

AMIT KUMAR

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EDUCATION

PURDUE UNIVERSITY, WEST LAFAYETTE, INDIANA, USA

Ph.D. in Civil Engineering, May 2014 (GPA: 3.8/4)

Major Area: Transportation and Infrastructure Systems

Dissertation: Path-Based Traffic Assignment Algorithms and Models to Enhance Deployment Robustness

Supervisor: Dr. Srinivas Peeta

INDIAN INSTITUTE OF TECHNOLOGY (IIT) BOMBAY, MUMBAI, INDIA

M. Tech. in Civil Engineering, August 2006 (GPA: 9.6/10)

Major Area: Transportation Systems Engineering

Dissertation: Real Time Public Transport Information System Using GIS & GPS Integration

(Received the **Best M. S. Thesis Award** for the year 2006)

Supervisor: Dr. K. V. Krishna Rao

MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR, B.R.A. BIHAR UNIVERSITY, INDIA

Bachelor of Science (Engineering) in Civil Engineering, July 2004 (Percentage: 78.5%)

Major Area: Civil Engineering

Project: Formworks for Structural Concrete at Delhi Metro Railway Construction

Supervisors: Dr. Achintya and Dr. Rajesh Agarwal

RESEARCH EXPERIENCE

PURDUE UNIVERSITY, WEST LAFAYETTE, INDIANA, USA

- **Graduate Research Assistant in Transportation and Infrastructure Systems in the School of Civil Engineering, 2008-2013**

Developed a post-processing technique to address the problem of solution noise in the outcomes of widely used four-step transportation planning process. Developed two new path-based solution algorithms for traffic assignment problem (TAP) labeled as SMPA and SPSA. The algorithms achieve smoother and faster convergence and endeavor to improve the behavioral consistency into the solution. Developed a hybrid solution approach for TAP that integrates the simultaneous path sets update strategy with the sequential equilibration technique. This facilitates applicability to large size networks and tends to eliminate order-bias in the solution. Developed a new model for solving the problem of non-uniqueness of path-based solution for TAP. Also developed a dynamical model to represent the day-to-day dynamics of route choice behavior of drivers under the disequilibrium of traffic networks.

NEXTRANS CENTER, PURDUE RESEARCH PARK, WEST LAFAYETTE, INDIANA, USA

- **Graduate Research Assistant (2008-2013), Research Associate (2014)**

NEXTRANS is the USDOT Regional University Transportation Center at Purdue University. I worked for multiple research projects involving the state-wide planning model, electric vehicles and infrastructure interdependencies.

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY, MUMBAI, INDIA

- **Graduate Research in Transportation Systems Engineering in the School of Civil Engineering, 2004-2006**

Developed a methodological framework for real-time information system (RTIS) for transit buses capable of disseminating the expected arrival time information using location technology (GPS) and referenced data-base management system (GIS). In addition, performed a stated preference survey design and experiment to develop a model to predict the value of RTIS for bus riders.

TEACHING EXPERIENCE

PURDUE UNIVERSITY, WEST LAFAYETTE, INDIANA, USA

- **Instructor in the Workshops in the School of Civil Engineering, 2009-2010**
Performed the role of instructor for professional development workshops for graduate students on “Introduction to Optimization Techniques” and “MATLAB applications”. I had the responsibility of planning and conducting these workshops which included preparing class handouts, deciding instruction plan and teaching.
- **Instructor in the Graduate Level Course in the School of Civil Engineering, Fall- 2011, Spring 2014**
Performed the role of instructor for some lectures for Transportation System Analysis, which is a core course for the graduate students in Transportation and Infrastructure Systems at Purdue University.
- **Workshops on Teaching Excellence**
Participated in the teaching workshops organized by Center for Instructional Excellence and instructed by the winners of Teaching Excellence Award at Purdue University.

NEXTRANS CENTER, PURDUE RESEARCH PARK, WEST LAFAYETTE, INDIANA, USA

- Performed the role of mentor to undergraduate summer interns at NEXTRANS center.

