
NEW VIEWS ON EXTREME EVENTS

COUPLED NETWORKS, DRAGON KINGS AND EXPLOSIVE PERCOLATION

*Workshop of the ETH Risk Center
October 25-26th, 2012
Zurich, Switzerland*

Assessment of Risks in strongly coupled financial, technical, or social systems requires deep understanding of event cascades and avalanche triggering. Recent development in the theoretical treatment of complex systems is providing novel concepts and tools which should now find their way into practical usage.

It is the purpose of the present Workshop to provide a bridge between Academy and Industry on this issue. We will bring together, on one side, outstanding researchers that, in the last 3 years, have produced remarkable theoretical ideas regarding Extreme Events with, on the other side, companies and organizations with potential interest in understanding and exploiting such events.

In particular, this Workshop will focus on three theoretical ideas: interdependence of Coupled Networks, Dragon-Kings, and Explosive Percolation. Below we briefly describe these novel concepts and their implications.

Complex Network theory has been developed to assess the resilience of network-like systems to failures or attacks. Typically, these networks are considered isolated, however in reality they are coupled and events taking place in one are likely to affect the others. Examples of **interconnected systems** are ubiquitous, for example, Internet, Router communication networks, and electrical power grids, or the different transport and energy infrastructures. In the last two years, the tools previously developed for single networks have been extended to coupled ones and uncover the strong impact of the coupling in the system vulnerability.

Moreover, one aspect which is still poorly understood by most Risk Managers is the appearance of **Dragon-Kings** - outliers even in a fat tail distribution of events. Previously treated simply as "undesired data", the study of this phenomenon, with applications that range from earthquakes to financial crashes, has proved to be challenging. If one could predict the behavior of such Dragons it would have a huge impact on Risk Mitigation strategies.

Also, it was recently shown that systematically suppressing the growth of the largest connected component leads to an “explosive” transition in the connectivity, a process known as **Explosive Percolation**. This transition is closely related to the rapid propagation of fear in a financial crisis, for instance, or to the spread of an idea in a social network.

Regarding the applications of these concepts, we believe that the following Business Sectors would be interested on discussing these problems:

- **Power Supply companies and their regulators.** Electricity producers and governmental agencies should be interested on how to access the risk of a major disruption in the production. Also, the major interdependency among the communication and power networks is also of their great interest.
- **Financial Market Companies and Organizations.** Retail and Investment Banks, as well as brokers and Financial Authorities, are interested in the prevision and impacts of a huge financial crisis. (Bank secrecy)
- **Civil Protection and Governmental Offices.** Dragon-king events, such as powerful earthquakes, volcanic eruptions, storm and floods, have the potential to end with millions of lives at stake. Understanding the occurrence of such disasters is of extreme importance to our society.
- **Transport and Logistics firms.** The disruption of the supply chain of many multinational companies after natural disasters is a problem still to be understood and improve.
- **Investment Banks and Venture Capital firms.** The appearance of companies of extreme success such as Google and Facebook, whilst at the same time many do not make through the first years, is a phenomenon that could be thought as an extreme, and not well understood, event.
- **Insurance and Reinsurance companies,** especially non-life, are interested in accessing and mitigating the risk of any human enterprise. For them, the presence of such extreme events might be a big source of trouble or, if correctly evaluated, profit.

To promote the exchange of ideas, we propose a format for the two days that alternate between theoretical sessions and discussions with Industrial partners. We plan presentations of **45 minutes** where researchers and industry representatives can expose their ideas, problems and challenges.

During these two days, we also plan time for discussion and debate between researchers and companies. A limit of **50 participants** is proposed. It is our intention that an informal

atmosphere of interaction where the exchange of ideas, formation of partnerships, or simply vibrant and interesting conversations could flourish.

By bringing together outstanding researchers and interested companies, we expect that, by the end, this Workshop will improve the knowledge of risk assessment in face of extreme, and potentially dangerous, events. We will consider it a success if both Academy and Industry improve their mutual interest and understanding of the challenges faced on Risk Management of Extreme Events.

