INSTITUT POLYTECHNIQUE DE PARIS

RESEARCH DAY

Researcher Biographies and Project Abstracts

Symposium "Transportation and Mobility"

December, 1st
1.30 pm to 3.30
Lecture hall 4

Chaired by
Fabien Leurent, Senior Researcher at CIRED, a laboratory of ENPC

Andrea Araldo is Associate Professor at Institut Polytechnique de Paris - Telecom SudParis, where he teaches Machine Learning for Networks.
His current research interests are Networked Systems Optimization, Mobility on Demand, Artificial Intelligence. He was awarded the French national Young Researcher funding (ANR JCJC) for the project "Multimodal Transit for Accessibility and Sustainability" (2022-26).
He received the PhD degree in Computer Science from Paris Saclay University (France - 2016). He was visiting researcher at KTH Royal Institute of Technology (Sweden - 2016) and Postdoctoral Associate Researcher at the Massachusetts Institute of Technology (US - 2017-18) in the Intelligent Transportation Systems Lab.

Reducing Accessibility Inequality via Flexible Mobility: a Descriptive and Prescriptive Analysis

Accessibility is a measure of how easily people can reach the opportunities around them, such as jobs, schools, cultural or health facilities. Today, in high density areas accessibility derives from Public Transport (PT), whereas in all the the other areas, it depends on cars. Such a setting is environmentally, socially and economically unsustainable, yet cities are striving to transition to a new one. One barrier is the rigidity of PT.
Araldo's recent research contributes to the state of the art in PT planning, operation and analysis, by providing new methods to achieve a more equal geographical distribution of accessibility. While accessibility has primarily been used for descriptive analysis, Araldo's approach attempts to operationalise accessibility as a prescriptive instrument and make it the main objective of PT planning and operations.

The talk will focus in particular on Demand-Responsive Transport (DRT). Although DRT is a promising solution for low density area, there are currently no methods to quantify easily interpretable accessibility indicators for DRT. Such quantification is essential to show the benefits of DRT to decision-makers and a broader audience, and thus justify the relatively high cost of the DRT deployment. Araldo will present a new statistical method, based on probabilistic machine learning models, that leverages data from real DRT deployments, in the frame of an industrial collaboration with the DRT operator Padam Mobility (Siemens Group). Finally, Araldo will present methods, based on Bayesian optimization, for planning DRT so as to reduce geographical inequality of accessibility.

Marion Leroutier is an applied environmental economist focusing on two major environmental issues, ambient air pollution and climate change. She's an Assistant Professor at CREST and ENSAE Paris, a research associate at the Institute for Fiscal Studies, and a research affiliate at the Institut des Politiques Publiques and at the Mistra Centre for Sustainable Markets. Her current research investigates the societal costs of air pollution, the health co-benefits of climate policies and the determinants of support for green policies, in the European context.

Tackling Car Emissions in Urban Areas: Shift, Avoid, Improve

co authored with Philippe Quirion

Car use imposes costly environmental externalities. We investigate to what extent car trips could be shifted to low-emission modes, avoided via teleworking, or improved via a transition to electric vehicles in the context of daily mobility in the Paris area. We derive counterfactual travel times for 45,000 car trips from a representative transport survey, and formulate modal shift scenarios including a maximum acceptable increase in travel time. For a daily travel time increase below 10 min, 46% of drivers could shift to e-bike – mostly – or public transit – rarely –, with half of them benefiting from a travel time decrease. Such modal shift would reduce daily mobility emissions by 15% and generate annual climate and health benefits worth €125 million. Factors such as living in the far suburbs, being male, or having a high income, are associated with inability to shift modes. Teleworking two days a week could save an additional 5% of emissions. Holding demand for mobility and public transport infrastructure fixed, greater emission reductions require improving cars' environmental performance via a transition to electric vehicles.

Virginie Boutueil is a researcher at École Nationale des Ponts et Chaussées (ENPC), in the City Mobility Transport Lab (LVMT). Her research in the field of mobility socioeconomics focuses on innovative mobility solutions (including shared mobility solutions), the digital transformation of mobility services, and related public policies. She teaches the analysis of mobility behaviors, the economics of new mobility services and the design of innovative mobility services to diverse audiences, in France and abroad.

Integrating intermediate modes in mobility research and policy: Prospects and challenges

“Intermediate modes” – transport options that blend features of private cars and public transit – represent promising alternatives to individual motorization across a variety of urban contexts. Despite their long-standing presence, especially in cities of the Global South, these modes have rarely been the subject of systematic analysis. The ongoing digital transformation of these services offers new opportunities to reassess their evolving roles and potential to contribute to more sustainable and resilient mobility systems.

First, the communication draws on data from the Worldwide Observatory of Shared Mobility Digital Platforms (WOSP) to track the global expansion of app-based shared mobility services between 2019 and 2025. It identifies key trends in the development of these platforms in cities of both the Global North and the Global South.

Second, building on selected case studies from the WOSP, the communication further explores the diverse regulatory challenges that digitally-enhanced intermediate modes pose to public authorities at different government levels and in varied urban contexts.

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Axel Parmentier is a professor at École Nationale des Ponts et Chaussées, where he founded and holds the artificial intelligence for air transport chair with Air France. His research lies at the intersection of operations research and machine learning, and notably enabled his group to win the 2022 EURO-NeurIPS challenge on dynamic vehicle routing. He received several awards, among which the AMIES PhD dissertation award for a thesis in applied mathematics in partnership with the industry, and the Robert Faure Prize, which is awarded every three years by the French Operations Research Society (ROADEF) to a researcher under 35 for their contributions to the field.

Combinatorial Optimization Augmented Machine Learning for Sustainable Transport and Logistics

The ecological transition demands more efficient industrial processes to reduce emissions. Operations Research, which focuses on process optimization, plays two crucial roles in this regard: reducing consumption with present-day technology by better allocating resources (e.g., better-filled trucks) and managing uncertainties that come with new technologies, such as mutualization in logistics, multimodal transport, or electric vehicles and their charging with green energy. To fulfill the first role, Operations Research has traditionally focused on making combinatorial optimization scalable, as optimizing processes reduces marginal costs and emissions with the size of the process being optimized. However, managing uncertainty leads to stochastic versions of combinatorial problems for which traditional approaches do not scale. Combinatorial Optimization Augmented Machine Learning (COAML) emerges as a promising solution. It excels in contextual and dynamic problems where uncertainty evolves over time, as demonstrated by its success in dynamic vehicle routing applications. After providing an overview of the field, we focus on recent learning algorithms for empirical cost minimization and structured reinforcement learning, and show how they unlock applications in the context of sustainable operations, both at the operational and strategic levels.

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