Interdicting Restructuring Networks with Applications in Illicit Trafficking

Daniel Kosmas
PhD Student
Department of Mathematical Sciences
Rensselaer Polytechnic Institute

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Abstract: We consider a new class of max flow network interdiction problems, where the defender is able to introduce new arcs to the network after the attacker has made their interdiction decisions. We provide an example of when interdiction can result in an increase to the maximum flow, and prove properties of when this restructuring will not increase the value of the minimum cut, which has important practical interpretations for problems of disrupting drug or human trafficking networks. In particular, it demonstrates that disrupting lower levels of these networks will not impact their operations when replacing the disrupted participants is easy. For the bilevel mixed integer linear programming formulation of this problem, we devise a column-and-constraint generation (C&CG) algorithm to solve it. Our approach uses partial information on the feasibility of restructuring plans and is shown to be orders of magnitude faster than previous C&CG methods. We apply this algorithm to the application of disrupting drug trafficking networks. We demonstrate that applying decisions from standard max flow network interdiction problems can result in significantly higher flows than interdictions that account for the restructuring.

Talk will take place on June 23, 2021 from 1:00PM - 2:00PM through Zoom.