# PLM RESEARCH TALK

## Incorporating Crowding Effects in Line Planning

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**Abstract:** In this presentation, I introduce the problem of determining lines and frequencies in a public transport system. In contrast to existing approaches, we explicitly consider crowding and assume that passengers may choose different routes to reduce discomfort due to crowding. Our solution approach targets at finding a system-optimal solution by generating passenger routes in a dynamic fashion, whilst also adding cutting planes to deal with the non-linearity introduced by the crowding terms. Since in practice passengers may deviate from system-optimal routes, line plans are evaluated by computing a user equilibrium routing based on Wardrop's principle. Numerical experiments based on grid instances show that incorporating crowding leads to fundamentally different line plans that achieve a lower perceived travel time, both for the system-optimal routing and for the user equilibrium but at the expense of higher physical travel times (joint work with Yahan Lu, Rolf van Lieshout, and Lixing Yang).

**About the speaker:** In her research, Layla addresses various operational research problems in transportation and logistics. She is particularly interested in shared mobility such as carsharing, bikesharing and ride-hailing. Most of her research focuses on strategic questions such as fleet design, but she always considers the operational implications of the decision. Layla has used various different methods, including mixed integer programming, Markov decision processes, and game theory. She strongly believes in the importance of using the right method for the problem at hand, rather than specializing in a single method. Therefore, she likes collaborating with methodological experts.

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