

A Model-Based Assessment of Cyber-Resilience Evaluation for Water Purification Plants with Societal Impact

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Abstract

Nowadays technology frequently makes use of IT components for implementing communication between the various elements that form a system. CPS (Cyber Physical Systems) are increasingly present in the industrial world and their application is transversal in all sectors. While this allows for greater efficiency, coordination and quality, it also opens to a series of completely new disruption scenarios with a potentially disastrous impact. In this context, the analysis of the system security and reliability pushes for a novel cyber-resilience perspective capable of evaluating not only the possibility of failures related to the physical and tangible part but also anomalies of and attacks to the IT counterpart. This work investigates this research dimension with respect to a water purification and distribution system. The presence of multiple documented events regarding cyber-attacks against the water industry and the consequences that such accidents could have on public health, further motivates this choice. A water desalination plant model and three cyber-attack scenarios have been developed in MATLAB/Simulink. To evaluate the societal impact of plant failures, a georeferenced water distribution network has been designed on EPANET. A set of resilience metrics has been customized for the system at hand, following a probabilistic approach that take into consideration the variability of cyber-attack's duration and system response, along with the physical modeling of the process. The results provide evidence on the benefits of cyber-physical inspired simulation for understanding the behavior of a system, identifying its criticalities, and designing corrective actions.

Keywords

Resilience, Cyber-resilience, Critical infrastructures, Systems theory, Resilience metrics

Biography

Francesco Simone is a recently graduated student in Mechanical Engineering specialized in Industrial Production at Sapienza University of Rome. Currently, after winning a research grant from Sapienza University of Rome, he is working as contract researcher at the Department of Mechanical and Aerospace Engineering. During his career, Francesco managed to deepen his knowledge on production engineering themes as: innovative manufacturing technologies such as LASER and Additive Manufacturing; Lean Manufacturing and Lean Thinking techniques; Operation and Project management fundamentals; safety and maintenance of plants and systems. He developed a particular interest on systems theory and its application on complex systems' resilience after his research work for Master Thesis in which he investigated societal impact cyber-attacks could have if successfully performed on CPSs. His aspiration is to give a valuable research contribution and continue his studies obtaining a PhD.