**Graduate School METRIK**

Model-Based Development of Technologies for Self-Organising Decentralized Information Systems in Disaster Management

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**Mission**

Recent progress in basic research has lead to visions how to use new self-organizing networks for advanced information systems. These networks function without central administration - all nodes are able to adapt themselves to new environments autonomously and independently. The addition of new nodes or failure of individual nodes does not significantly impact the network's ability to function properly. Information systems and underlying technologies for self-organizing networks, in the context of a specific application domain, are the central topic of research for this graduate school.

The research focuses on the important technologies needed at each individual node of a self-organizing network. Research challenges within this graduate school include: finding a path through a network with the help of new routing protocols and forwarding techniques, replication of decentralized data, automated deployment and update of software components at runtime as well as work-load balancing among terminal devices with limited resources. Furthermore, non-functional aspects such as reliability, latency and robustness will be studied.

The graduate school’s focus on decentralized information systems with self-organizing networks is sharpened by relating those more general research issues to a very specific application domain: computer-supported disaster management. For this reason, the graduate school emphasizes the use of techniques, methods, and concepts for designing and implementing geographic information systems on top of dynamic, highly flexible, self-organizing networks and their integration with services for geographic information systems based on existing technologies in these areas.

A key differentiator of this graduate school is its model-based approach that will be applied to all layers of the system. Meta-model languages will aid disaster management experts to model their workflows, which may in turn be simulated in order to assess decision processes.

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**Transparent Land Use Change Modeling**

SLEUTH is a well-established cellular automata and data-driven approach to model urbanization. It was applied in a number of different research projects as well as used for planning and politics.

In order to model the urban growth process in Greater Tirana region, we modified the existing model to overcome the lack of available data and moreover, to include additional population information. The application of a model-based development approach with coupled DSLs (ECAL, ExpL, GIS-DSL) augments the existing approach using C/C++ as a modeling language. Combining separate models, i.e. SLEUTH-PD; experiment and analysis models, allowed us to avoid technical intricacies of programming, to provide a reusable formal model and to represent the modifications in a transparent way.

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**Earthquake Early Warning**

The concept of Self-Organizing Seismic Early Warning Information Networks (SOSEWIN) is being developed within the EU-project SAFER in cooperation with the GeoForschungsZentrum Potsdam (GFZ). It focuses on the adoption of METRIK-technologies concerning self-organizing, ad-hoc communication infrastructures and model-based software development for prototyping Earthquake Early Warning Systems (EEWS). The SAFER project aims to exploit the possibilities offered by real-time analysis of signals coming from seismic networks for a wide range of actions. These actions include shutting down of critical systems and industrial processes, closing highways, railways, etc., and supporting rapid response decisions that must be made by emergency management. An installation of a prototype system is established in the mega-city Istanbul, a region threatened by strong earthquakes.