EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

Time Discretization in Integer Programming

ABSTRACT – Optimization problems in which the critical decisions concern the timing of activities are pervasive in real-world applications. For example, in less-than-truckload logistics, consolidation opportunities, which must be exploited if the enterprise is to be profitable, are only realized if the goods to be consolidated are available at the same time; the timing of truck departures is critical to the efficiency of the operation. In path planning in networks subject to congestion, the travel time along an arc can differ by the time at which the travel starts; carefully accounting for this is important in minimizing travel duration. In vendor-managed inventory situations, in which vendors replenish customers using delivery routes and the customer demand evolves in continuous time, keeping track of the timing of vehicle arrivals at customers is needed to ensure the customer does not run out of inventory at any point in time.

Optimization of timing decisions has, in the past, been done successfully with the assistance of time-expanded networks. To construct these networks, time is discretized. Such discretization is usually done a priori, and then an integer programming (IP) model solved over the resulting network. This has been successful because IP models based on time discretization are usually quite strong. Unfortunately, discretization introduces approximation. If the discretization is too coarse, solutions to the discretized model may be either suboptimal, or unobtainable, depending on how the approximation is made. But if the discretization is too fine, the networks become too large, and the IPs become intractable.

In recent years, the idea of dynamic generation of the time-expanded network has emerged, and algorithms that seek to iteratively generate only the discrete time points needed to obtain optimal solutions, and to prove their optimality, have been developed. Dubbed Dynamic Discretization Discovery (DDD), the paradigm has so far shown itself to be both powerful, and flexible. This talk will explain the key concepts of the DDD paradigm, and describe how specific algorithms for the optimization problems described above have been designed. Computational results, illustrating the performance of the algorithms, will be discussed.

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SPEAKER BIO – Natashia Boland is a professor in the Stewart School of Industrial & Systems Engineering at Georgia Tech. She received her BSc(Hons) and PhD from the University of Western Australia in 1988 and 1992, respectively. After completing two years of postdoctoral research in 1994 and 1995, at the University of Waterloo, Canada, and the Georgia Institute of Technology, respectively, she took up her first faculty position in her home country of Australia, in the Department of Mathematics and Statistics at the University of Melbourne. She then, in 2008, moved the University of Newcastle, Australia, to take up a position as Professor of Applied Mathematics, where she remained until moving to take up her current position, commencing in 2015. Dr. Boland is an expert in the field of integer linear programming and discrete optimization, and an exponent of its application to address complex problems in government and industry. Her contributions to the field have spanned theory, algorithms, modeling and applications, in mining, defense, renewable energy, airline planning, freight transport, port logistics and water management. Dr. Boland has published more than 70 refereed journal articles and has graduated 20 PhD students. Her research is currently supported by UPS, NSF and Optym.

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3:30PM – 4:50PM

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