INDIAN INSTITUTE OF TECHNOLOGY (IIT) BOMBAY, MUMBAI, INDIA

- **Teaching Assistant in the Structural Engineering in the Department of Civil Engineering, 2004**
Heavy Structural Engineering Lab is the part of undergraduate courses in the Department of Civil Engineering. I was responsible for demonstrating the experimental set up and explaining the theoretical background of the experiment. I was also responsible for grading the lab reports submitted by the students. In addition, I also acted as the grader for AutoCAD Lab for undergraduate students.
- **Teaching Assistant in the Transportation Systems Engineering in the Department of Civil Engineering, 2005**
Transportation Engineering is the core course for undergraduate students in the Department of Civil Engineering. I was responsible for demonstrating the experimental set up for the experiments in the Pavement Engineering Lab which is part of this course.
- **Teaching Assistant in the Transportation Systems Engineering in the Department of Civil Engineering, 2006**
Traffic Engineering is the core course for graduate students in the Transportation Systems Engineering. The experiments for this course involved both in lab and field activities. I was responsible for explaining the theoretical background and the sequence of the steps of the experiments in addition to helping the students working on the experiments.

PROFESSIONAL EXPERIENCE

RELIANCE INDUSTRIES LIMITED, MUMBAI, INDIA

- **Assistant Manager (Transportation Engineering), 2006-2007**
Reliance Industries Ltd. (RIL) is the largest private sector enterprise in India. It hosts a group of companies diversified in multiple business ranging from infrastructure to oil and natural gas. I worked for the NMSEZ Development Co. Pvt. Ltd. and Transportation Infrastructure Business Group (TIBG) on several projects involving city planning, planning for disaster and incident management, financial evaluation of transportation projects and preparation of bidding documents. I was ranked 5 (on the scale of 1 to 5) on the performance based employee ranking for the consecutive years and received the recognition of “Top Ten Assistant Managers” by the company.

DELHI METRO RAIL CORPORATION LTD., NEW DELHI, INDIA

- **Under-Graduate Intern, 2003**
Task involved: investigating the performance of the formworks for structural concrete and safety inspections at Delhi Metro Rail Construction sites.

FUNDED RESEARCH PROJECTS

- **Transportation Planning / Travel Demand Modeling Project:** *“Post-Processing Techniques to Enhance Reliability of Assignment Algorithm Based Performance Measures”*, Funded by Indiana Department of Transportation (INDOT)
 - Developed an enhanced transportation planning framework by augmenting the sequential four-step planning process with post-processing technique
 - Conceptualized and tested O-D prioritization schemes in traffic assignment for improving the convergence and stability of Indiana State-Wide Travel Demand Model
- **Multimodal Network Modeling / High Speed Rail Project:** *“Incorporating High Speed Passenger Rail into a Multimodal Network Model for Improved Regional Transportation Planning”*, Funded by US Department of Transportation (USDOT) through University Transportation Center (UTC) at Purdue University
 - Developed an generic framework for estimating the ridership of high speed rail for intercity transportation alternative under multimodal scenario
 - Analyzed the potential for high-speed rail as a part of the existing multimodal transportation system for the Midwest corridor in the United States
- **Infrastructure Interdependency Project:** *“Integrated Framework to Capture the Interdependencies between Transportation and Energy Sectors due to Policy Decisions”*, Funded by USDOT through UTC at Purdue University
 - Developed a system-of-systems (SOS) based infrastructure computable general equilibrium (ICGE) framework for analyzing the interdependencies between the transportation and energy sectors
 - Exemplified the SOS based method for evaluating the policy instruments, e.g. subsidizing the electric vehicles using the ICGE framework

AREAS OF PROFICIENCY

TRANSPORTATION PLANNING AND TRANSPORTATION SYSTEMS ANALYSIS

Extensive work in the area of traffic assignment techniques especially for the static demand case. Developed two new path-based traffic assignment algorithms capable of solving the assignment problem for real-world size networks. Developed a day-to-day dynamical model for traffic disequilibrium. Recently developed a new model to solve the problem of non-uniqueness of path flows for static traffic assignment. Good familiarity with discrete choice models as well as network optimization techniques. Familiarity with system-of-systems based approach for modeling the infrastructure interdependencies.

