On the robust bilevel toll setting problem

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This talk addresses the robust bilevel toll setting problem in which a leader sets edge tolls in a network while multiple followers choose their shortest paths between given source–target pairs. Followers' edge costs are uncertain and originate from a polyhedral uncertainty set. The leader seeks to maximize its worst-case revenue, anticipating the most adverse realization of followers' costs and their optimal routing responses. The talk provides a comprehensive analysis of the problem, covering complexity results and showing that its supremum is, in general, not attained. Then, a recent generic framework for robust bilevel optimization is applied for solving the problem, combining (i) a single-level MILP reformulation over a discrete uncertainty set, (ii) a worst-case follower response problem, and (iii) computing a characteristic uncertainty realization to be added to the discrete uncertainty set. These steps are iterated until the solution approaches the supremum on the original polyhedral uncertainty set with a given, arbitrary small margin. Computational experiments on networks with up to 100 vertices and 10 followers demonstrate that small instances are solved within seconds, while larger instances remain challenging. The main computational bottleneck is the discrete-uncertainty subproblem, showing a significant complexity increase compared to the deterministic case. The talk concludes with directions for future research aimed at improving computational efficiency.