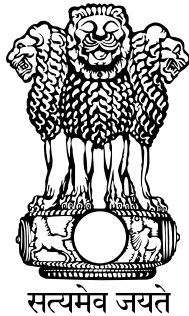

Transportation Systems: Dynamics and Control for Traffic, Vehicles, and Pedestrians

by Pushkin Kachroo, Ph.D., Ph.D., P.E., UNLV

🏠: <https://pushkin.faculty.unlv.edu>



Global Initiative of Academic Network



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Course Details

Venue: Department of Civil Engineering
IIT Delhi

Overview

Transportation is the backbone for the economic and financial well being of any society. Hence, it is essential that the transportation system that involves mobility for goods and people be highly efficient and robust. The two main aspects of transportation are throughput and safety. Throughput measures the quantitative aspect of the efficiency of the system, while safety is related to the qualitative aspect. Unfortunately, transportation systems all over the world are failing in multiple aspects. There are too many congestions that cause very serious loss of productivity. For instance, in the United States of America, every state loses billions of dollars every year in lost productivity due to congestion problems. Similarly, there are too many fatalities every year due to traffic accidents. About 1.35 million people die in road traffic crashes every year world wide and about 150,000 persons die in India alone.

Many technology based solutions are being implemented and developed at a furious pace all over the world. These include using sensors, communications, and control devices in the infrastructure, on the vehicles as well as in person. Vehicle to vehicle (V2V) technologies are coming into vehicles that have a tremendous potential to improve safety and throughput. Most driving tasks are getting progressively automated so that human errors in driving that cause about 70% of accidents as well as congestion problems can be eliminated. Many companies and agencies are developing automated cars. Not only V2V, but also V2I (vehicle to infrastructure), V2P (vehicle to pedestrian), and in general V2X systems are being developed and

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standards established.

This course is designed to teach the dynamics of the traffic system and also how to design controllers for various subsystems. Specifically, the course will address the following topics:

1. Macroscopic Traffic Dynamics (First order and higher order continuum macroscopic traffic models, their derivation, analysis, numerical schemes, and simulation)
2. Mesoscopic Traffic Model (Statistical mechanics based Prigogine traffic dynamics and its relationship to macroscopic and microscopic modeling)
3. Microscopic Traffic Dynamics (Vehicle dynamics, engine, tire and vehicle modeling, engine dynamics, electric motors, hybrid cars, transmission, car following models, automated vehicles)
4. Transportation Control Architecture, sensors, actuators, and processors, Transportation Planning
5. Traffic Control (Ramp metering, traffic routing/diversion, signalized intersection, communications based systems such as signalless automated systems, etc.)
6. Vehicle Control (Traction control, ABS, Adaptive cruise control, string stability, topological platoon control, lateral (steering) control, maneuvers, combined longitudinal/lateral control, etc.)
7. Pedestrian Dynamics and Control

Objectives

1. Exposing participants to the fundamentals of transportation dynamics and control methods
2. Building in confidence and capability amongst the participants in the application of engineering technology in terms of sensors, actuators, processors, software methods and control design principles for transportation problems
3. Providing exposure to practical problems and their solutions
4. Enhancing the capability of the participants to use mathematical modeling and control design techniques to solve traffic and vehicle related problems.

Modules

Prerequisite Modules

Pre-Module A: Calculus Review

Pre-Module B: Ordinary and Partial Differential Equations

Pre-Module C: Overview of Python Language

Pre-Module D: Numerical Methods for Simulations

Pre-Module E: Arduino Board and Embedded Systems Development

Main Modules

Module A: Macroscopic Traffic Dynamics

Module B: Mesoscopic Traffic Model

Module C: Microscopic Traffic Dynamics

Module D: Architecture, electronics, and planning

Module E: Traffic Control

Module F: Vehicle control

Module G: Pedestrian dynamics and control

Who should attend

- Executives, engineers and researchers from transportation sector and government organizations including R&D laboratories.
- Student at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions.

Fees

The participation fees for taking the two-weeks course is as follows:

I. Students:	Rs. 7,500
II. Academic Institutions (Faculty Members):	Rs. 12,000
III. Working Professionals (Research/Industry):	Rs. 20,000
IV. Participants from Overseas:	USD 300

The above fee includes all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hour free internet facility, and one site visit expenses. The participants will be provided with accommodation on payment and first-come-first-serve basis.

