Department of Systems Engineering
香港城市大學
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Engineering Energy Networks Facing Global Transition: From Predicting Cascading Failures to Optimizing System Safety

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Abstract

Aiming at a sustainable energy production and at securing their energy supply, many countries are about to transition from a fossil-dominated to a green energy mix encompassing sunlight, mechanical energy and heat together with fossil and synthetic fuels. At the same time, the energy infrastructure is evolving from a collection of independently built, isolated energy carrier networks towards globally-integrated multi-energy systems. The integration of networks is clearly beneficial in view of designing optimal sustainable energy systems, but their heavily interconnected nature makes them vulnerable to cascading failures with potentially catastrophic consequences. This talk addresses the grand challenges and presents the methodological developments necessary to guide the evolution of energy infrastructure through vulnerability-based adaptation. They encompass (i) the development of high-fidelity, efficient mathematical models for quantifying the risk of cascading failures across the power infrastructure; (ii) investigating the trade-offs and optimal solutions in the energy trilemma for active distribution networks; (iii) developing and validating early warning indicators of critical transitions and fault diagnosis tools in complex dynamical systems; (iv) quantifying the cost of resilience in the design of carbon capture, transport and storage supply chains. Aside from presenting recent methodological developments, the future research challenges related to the engineering of resilient energy networks are also discussed.

About the Speaker

Giovanni Sansavini is an Associate Professor of Reliability and Risk Engineering at the Institute of Energy and Process Engineering, ETH Zurich. Currently, he is chairperson of the ETH Risk Center and of the Technical Committee on Critical Infrastructures of the European Safety and Reliability Association (ESRA). Giovanni Sansavini graduated in Nuclear Engineering (MSc, 2005 & PhD 2010, Politecnico di Milano, 2010) and Mechanical Engineering (PhD, 2010, Virginia Tech). His research focuses on the development of hybrid analytical and computational tools suitable for analyzing and simulating failure behaviors of engineered complex systems, with focus on physically networked critical infrastructures and sustainable energy systems. He aims to quantitatively define reliability, vulnerability, resilience, and risk within these systems using a computational approach based on physical system modeling, advanced Monte Carlo simulation, soft computing techniques, and optimization.

Enquiry: 3442 8422 | All are welcome