INSTITUT POLYTECHNIQUE DE PARIS

RESEARCH DAY

Researcher Biographies and Project Abstracts

Symposium
“Energy”

December, 1st
1.30 pm to 3.30
Lecture hall 3

Chaired by
Tony Lelievre, Chair of the Committee,
Professor at CERMICS,
a laboratory of ENPC, E4C
Marieke Stein, Associate Professor at FoAP,
a laboratory of ENSTA

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François Trahay is a Full Professor at Telecom SudParis, where he specializes in the performance analysis and optimization of high- performance computing (HPC) systems. His research focuses on runtime systems for HPC, multithreading over multicore architectures, and the broader challenges of designing efficient high-performance systems.
With a strong background in computer science and parallel computing, François Trahay has made contributions to understanding and improving the scalability, efficiency, and energy consumption of modern supercomputing environments. His work addresses critical issues in parallel programming models, resource management, and performance tuning, particularly in the context of increasingly complex and heterogeneous hardware architectures.

Energy Footprint of Numerical Simulations on Supercomputers

Numerical simulations, essential for advancements in fields like climate modeling, computational fluid dynamics, and materials science, demand immense computational resources, leading to substantial energy footprints. This presentation explores the energy challenges associated with large-scale simulations on supercomputers, examining both hardware and software factors that influence power efficiency.

We analyze the energy consumption patterns of numerical simulations, highlighting key contributors such as algorithmic complexity, parallelization strategies, and hardware architecture. We discuss emerging solutions—such as energy-aware scheduling, system-level mitigation strategies, and algorithmic optimizations—that aim to mitigate the environmental and operational costs of supercomputing.

By addressing these challenges, this work seeks to foster sustainable practices in HPC, ensuring that the pursuit of scientific innovation aligns with global energy efficiency goals.

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Daphné Tuncer is currently with École nationale des ponts et chaussees, Institut Polytechnique de Paris, France. For the past 18 years, she has been trying to understand how to manage the complexity of networked system infrastructures and resources. Daphne is the scientific co-chair the research action 7 of Energy4Climate (E4C). Her full bio can be found on her webpage. http://dtuncer.com/

Inter-domain and multi-stakeholders system infrastructure orchestration

The engineered systems of a city have traditionally been operated in silos, per domain, following vertical mode of collaboration. In the recent years, a number of applications in different areas of the systems of a city (e.g., energy, built environment, transport) have however been exploring the potential of horizontal collaboration to develop new types of services, such as smart charging solutions, green computing services, or Mobility-as-a-Service. Under these configurations, system infrastructure management processes cannot only work on system-level targets when optimising operations. They also need to take account of global cross-system objectives. From a management perspective, this requires the development of a functionality that enables the orchestration of coupled, heterogeneous system infrastructures. This talk will discuss our current work on how to effectively orchestrate system infrastructures in environments that are multi-stakeholders and inter-domain. In particular, we will present the digital twin platform that we have been developing for the smart building demonstrators of E4C to illustrate the functionality of a management procedure that is adapted to these types of environments.

Louis-Gaëtan Giraudet is Director of Research at École des Ponts ParisTech and the International Center for Research on Environment and Development (CIRED). His research focuses on evaluating energy renovation policies in the housing sector, including MaPrimeRénov', energy saving certificates, zero-interest eco-loans, carbon taxes, and renovation requirements. It also covers the role of air conditioning in adapting to climate change in Europe and Africa. L.-G. Giraudet coordinates the development of the Res-IRF tool for evaluating energy renovation policies. He teaches at Ecole des Ponts and Sciences Po PSIA.

The economics of home energy retrofits

In France, about six billion euros are spent each year by public authorities and energy suppliers on subidy programs for home energy retrofits. These programs receive a lot of criticisms -- their rules are ever-changing, their results deceptive, and their realization subject to fraud. This raises two questions: What economic problems justify so much spending? Does current spending in turn match its objectives? To answer this question, we conduct cost-benefit analysis in a comprehensive framework factoring in the social value of climate action and the health benefits from reduced cold-related illness. We find that, even when accounting for lower-than-predicted energy savings, the social benefits of retrofits far exceed their cost. They however appear unprofitable to private decision-makers, thus justifying massive suppport. While current spending matches the identified financing needs, it only meets two-thirds of its target. This calls for increasing subsidies in rental and multi-family housing.

Yann Marco is a full Professor at ENSTA, a reseaarcher at IRDL (UMR6027) and head of the Mechanics Department. He is also a fellow Lecturer at the Prague University. He has supervised 32 PhD Thesis (9 running) and written over 200 publications (over 2800 citations). He is currently involved and lead several national research collaborative projects over the last 15 years. His main research topics investigate design against fatigue and ageing of organic materials (Elastomers, Polymers, Composites) for various industrial fields, from Aeronautics to Automotive and Marine renewable Energy.

Future floating wind turbines: scientific obstacles and contribution of modelling to synthetic anchoring solutions

Floating wind platforms developed for marine renewable energies in shallow waters (between 50m and 100m) will be located in exposed areas where waves and wind are significant. The challenge for the sub-sea installations is to find a robust and suitable solution that damps the dynamic loading for long-term applications. One proposed solution is a semi-taut mooring system with synthetic rope materials. Polyamide 6 (PA6) is of high interest for these mooring systems thanks to its competitive price, high elongation to failure (up to 20%) and low stiffness. These mooring lines must last 20 years and limit the need for maintenance and re-tension procedures. Hence, they should show durability in terms of aging, fatigue life and creep. These test takes time and even more considering that the load frequency is the one of the waves (0.1Hz) and that the life time expected is 20 years. To speed up this characterization and lead to reasonable tests durations it is mandatory to take advantage of a fast fatigue evaluation based on the characterization of the energy dissipated under cyclic load. This is no easy task for several experimental reason (immersion in water, large displacements, ...) but also for modelling and numerical reasons these ropes are architecture materials, with numerous dissipative and damage mechanisms at multiple intricated scales. This presentation will illustrate the input of combining several experimental (IR thermography, X-Ray tomography, friction measurements, ...) and modeling tools (behaviour models, coupled thermo-mechanical FE simulations, ...) to the understanding of the energy balance and the failure properties of these materials.

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