

Research Profile

My research philosophy is that of being problem motivated—that is, given a relevant, interesting, real-world application, develop and analyze mathematical models for the related problem. Of particular interest is the creation of novel, innovative application areas for Operations Research techniques. My solid Engineering background coupled with an excellent, in-depth knowledge of a broad range of Operations Research techniques give me the tools that are necessary for effectively performing this type of research activity.

Recent Research Summary

Over the last several years I have been active in the following research areas:

Scheduling of Spatially Distributed Degrading Jobs

Job degradation of spatially scattered jobs has many real-world applications. These include pothole repair, emergency service response, and controlling forest fires. A doctoral student, Fatemeh Aarabi is working on this topic.

Hazardous Materials Routing/Logistics

Recent work on hazardous materials routing was supported by the National Science Foundation and by Erie County. Two doctoral students (Masoumeh Talsimi and Tolou Esfandeh) recently completed doctoral dissertations in this area, co-supervised with Changyun Kwon. An MS student, Harshavardhan Vemupati, finished working in this area, co-supervised with Joy Bhadury. A visiting student from France, Melanie Braga Tavares, also worked in this area.

Routing/Scheduling for Search Missions

Recent work in the area of routing/scheduling for search missions was supported by two grants from the Office of Naval Research. One of the graduated doctoral students, Mike Moskal, worked in the area of routing for search over micro-grids, which includes elements of prize collection and movement planning between micro-grids. The other graduated doctoral student, Yan Xia, explored the value of the price of anarchy in decentralized Markov decision processes, when reward has uncertainties associated with it. Yan's work was co-supervised by Rakesh Nagi.

Convoy Routing

A doctoral student (Azar Sadeghnejad) worked in this area, co-supervised by Moises Sudit. The general problem is that of routing convoys (long sets of vehicles that move together) in both peacetime and war time settings. A key feature is the separation in time and space of the convoys.

School Bus Routing

I have explored many elements of school bus routing, including overbooking of buses, special education bus routing, and studying the impact of pickup restrictions and policies. This work was supported by the Williamsville School District. A doctoral student (Hernan Caceres) completed his doctoral dissertation in this area, co-supervised by Qing He.

Gasoline Supply Logistics

Two aspects were explored. The first relates to supply of gasoline after a natural disaster has occurred. This is supported by the University Transportation Research Center in CUNY. A graduated MS student, Xiaoping Li, worked on this topic, co-supervised by Changyun Kwon. The other aspect relates to

regular gasoline supply. A graduated doctoral student, Yan Cheng-Hsu, worked in this area, co-supervised by Jose Walteros.

Electric Vehicle Routing and Location of Charging Stations

The problem of modeling charging station capacity when considering routing of electric vehicles and location of charging stations was explored. A recently doctoral student, Nan Ding, worked in this area, co-supervised by Changhyun Kwon.

Evacuation Planning

This research focuses on efficient management of the evacuation process, which include reaching appropriate evacuation targets by zones, managing traffic congestion in the impacted area, and maintaining equity of access for elderly and physically challenged individuals. Recent work is with a graduated MS student (Rahul Swamy) and a visiting PhD student (Sarah Dian), both co-supervised by Jamie Kang.

Disaster Relief Supply in a Mountainous Area

This research focuses on providing relief supplies to an impacted area after a natural disaster. The area being modeled is in mountainous territory and requires supply delivery using porters who travel on trails, in conjunction with helicopters who deliver supplies to porters at strategic supply points. Recent work is with a graduated MS student, Abhinav Khare, co-supervised by Jamie Kang.

Grocery Store Layout Optimization

This research focuses on optimization of a grocery store layout, with the aim of maximizing impulse item sales, while keeping customer inconvenience under control. Various aspects of the problem are being studied. Recent work is with a doctoral student, Jessica Dorismond, co-supervised by Jose Walteros.

Exploring the Role of Social Media in Planning Pre-Positioning of Supplies Prior to a Natural Disaster

This research focuses on using social media as a tool that can help with planning pre-positioning of key supplies prior to a natural disaster striking an area. Two doctoral students, Abhinav Khare and Monir Sabbaghtorkan, and two undergraduate students, Ling Lin and Obe Joseph are studying various aspects of this project, which is sponsored by the National Science Foundation. All of this work is joint with Qing He.

Order Picking Strategies in an On-Line Replenishment Warehouse

This research focuses on order picking strategies for a warehouse that is used to replenish items that are ordered online. A doctoral student, Atieh Madani, is working on various topics in this area, co-supervised by Mark Karwan.

Submitted Papers

Submitted Papers (can be requested by writing to Rajan Batta at batta@buffalo.edu)

M. Taslimi, R. Batta and C. Kwon, "Medical Waste Collection Considering Transportation and Storage Risk," submitted to *Computers and Operations Research*. HAZMAT ROUTING

F. Aarabi and R. Batta, "A Mixed Integer Programming Approach for Scheduling Spatially Distributed Jobs with Degradation Rate: Application to Pothole Repair," revision under preparation for *European Journal of Operational Research*. JOB SCHEDULING

M. Sabbaghtorkan, R. Batta and Q. He, "Prepositioning of Resources and Supplies in Disaster Operations Management: Review and Research Gap Identification," revision under preparation for *European Journal of Operational Research*. HUMANITARIAN LOGISTICS

J. Dorismond, J. Walteros and R. Batta, "A Simulation Based Tool to Guide Periodic Changes in a Supermarket Layout," submitted to *European Journal of Operational Research*. SUPERMARKET LAYOUT

A. Khare, R. Batta and J. Kang, "On the Analysis of Last-Mile Relief Delivery on a Tree Network: Application to the 2015 Nepal Earthquake," submitted to *European Journal of Operational Research*. HUMANITARIAN LOGISTICS

A. Khare, Q. He and R. Batta, "Predicting Gasoline Shortage During Disasters Using Social Media," revision under preparation for *OR Spectrum*. HUMANITARIAN LOGISTICS

B. Bhattacharya, L. Lin, R. Batta and P. Ram, "Stock-out Severity Index: Tool for Evaluating Inequity in Drug Stock-outs," revision under preparation for *Central European Journal of Operations Research*. HEALTH CARE DELIVERY

A. Madani, R. Batta and M. Karwan, "The Balancing Traveling Salesman Problem: Application to Warehouse Order Picking," revision under preparation for *TOP*. WAREHOUSE ORDER PICKING

L. Lin, Q. He and R. Batta, "Natural Disaster Damage Loss Prediction Using Social Media Data: The Study Case of Hurricane Irma," submitted to *Natural Hazards*. HUMANITARIAN LOGISTICS

O. Joseph, Q. He and R. Batta, "Predicting Hurricane Landfall from the Atlantic on United States Territories using Historical Advisory Data from 1998 to 2018," submitted to *Natural Hazards*. HUMANITARIAN LOGISTICS