The Participation fees for the CEP programmes under GIAN will be accepted only through Demand Drafts drawn in favour of "IITD CEP Account" or e-transfer/RTGS/NEFT. Bank detail are given below: Under:

Bank Account No.	36819334799
Bank Address	State Bank of India, IIT Delhi, Hauz Khas New Delhi-16
MICR Code	110002156
Beneficiary	IITD CEP ACCOUNT
IFSC Code	SBIN0001077
Account Type	Savings

Faculty

Pushkin Kachroo, Ph.D., Ph.D., P.E. is the Lincy Professor of Transportation in the department of Electrical and Computer engineering at the University of Nevada Las Vegas (UNLV). He was the visiting Professor at the University of California at Berkeley in 2013-14 working with Dr. Shankar Sastry. He obtained his Ph.D. in Mechanical Engineering from University of California at Berkeley performing research in Vehicle Control in 1993 under Professor Masayoshi Tomizuka, and obtained another Ph.D. in Mathematics from Virginia Tech in Mathematics in the area of hyperbolic systems of partial differential equations with applications to traffic control and evacuation under Professor Joseph A. Ball. He did his B.Tech. in Civil Engineering from the Indian Institute of Technology Bombay (IIT Bombay) in 1988 under Dr. S. L. Dhingra, where his B. Tech thesis was on operations research methods in transportations. He has authored 11 books on traffic and vehicle control and about 200 publications that include books, research papers, and edited volumes. He was awarded the most outstanding new professor at Virginia Tech, and also has received many teaching awards and certificates both at Virginia Tech and UNLV. More information can be obtained from <http://faculty.unlv.edu/pushkin>.



Geetam Tiwari, Ph.D. (University of Illinois Chicago) is currently a MoUD Chair Professor in Civil engineering and Faculty in Transportation Research and Injury Prevention Programme (TRIPP). Her research interests include Public Transportation Systems modelling, Pedestrian and bicycle infrastructure planning and design and urban and highway traffic safety. Currently she is the Editor-in-Chief of "International Journal of Injury Control and Safety Promotion" (Taylor and Francis)



K. Ramachandra Rao, Ph.D. (IIT Kharagpur) is currently a Professor in Department of Civil Engineering at the Indian Institute of Technology Delhi. His research interests are Traffic modelling, pedestrian dynamics and public transit planning. He is also an Associate Faculty at Transportation Research and Injury Prevention Programme (TRIPP). Prof. Rao has published more than 70 papers in peer reviewed journals and conference proceedings.



Module Details

Module A: Macroscopic Traffic Dynamics

Lecture 1 : Macroscopic traffic dynamics derivation and analysis

Lecture 2 : Numerical Scheme for traffic dynamics

Lecture 3 : Software development for the model

Module B: Mesoscopic Traffic Model

Lecture 1 : Mesoscopic traffic dynamics derivation and analysis

Lecture 2 : Numerical Scheme for traffic dynamics, and software development for the model

Module C: Microscopic Traffic Dynamics

Lecture 1 : Vehicle dynamics, engine, tire and vehicle modeling, engine dynamics

Lecture 2 : Electric motors, hybrid cars, transmission

Lecture 3 : Car following models, automated vehicles

Module D: Architecture, Electronics, and Planning

Lecture 1 : Transportation Control Architecture

Lecture 2 : Electronics (traffic and vehicle sensors, actuators, and processors)

Lecture 3 : Transportation Planning steps and methods

Module E: Traffic Control

Lecture 1 : Ramp metering (Traffic dynamics review, control design, software simulation)

Lecture 2 : Traffic routing/diversion (Traffic dynamics, control design, software simulation)

Lecture 3 : Signalized intersection, and other control methods

Module F: Vehicle Control

Lecture 1 : Traction control (Vehicle dynamics review, control design, software simulation)

Lecture 2 : Adaptive cruise control, string stability, topological platoon control (Vehicle dynamics, control design, software simulation)

Lecture 3 : lateral (steering) control, maneuvers, combined longitudinal/lateral control (Vehicle dynamics, control design, software simulation)

Module G: Pedestrian Dynamics and Control

Lecture 1 : Pedestrian Dynamics (Macroscopic, Microscopic, simulations)

Lecture 2 : Pedestrian Control (Pedestrian dynamics, control design, software simulation)

Time Table

Week 1				
Dec 2	Dec 3	Dec 4	Dec 5	Dec 6
PM A, PM B	PM C, PM D	PM E, M A	M A, M B	

Week 2				
Dec 9	Dec 10	Dec 11	Dec 12	Dec 13
M C, M D	M E	M F	M G	

PM: Pre-module; M: Module