TRANSPORTATION SYSTEMS EVALUATION

Good understanding of transportation infrastructure development process. Good understanding of methodologies of economic evaluation of transportation projects. Familiarity with multi-criteria based decision making process.

OPERATIONS RESEARCH

Good familiarity with linear, non-linear and multi-objective optimization problem solving techniques including the Simplex method, interval reduction methods, conjugate gradient methods, quasi-Newton methods, penalty methods, interior point methods, Lagrangian relaxation, and non-smooth optimization techniques.

DATA ANALYSIS

Good familiarity with various statistical data analysis and sampling techniques. In addition, familiarity with design of experiment, stated preference survey questionnaire design and use of software package LIMDEP and MS-excel for modeling process.

COMPUTER PROGRAMMING AND SOFTWARE DESIGN

Extensive experience in programming especially for solving network optimization problems. Developed codes for traffic assignment algorithms that harnessed the capabilities of MATLAB as well as C. Developed codes of day-to-day dynamical evolutionary models in C++ and implemented it with large scale networks. Familiarity with the parallel processing, cluster computing and GPU computing techniques.

PUBLICATIONS

PEER-REVIEWED JOURNAL PUBLICATIONS

- Kumar, A. and S. Peeta. "Entropy Weighted Average Method for the Determination of a Unique Path Flow Solution for the Static User Equilibrium Traffic Assignment Problem.", *Transportation Research Part B*, 71, pp. 213–229, 2015.
- Kumar, A. and S. Peeta. "A Day-To-Day Dynamical Model for the Evolution of Path Flows under Disequilibrium of Traffic Networks with Fixed Demand.", *Transportation Research Part B*, 2014, submitted for 2nd round of Review (Tentatively accepted).
- Kumar, A. and S. Peeta. "Slope-Based Path Shift Propensity Algorithm for the Static Traffic Assignment Problem.", *International Journal for Traffic and Transport Engineering*, 4(3), pp. 297-319, 2014.
- Kumar, A. and S. Peeta. "Strategies to Enhance the Performance of Path-Based Static Traffic Assignment Algorithms.", *Computer-Aided Civil and Infrastructure Engineering*, 29(5), pp. 330-341, 2014.
- Kumar, A., S. Peeta and Yu-Nie. "Update Strategies for Restricted Master Problems for the User Equilibrium Traffic Assignment Problem: A Computational Study.", *Transportation Research Record: Journal of the Transportation Research Board*, 2283(1), pp. 131-142, 2012.
- Kumar, A. and S. Peeta. "Slope-Based Multipath Flow Update Algorithm for Static User Equilibrium Traffic Assignment Problem.", *Transportation Research Record: Journal of the Transportation Research Board*, Transportation Research Board of the National Academies, Washington, D.C., 2196(1), pp. 1-10, 2010.

