CE434 (3 0 0 6) - Traffic Analysis and Design

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Tom V Mathew

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1 Announcements

1.1 Lectures notes

1. See the Lecture plan
2. See the relevant lecture notes from the Lecture Notes Page

2 Introduction

2.1 Course contents

Introduction, Basic for traffic engineering; Planning and design of facilities; Travel forecasting principles and techniques; Design Hourly volumes and speed; Highway capacity and performance characteristics; Parking, simulation in Traffic engineering design.

2.2 Lecture schedule: Slot 12

Mon 17:05-18.30

Thu 17:05-18.30

(Contact hours after class)

2.3 Grading

Evaluation mode	Project Mode	Regular Mode
Assignment		10
Project	25	
Quiz	15	20
Mid Sem	25	30
End Sem	35	40
Total	100	100

2.4 Teaching Assistants

1. Sreekumar M (Ph.D)
2. Remya K P (Ph.D)
3. Anna Charly (Ph.D)

3 Evaluation

3.1 Assignments

Instructions: To be announced later

3.2 Course Project

3.2.1 Deliverables

To be announced later

3.2.2 Description

The course project is based on Traffic Engineering principles studied in the class. Use of VISSIM software is encouraged.

1. Decide a traffic situation to study by your own. Collect relevant field data. Assume rest of the data, preferably from books/reports/journal papers. Write the problem statement in your words. Simulate and evaluate the facility, and report the results.
2. Some sample problem statements are below. They are presented in the order of complexity. You may select the one of the following problem, and modify. Or write a problem statement of your own.
3. Identification of a similar study report from published sources (journals, conference, etc.,) before the commencement of the work will be helpful.
4. All field data collected should be preserved, preferably using video.

3.2.3 Topics given in 2014

1. **Modeling traffic stream characteristics:** Typical steps include: Flow and speed data collection from uniform road stretch; Data extraction and analysis; Calibration and validation of some popular stream model; and Simulation of facility in VISSIM and comparison with field data.

2. **Analysis of unsignalized intersections:** Typical steps include: Data collection such as volume, composition, gap acceptance, speed, etc.; Analysis will include determining critical gap and capacity; Suggest possible measures to improve intersection performance; and Demonstration using simulation.

3. **Analysis signalized intersections** Data collection such as geometry, current signal timing plans, volume, saturation flow, and delays. Represent the same in VISSIM after calibration. Suggest improvement of the signal and demonstrate in VISSIM.

4. **Development of PCU values** Develop PCU values of a traffic facility (three lane road, signalized intersection, rotary, etc.) by various methods and study the sensitivity of the vehicle composition using VISSIM.

5. **Traffic management study in VISSIM:** Coordinated traffic signals between IIT Market gate, Main gate and Pizza-hut junction.

6. **Traffic management study in VISSIM:** Traffic signal operations at IIT Main gate junction (including pedestrian).

7. **Traffic management study in VISSIM:** Existing and proposed traffic operation inside IIT Campus (comprising main gate, market gate, KV school, and academic area).

8. **Traffic management study in VISSIM:** Traffic management and vehicle routing problem to eliminate congestion (for example at a railway station or airport).

9. **Traffic management study in VISSIM:** Parking management system: How the parking operation around a facility can be optimally designed.

10. Develop an adaptive or vehicle actuated traffic control algorithm and evaluate using VISSIM. The project involves good understanding of C/C++ or java programming and software inclination.

11. Modeling mixed traffic with discrete choice theory: The project deals with the lateral movements of the vehicles observed more significantly in Indian traffic conditions. Tasks involved: (i) Choice theory formulation using angle based approach (ii) 1 hr Data collection and extraction for estimation of the proposed modeling approach (iii) Validation with 15 min traffic data. Ref: Yasuhiro. S., Teruaki. H., Nobuhiro. U., Hiroshi. S., 2014. Modelling mixed traffic flow with motorcycles based on discrete choice approach. Proceedings of the 93rd Annual Meeting of Transportation Research Board, Washington DC.

12. Calibration of Lane changing model in VISSIM: The project deals with the calibration and validation of lane changing model present in the traffic simulation tool VISSIM with the real world data. Tasks involved: (i) Identification of the lane changing model parameters in VISSIM (ii) Calibration of the parameters using 1hr real world data (iii) Validation of the model with the number of lane changes observed and lane change duration. Ref: Tony Woody, 2006. Calibrating freeway simulation models in VISSIM. MS thesis, University of Washington.

13. Development of headway models for motorcycles in mixed traffic: The project deals with development of multidimensional headway models appropriate for motorcycle movement in mixed traffic conditions. Tasks involved: (i) Data collection on a typical urban road. (ii)Observation of the data collected and identifying the unique travel patterns of two-wheelers (iii) Data extraction for the parameters required to explain the identified patterns (iv) Model estimation using appropriate estimation tools(eg., Bayesian estimation using some available tools) Ref: Lee. T., Polak., J W., Bell. M G., 2009. New approach to modelling mixed traffic containing motorcycles in urban areas. Journal of Transportation Research Board, 2140: 195-205.

14. Development of a car-following model using particle interaction analogy: The project deals with the development of a new car-following model similar to GM model using the dynamics involved in particle interaction system. Tasks involved: (i) Basic theory of particle interaction system (ii) Development of analogy with traffic system (iii) A numerical example illustrating the correctness of the analogy developed (iv)Testing of the model with 15min car-following data collected. Note: The particle interaction is just one of the examples. You can think of any other dynamical system applied in other fields. Motivation of this project: Successful engineers take old ideas from one field and apply it to other fields.

15. Simulate the traffic (both homogeneous and heterogeneous) on a two-lane road of 5 km with a side-road at 3km point. Flow on the side-road can be varied so that the vehicles after the 3km point face congestion. Evaluate the exit flow, density and travel time for the whole section. The simulator should be calibrated using appropriate field data.

16. Simulate the following problem using VISSIM. Consider a long homogeneous freeway of length 20 km. The entrance density is 50 veh/km. Due to an incident near the downstream end of the freeway; the traffic density profile is formed in which a jam-packed condition of 5 km long occurs from 10 to 15 km measured from the upstream entrance of the freeway. In order to release the traffic jam condition downstream, the authority blocks the freeway entrance for 10 min, after which traffic is released again from the freeway entrance at the capacity density of 75 veh/km. After 20 min, the entrance flow returns back to normal with a density of 50 veh/h. Study how traffic density changes at various location of the freeway 10, 30, 60 and 90 minutes. (Bas paper: Transportation Research Part B 42 (2008) 355-372).

17. Simulate the following problem using VISSIM. On Wednesday 9:00 AM, there is an accident on northbound Interstate- 91. The traffic operation center (TOC) has to decide how to clean up the accident. After collecting information and communicate with highway patrol and emergency operator, the TOC determines that there are two alternatives: Alternative 1: Completely shut the Interstate off for 10 minutes, cleanup, and then reopen the Interstate for normal operation, or Alternative 2: Partially open the Interstate at reduced capacity, but the cleanup requires longer time - about 30 minutes - before normal operation can be resumed. One of the concerns at the TOC is how long the queue will spill back because the queue on the Interstate will overflow via ramps and further block upstream surface streets. As a transportation engineering student, you are asked to offer you knowledge to help the TOC make decision. (Base paper: Lecture notes in traffic flow theory by Daiheng Ni, 2012).

References