Advanced Theory of Traffic Flow (CE 391F)

Spring 2013

Instructor: Steve Boyles
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Course Meeting Time and Place: Tuesday and Thursday, 12:30-2:00, ECJ 5.416
Office Hours: Monday and Wednesday, 12:30-2:00 and by appointment
Course Website: `http://webspace.utexas.edu/~sdb382/teaching/ce391f/index.html`

Welcome to CE 391F! This course covers a range of modeling techniques used to represent the flow of vehicles. The course starts with macroscopic models which approximate vehicles as a continuous fluid; this is a major simplification, but yields an elegant theory which has proven useful in practice. Next, the course moves toward more detailed representations of vehicle flow, with brief coverage of vehicle dynamics and driver behavior, followed by cellular automata and car-following models which treat vehicles as discrete entities. The focus of this course is primarily on automotive modes, but the same concepts can be fruitfully applied to nonmotorized modes and mixed traffic streams as well.

Prerequisites

The *only* prerequisite for CE 391F is graduate standing. The course draws on concepts of calculus and differential equations, which will be briefly reviewed as necessary. Some basic experience in computer programming is helpful, but not required. The content on simulators at the end will introduce elementary concepts of number theory.

Course Materials

The primary reading material is the Revised Monograph on Traffic Flow Theory, published by the Transportation Research Board's Traffic Flow Committee. This monograph can be obtained free-of-charge online at `http://www.fhwa.dot.gov/publications/research/operations/tft/`. The monograph will be supplemented by journal papers and lecture notes, as necessary.

Grading

Final course grades are determined by performance on homeworks, an in-class exam, a term project (done in groups of three), and class participation. The weight of each of these factors is as follows:

Category	Weight
Homeworks	30%
Exam	30%
Project	30%
Paper presentation	10%

These components are designed to work together: the exam focuses on concepts, while the course project involves application and skills involved in engineering practice. The homeworks and lectures give you a chance to learn these skills and practice them throughout the semester. Around mid-semester, each student will choose one technical paper to present to the class in the format of an instructional lecture.

Five homeworks will be assigned throughout the semester, each worth 6% of your final grade. Homeworks are assigned, collected, and returned on a two-week cycle. Each homework will be graded and returned before the next is assigned. Parts of assignments involving computer work (including spreadsheets or graphs) will need to be typed (although you are certainly welcome to type the rest of the assignment as well!). You are encouraged to work together on homeworks, but you must submit solutions in your own words. These homeworks will require a significant amount of time and effort do not wait until the night before to start! Late homeworks are only accepted if you notify me of a time conflict or need for extension before the due date.

The exam will take place before the end of the semester, and is comprehensive. No final exam is scheduled during finals week. This exam is open-book and open-notes, and no calculators will be needed.

The project will culminate in oral presentations and a written report, both due in the last week of class. Potential project topics include application of one or more traffic flow models to a real-world scenario, presenting one or more important journal papers (please discuss with me beforehand), computer implementation of a model presented in class, or another related topic of interest. Please send your project topic to me for approval by March 31 at the very latest, but you are strongly encouraged to start earlier. At the end of the semester, you will be required to present your project to the rest of the class, and complete a written report documenting all of your work.

Miscellanea

The standard instructor and course evaluation survey will be distributed near the end of the semester.

From the 1st through the 4th class day, graduate students can drop a course via the web and receive a refund. During the 5th through 12th class day, graduate students must initiate drops in the department that offers the course and receive a refund. After the 12th class day, no refund is given. No class can be added after the 12th class day. From the 13th through the 20th class day, an automatic Q is assigned with approval from the Graduate Advisor and the Graduate Dean. From the 21st class day through the last class day, graduate students can drop a class with permission from the instructor, Graduate Advisor, and the Graduate Dean. Students with 20-hr/week GRA/TA appointment or a fellowship may not drop below 9 hours.

The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. For more information, contact the Division of Diversity and Community Engagement, Services for Students with Disabilities, 471-6259 (voice) or 232-2937 (video phone) or `http://www.utexas.edu/diversity/ddce/ssd`.

Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. For further information, please visit the Student Judicial Services website at `www.utexas.edu/depts/dos/sjs/`.

Schedule

A tentative class schedule is shown below. All dates and topics are subject to change.

Tuesday	Thursday
Jan 15th **No class: TRB**	17th **1** Course orientation and overview
22nd **2** Introduction to traffic flow models and applications.	24th **3** Lighthill-Whitham-Richards model
29th **4** Newell's method	31st **5** Daganzo's variational method

Tuesday		Thursday	
Feb 5th Cell transmission model	**6**	7th Lagrangian-time reformulation	**7**
12th Lagrangian-space reformulation	**8**	14th Calibrating the LWR model	**9**
19th Higher-order continuum models	**10**	21st Higher-order continuum models	**11**
26th Two-fluid theory	**12**	28th Two-fluid theory	**13**
Mar 5th Paper presentations	**14**	7th Paper presentations	**15**
12th **No class: Spring break**		14th **No class: Spring break**	
19th Driver performance	**16**	21st Vehicle performance	**17**
26th Fuel consumption	**18**	28th Basic car following models	**19**
Apr 2nd Steady-state flow	**20**	4th Cellular automata	**21**
9th Cellular automata	**22**	11th Basic queueing theory	**23**
16th Gap acceptance	**24**	18th Multiple interacting streams	**25**
23rd Developing a simulator	**26**	25th Variance reduction techniques	**27**
30th **Semester Exam**	**28**	May 2nd Project presentations	**29**