PEER-REVIEWED CONFERENCE PROCEEDINGS

- Agarwal, A., A. Kumar, H. Zheng, and S. Peeta. Routing Aspects of Electric Vehicle Users and Their Effects on Network Performance. In the proceedings of 93rd Annual Meeting of Transportation Research Board of the National Academies, Washington, D.C., 2015.
- Kumar, A. and S. Peeta. A Day-To-Day Dynamical Model for the Path-Shift Behavior of Drivers under Disequilibrium of Traffic Networks with Fixed Demand. In the proceedings of 93rd Annual Meeting of Transportation Research Board of the National Academies, Washington, D.C., 2014.
- Kumar, A. and S. Peeta. A post-processing technique for the four-step travel demand modeling executed through a feedback loop. *Procedia-Social and Behavioral Sciences*, Elsevier, Vol. 104, pp. 611–620, 2013.
- Kumar, A. and S. Peeta. Strategies to Decrease the Computational Burden of Path-Based Static Traffic Assignment Algorithms. In the proceedings of 92nd Annual Meeting of Transportation Research Board of the National Academies, Washington, D.C., 2013.
- Velaga, N.R. and A. Kumar. Techno-economic Evaluation of the Feasibility of a Smart Street Light System: A case study of Rural India. *Procedia-Social and Behavioral Sciences*, Elsevier, Vol. 62, pp. 1220-1224, 2012.
- Kumar, A. and S. Peeta. An Enhanced Travel Demand Modeling Framework with a Post-Processing Technique Executed through a Feedback Mechanism. 4th Transportation Research Board Conference on Innovations in Travel Modeling (ITM), Tampa, Florida, 2012.
- Kumar, A. and S. Peeta. An Improved Social Pressure Algorithm for the Static Deterministic User Equilibrium Traffic Assignment Problem. In the proceedings of 90th Annual Meeting of Transportation Research Board of the National Academies, Washington, D.C., 2011.
- Kumar, A. Intelligent Incident Management System for a Trans Harbour Link Using Location Technologies. In 3rd International Conference on Positioning, Navigation and Surveying, LOCATION 2008, Noida, India, 2008.
- Kumar, A. and K. V. K. Rao. Study of Impact of ITS Enabled Public Transit System. 11th World Conference on Transportation Research, Berkeley, USA, 2007.
- Kumar, A. and K. V. K. Rao. Uninterrupted Traveler Information System for Transit Busses Using GIS and GPS Integration. In 2nd International Conference on Positioning, Navigation and Surveying, LOCATION 2006, Bangalore, India, 2006.

REPORTS

- Peeta, S., A. Kumar, and S. Sharma. *Post-Processing Techniques to Enhance Reliability of Assignment Algorithm Based Performance Measures*. Publication FHWA/IN/JTRP-2011/19. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2011. doi: 10.5703/1288284314643.
- Peters, J.C., E. Han, A. Kumar, S. Peeta and D. DeLaurentis. *Incorporating High Speed Passenger Rail into a Multimodal Network Model for Improved Regional Transportation Planning*. NEXTRANS Project No. 055PY03. Purdue University Discovery Park, 2014.
- Peeta, S., J.C. Peters, A. Kumar, H. Zheng and S. Agrawal. *Integrated Framework to Capture the Interdependencies between Transportation and Energy Sectors due to Policy Decisions*. NEXTRANS Project No. 079PY04. Purdue University Discovery Park, 2014.

CONFERENCE PROCEEDINGS REVIEWED BY ABSTRACT

- Kumar, A. and S. Peeta. "Entropy Weighted Average Method for the Determination of Unique Path-Flow Solution for Static Deterministic User Equilibrium Traffic Assignment Problem.", INFORMS Annual Meeting, San Francisco, California, USA, 2014.
- Agrawal, S., A. Kumar, H. Zheng and S. Peeta. "Evaluation of Market Penetration Rate of Electric Vehicles on Network Performance.", INFORMS Annual Meeting, San Francisco, California, USA, 2014.
- Kumar, A. and S. Peeta. "Dynamical System Based Formulation to Represent the Day-to-Day Dynamics of Transportation Network under Fixed Demand.", INFORMS Annual Meeting, Minneapolis, Minnesota, USA, 2013.
- Kumar, A. and S. Peeta. "Dynamical System Based Formulation to Represent the Day-to-Day Dynamics of Transportation Network under Fixed Demand.", INFORMS Annual Meeting, Minneapolis, Minnesota, USA, 2013.
- Kumar, A., S. Peeta and Y. Nie. "Investigating the Performance of Path-Based Algorithms for the Static User Equilibrium Traffic Assignment Problem.", INFORMS Annual Meeting, Charlotte, North Carolina, USA, 2011.
- Kumar, A. and S. Peeta. "Disequilibrium to Equilibrium for Transportation Networks with Fixed Demand and Representation of Day-to-Day Dynamics.", INFORMS Annual Meeting, Charlotte, North Carolina, USA, 2011.
- Kumar, A. and S. Peeta. "An Enhanced Transportation Planning Framework with an Improved Traffic Assignment Algorithm Executed with a Feedback Mechanism.", 9th International Workshop on Transportation Planning & Implementation Methodologies for Developing Countries, IIT Bombay, Mumbai, India, 2010.
- Kumar, A. and S. Peeta. "An Improved Traffic Assignment Algorithm that Inherits the Concept of Social Pressure and Slope.", INFORMS Annual Meeting, Austin, Texas, USA, 2010.
- Kumar, A. and S. Peeta. "An Improved Path-based Flow Update Algorithm for the Static User Equilibrium Traffic Assignment Problem.", INFORMS Annual Meeting, San Diego, California, USA, 2009.
- Kumar, A., V. N. Rao and S. L. Dhingra. "Opportunities of Harnessing Emerging ITS Technologies for Transforming Urban and Rural India.", National Conference on Civil Engineering Systems, Osmania University, Hyderabad, India, 2006.

