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Modelling, optimization and control for sustainability
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Abstract

In the last years, several negative environmental impacts have affected our world (climate change, pollution of water, air soil, resources scarcity, waste increase, etc.) that created the necessity of defining new alliances and regulation at international level to protect our environment. The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice. Within the goals of Sustainable Development, this Open Invited Track is focused on the impact on environmental systems, including three main macro-areas: pollution (water, air, soil); natural and technological risk management (floods, forest fires, dangerous goods transportation and production); conservation of resources (circular economy, waste management, sustainable energy production and distribution, etc.). In particular, attention is posed on models, methods and technologies that are useful to improve the management of the above mentioned areas of research. The proposed Open Invited Track aims to collect new advances in the study of sustainability, both from an application and methodological point of view.

Detailed description:

Modelling, optimization and control can provide useful tools and approaches to preserve our environment and to achieve the ecological and energy transition in the overall framework of sustainable development. This is a wide area of research including at least three macro-areas (pollution, risk management, conservation of resources) in which simulation, optimization and data management are already consolidated tools used both in research and applicative studies at international level.

In the area of conservation of resources, for example, optimization models are used for solid waste collection, disposal and treatment both for technologies' management and logistics problems. The use of renewable resources for energy production implies the use of tools like Geographic Information Systems and machine learning for resource availability assessment and forecasting, and the adoption of optimization models and controllers both for planning and management purposes. Moreover, the sustainable energy topic is strictly correlated with the area of smart grids, smart buildings, electric vehicles, hydrogen, etc., in which energy management and automation systems are fundamental. Life Cycle Assessment tools can be used to quantify impacts in a circular economy framework.

The area of risk management is wide itself and implies the development of decision support systems and simulation models for the assessment, prevention and management of different kinds of risks (floods, forest fires, technological and transportation risks). In this case, it is necessary to model vulnerabilities, quantify costs, consider probabilities of occurrence of the different events, integrate and elaborate data coming from sensors in field, and to model the involved physical systems integrating different disciplines (hydraulics, hydrology, forest modelling, physics, meteorology, etc.). The aim is, on one side, to assess the risks, and, on the other side, to define actions for risk management (both in pre-operational management and emergency situations).

The area of pollution includes different sub-topics related to water quality and preservation, air pollution, and soil contamination. In this case, it is necessary first of all to model the physical system that is characterized by different kinds of subsystems (for example in the case of water management: hydraulic, hydrologic, ecological models), and then to assess the effects of some actions and scenarios (through simulation tools) on the environment and health. Finally, simplified systems' models should be developed to be inserted in optimization models and controllers to manage resources in the short term. The water quality problem is strictly related to water management in general for industrial, agricultural, and human uses, thus focusing on crucial aspects like water networks management (both in terms of estimation, prevention of losses and remote control).

The proposed Open Invited Track aims to collect new advances in the study of sustainability, both from an application and methodological point of view. Specifically, the topics of the proposed Open Invited Track are specifically related (but not limited to) to the following methods and application areas:

- Distributed control and optimization

- Fault detection and state estimation

- Machine learning-based control and optimization

- Optimal control

- Simulation tools for Intergrated Impact Assessment

- Water management (marine, lakes, rivers, etc.)

- Air quality modelling and management

- Sustainable power and energy systems

- Sustainable energy communities

- Environmental Impact Assessment

- Waste management

- Natural Risk management (floods, forest fires, etc.)

- Life Cycle Assessment

- Technological risk management

- Transportation of dangerous goods

- Circular economy

- Pollution reduction

- Agricultural systems

- Water networks

- Ecological modelling