understand the onset and maintenance of common mental health disorders like depression in order to explore new targets for prevention and treatment.