REVIEWER

Journals: *Transportation Research Record, Transportation Letters, Networks and Spatial Economics*

Conferences: *Transportation Research Board (TRB)*

PROFESSIONAL MEMBERSHIPS

- Institute for Operations Research and Management Sciences (INFORMS)
- Institute of Transportation Engineers (ITE), served as the vice president of student chapter, Purdue University (Fall 2009 to Spring 2010)
- Association of Transportation Professionals of Indian Origin (ATPIO)

TECHNICAL SKILLS

Transportation: Transportation Systems Analysis, Urban Transportation Planning, Traffic Engineering, Transportation Systems Evaluation, Engineering Economics, Intelligent Transportation Systems.

Optimization and Systems Analysis: Linear Optimization, Non-linear Optimization, Multi-Objective Optimization, Network Optimization, System of Systems Analysis, Queuing Theory, Computer Algorithms for Systems Analysis.

Statistics and Econometrics: Applied Probability, Transportation Demand and Economics, Advanced Demand Modeling (Regression, Discrete Choice Theory and Analysis, Sampling, Design of Experiments).

COMPUTER SKILLS

Programming: MATLAB, C, C++.

Statistical/Econometrics: Excel, LIMDEP, SPSS, R.

Transportation Planning: TransCAD, Cube, Cube Voyager, VISSIM.

Others: ArcGIS, AutoCAD, MS Office, Adobe Creative Suit.

GRADUATE LEVEL COURSES OF STUDY

TRANSPORTATION ENGINEERING COURSES

- Analysis of Transportation System
- Urban Transportation System Planning
- Regional and Rural Transportation System Planning
- Economic Evaluation and Analysis of Transportation Projects
- Pavement Systems Engineering
- Traffic Engineering
- Transportation Infrastructure Systems
- Comprehensive Urban Planning Process
- Transportation Systems Analysis
- Transportation Systems Evaluation

STATISTICS AND ECONOMETRIC COURSES

- Applied Statistics
- Time Series and Applications
- Statistical and Econometric Methods I
- Statistical and Econometric Methods II

OPERATIONS RESEARCH COURSES

- Optimization Methods for Systems and Control
- Multiple Objective Optimization
- System of Systems Analysis & Design
- Multidisciplinary Design Optimization

HONOURS AND AWARDS

- Best M. S. Thesis Award (2006) at Indian Institute of Technology (IIT) Bombay, Mumbai, India
- Recognized as the “Top Ten Assistant Managers (2006)” in NMSEZ Development Co. Pvt. Ltd., Reliance Group of Companies, Mumbai, India

EXTRA-CURRICULAR ACTIVITIES

- Third prize for photography competition (2000) at Muzaffarpur Institute of Technology, Muzaffarpur, BRA Bihar University, India
- Award for active participation in the state sponsored program “Paryawahan Vahini” of tree plantation and forest preservation (1994) in Kalahandi district, Orissa, India