Proactive Infrastructure Security: From Evolutionary Approaches to the Use of Cellular Automata

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Reactive Infrastructure Security

• Understanding and Exploring Infrastructure Systems' Vulnerabilities
• Based on the Use of Evolutionary Models and Algorithms
Reactive Infrastructure Security

- Representation of asymmetric terrorist threats
- Modeling gradual evolution of terrorist scenarios
- Identification of infrastructure systems' weaknesses
- Acquisition of knowledge about system's vulnerabilities
Reactive Infrastructure Security

Examples of terrorist scenarios generated and optimized by TerrorMax/Capitol Hill
TerrorMax's visualization module displaying a feasible terrorist scenario for the Capitol Hill area.
Reactive Infrastructure Security

Visualization of a toxic gas flow in one of the terrorist scenarios generated by TerrorMaxBlast
Proactive Infrastructure Security

• Holistic Understanding of Security of the Entire Infrastructure Systems
• Based on the Use of Coevolutionary Models and Algorithms
Proactive Infrastructure Security

- Representation of terrorist and security scenarios
- Generation of feasible terrorist scenarios
- Generation of corresponding security scenarios
- Support for decision making processes
Proactive Infrastructure Security

Coevolving populations of terrorist and security scenarios in TerrorMax/Water
Proactive Infrastructure Security

Terrorist and security scenarios generated by TerrorMax/Water for a municipal water distribution system
Emergent Infrastructure Behavior

- Understanding Infrastructure Systems Operating in Emergency Mode
- Based on the Use of Cellular Automata Models and Evolutionary Algorithms
Emergent Infrastructure Behavior

- Modeling infrastructure systems as complex adaptive systems
- Simulation of dynamical behavior of infrastructure systems
- Modeling emergent behavior and self-organization processes
- Optimization of infrastructure control strategies
Emergent Infrastructure Behavior

A simple model of a traffic control system operating in emergency mode based on cellular automata

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Credits

Results presented in this poster have been produced by a team of researchers at George Mason University, including: Dr. Tomasz Arciszewski, Dr. Kenneth De Jong, Dr. Michael Bronzini, Dr. Rainald Lohner, Dr. Fernando Camelli, Dr. Rafal Kicinger, Zbigniew Skolicki, Elena Popovici, Moe Wadda