

## Semester Thesis Proposals

**Topic :** Identifying the common pattern(s) of the recent Critical Infrastructure (CI) incidents caused by the interdependencies

**Goal :** The CIs our daily life depends on are mutually dependent at multiple levels, of different types and coupling degree. All these interdependencies have caused the CIs to be exposed to new threats and therefore, make them more vulnerable to cascading failures with widespread disasters. The failure or debilitation of one infrastructure can result in the disruption of other infrastructures, which will cause severe economic harm and maybe loss of life. A number of recent CI incidents have taught us that this is more than a theoretical concept. For example, North American major blackout in 2003 had caused the disruption not only to electrical power system, but also other CIs such as Transportation, Railway system, Water Supply, and Telecommunication. The object of this Master thesis work is to provide the complete compilation and evaluation of all these "major" incidents which demonstrate cascading failures caused by the interdependencies between CIs. Furthermore, the common pattern(s) of those events can be identified.

**Keywords:** Interdependency, Critical Infrastructure Protection, Pattern Reorganization

**Contact:** Cen Nan [nan@mavt.ethz.ch](mailto:nan@mavt.ethz.ch)

**Topic :** Collection and statistics of security incidents in industrial control systems

Supervisory control and data acquisition (SCADA) networks contain computers and applications that perform key functions in providing essential services and commodities (e.g., electricity, natural gas, gasoline, water, waste treatment, transportation) to the society. They are part of the nation's critical infrastructure and require protection from a variety of threats from physical destruction and cyber space today. Most organizations are highly reluctant to report security incidents as they are viewed as potential embarrassments. In fact, many organizations have denied that there even is a risk to industrial systems from cyber attack. However there are still some incidents which have been reported or divulged to the public. Collection and statistics of these industrial security incidents become important for further identifying and analyzing the vulnerability within SCADA systems. Since it is part of a project on the security and vulnerability of information communication and technology in Switzerland, to collect the incidents occurring in Switzerland and find the present security status of Swiss SCADA systems would be most needed.

**Key words:** SCADA, Industrial control system, physical and cyber security, security incidents and attacks, security threats

**Contact:** Ling Zhou [zhou@mavt.ethz.ch](mailto:zhou@mavt.ethz.ch)

**Topic :** Influence of renewable energies and distributed generation on a reliability of the power system

Analyzing the risks to networked technical systems comprises one focus of current research activities. The electricity industry is having to incorporate a continuously rising amount of renewable energies and power generation is becoming increasingly decentralized. The impact on the reliability and vulnerability of the power system is discussed controversially. As a result, there is a need for further investigation.

The electricity industry is having to incorporate a continuously rising amount of renewable energies and power generation is becoming increasingly decentralized. This work aims to discuss how far reliability of the power system is affected by renewable energies and distributed generation. The work should be based on a literature research and on a statistical analysis of reliability data e.g. of the UCTE / ENTSO-E.

**Contact:** Arne Lüllmann [arne.luellmann@isi.fraunhofer.de](mailto:arne.luellmann@isi.fraunhofer.de)

**Topic:** Influence of node density to vulnerability of networks suffering large area damaging events

**Goal:** To identify what is the influence of node density to the vulnerability of a network, such as the electric power grid, if large area damaging events (e.g. earthquakes) lead to the regional destruction of nodes?

**Keywords:** electric power grid, network theory, earthquake, vulnerability

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**Topic:** General properties of complex systems *emergence and self-organization* analyzed from the point of view of one of the Critical Infrastructures (Electric Power Supply Systems or Information and Communication Systems or Transportation Systems).

**Goal:** Critical Infrastructures are complex systems. They are often described through properties like high dynamic, nonlinearity, interdependencies, feedback loops, emergence and self-organization. Two last properties can be observed in nature and society. Most of publications dealing with these phenomena arise from the biological, the physical and the social scientific communities. The question is whether Critical Infrastructures are self-organized or do they exhibit emergence features (or both)? The goal of this semester thesis is to find out the answer for one of Critical Infrastructures

**Keywords:** critical infrastructures, modeling, self-organization, emergence

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**Topic:** Method for the reliability analysis of an electronic safety system: Transferring the model into Markov chains

For the reliability analysis of the protection system of a particle accelerator (LHC at CERN), a modeling approach has been developed. The model of the system is currently implemented using Monte-Carlo simulation and an analytical description. The underlying component model can be described based on Markov chains. As a next step, it is to be investigated whether and to which extent the whole system model can be transferred into Markov chains.

**Tutorial:** Sigrid Wagner [wagner@mavt.ethz.ch](mailto:wagner@mavt.ethz.ch)

**Topic:** Reliability Databases for Risk Studies

Availability of high quality reliability data is highly important for risk studies and consequently for cost efficient installation, operation, maintenance and general risk management of complex engineering systems. Nevertheless, the data being publicly available today through reports and/or electronic databases varies a lot with respect to contained information, quality, quantity and application.

**Goal:** The project is based on a state-of-the-art overview over pre-selected databases of reliability data being currently available. Investigation and comparison of their structure, contained information and function based on specific components will be performed. The goal of the project will be to understand the influence of the differences of the various reliability data on risk analysis methods. Application in the framework of the Laboratory's projects (Power Grids, Rail Transport, CERN, ...) will also be considered.

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