CONFIRMED SPEAKERS FROM THE ACADEMY

- **M. Dacorogna**, from the global reinsurance company SCOR, will talk about Financial Market and “Extreme events according to their exposure”.
- **M. Geidl**, from SwissGrid, will talk about major challenges in the infrastructure industry on “Keeping 100% electricity coverage in face of Extreme Events.”
- **S. Havlin**, Professor at the Bar-Ilan University, Israel, will talk about the extreme vulnerability of network of networks.
- **C. Klüppelberg**, Professor at the Munich University of Technology, will talk about recent developments on "Risk Analysis and Stochastic Modelling".
- **A. Korotayev**, Professor and Director of the Anthropology of the East Center at the Russian State University for the Humanities, Moscow, will discuss the origins of Dragon-kings and their occurrence in society.
- **J. Kertesz**, Director of the Institute of Physics at the Budapest University of Technology and Economics, is going to talk about Explosive Percolation.
- **J. P. MacIntosh**, Honorary Professor at University College London, will talk about “Decisive action and learning beset by the uncertain flow of events”.
- **J. Nagler**, Professor at the Max Planck Institute for dynamics and Self-organization, is going to talk about Explosive Percolation.
- **S. Solomon**, Professor of Physics at the Hebrew University, Israel, will discuss sets that act on their own elements: a Generic Mechanism for Extreme Events.
- **R. M. D'Souza**, Associate Professor at University of California, Davis, one of the major contributors of the theory of Explosive Percolation and with contributions in the field of Coupled Networks, proposed the talk “Percolation and Sandpile cascades in interdependent networks”.

SCIENTIFIC COMMITTEE

- H. J. Herrmann
- D. Helbing
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LOCAL ORGANIZER

- V. H. Louzada, louzada@ethz.ch

CONFIRMED INDUSTRIAL PARTNERS

- SwissRe

PROGRAM

	Thursday, October 25 th	Friday, October 26 th
8:00-9:00	Registration – Welcome Coffee	Welcome Coffee
9:00-9:30	Opening by Dr. S. Schreckenberg (SwissRe): “Industry and Extreme Events”, and by Prof. Herrmann (ETH Zurich): “Theories for Extreme Events”	T.B.A. “Hurricanes as Extreme Events”
9:30-10:15	Talk by Prof. Klüppelberg (TU München): “Risk Analysis and Stochastic Modelling”	Prof. S. Solomon (Hebrew U.): “A Generic Mechanism for Extreme Events”
10:15-10:45	Coffee break	Coffee break
10:45-11:30	Dr. M. Geidl (SwissGrid): “Keeping 100% electricity coverage in face of Extreme Events.”	Dr. M. Dacorogna (SCOR) “Extreme events according to their exposure”
11:30-12:15	Prof. S. Havlin (Bar-Ilan U.): “Extreme vulnerability of network of networks”	Prof. A. Korotayev (Russian State U.): “Origins of Dragon-kings and their occurrence in society”
12:15-14:00	LUNCH	LUNCH
14:00-15:30	Panel “Extreme Events in Infrastructure”. Informal debates and <i>hands-on</i> interaction.	Panel “Extreme Events in Financial Markets” Informal debates and <i>hands-on</i> interaction
15:30-16:00	Coffee break	Coffee break
16:00-16:45	T.B.A. “Energy infrastructure/dependency on the global market”	Prof. J. Kertesz (Budapest U.): (Title to be defined)
16:45-17:30	Prof. D'Souza (U. California): “Percolation and Sandpile cascades in interdependent networks”	T.B.A. “Herding Behavior and Extreme Events in the Financial Market”
17:30-18:15	Prof. J.P. MacIntosh (U. College London) “Decisive action and learning beset by the uncertain flow of events”	Dr. J. Nagler (Max Planck Institute): (Title to be defined)