BERGISCHE UNIVERSITÄT WUPPERTAL

Microscopic Modelling and Simulation

Basic information

Master:	Verkehrswirtschaftsingenieurwesen	Bauingenieurwesen
Mandatory/optional:	Mandatory	Optional
Workload:	6 LP / 180 hours	3 LP / 90 hours
Requirements	Written exam (60 min, 4 LP) Homework (without grade)	Written exam (60 min, 3 LP)
Duration of module:	1 Semester	
Recommended semester:	2nd Semester	
Frequency:	Every second semester (summer semester)	
Can be repeated:	Twice (exam)	
Components	• Fundamentals of microscopic modeling and simulation of traffic • Types of models • Stochastic • Measures of error	

Instructors

Lectures: Univ.-Prof. Dr.-Ing. Heather Kaths (Chair of Bicycle Traffic)

Appointments upon request per email
Room: HD 34

Exercises: Daniel Muthmann from PTV

Student support: Danil Belikhov, research associate at the Chair of Bicycle Traffic

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Room: HD 34

Learning Objectives / Learning Outcomes - Overview

Content and Learning Objectives: Students will learn the fundamentals of microscopic traffic simulation and can create a model of a simple intersection using the simulation software PTV Vissim.

Lernergebnisse: Students will:

- Understand the concepts of model and simulation in general and in relation to transportation.
- Know the different scales of modeling and simulation (macroscopic, mesoscopic, and microscopic) and when each type of model should be used.
- Understand the types of field data required to create, calibrate, and validate a microscopic traffic simulation model.
- Be able to create a simple model using the microscopic simulation

software PTV Vissim, including road network, traffic demand, and realistic behavior of road users.
- Understand the concepts of calibration and validation and apply simple approaches to both.
- Understand how to use a calibrated and validated simulation model to conduct a traffic study and calculate the number of required simulation runs.
- Familiarize themselves with the microscopic traffic simulation software Aimsun and SUMO.

Moodle

All materials for the microscopic modeling and simulation course will be posted on Moodle. Moodle will also be used to communicate with students about anything that might come up in the semester.

Important dates 2025

- First lecture: April 1st, 2025
- Last lecture: July 8th, 2025
- Homework due (VWing): July 31st, 2025
- Exam: TBD

Lectures will take place on Tuesdays from 10 am – 11:30 am in room HC.01.38. Exercises will take place in the same room from 10 am – 12 pm.

Software

The exercises of this course will be performed using the microscopic traffic simulation software PTV Vissim. Licenses are available to students to download on their personal computers. You will need to have PTV Vissim up and running on your laptop at the start of the exercise on April 16th. Information about the PTV Vissim licenses will be posted on Moodle.

Schedule 2025

Date	What	Who
08.04.2025	Lecture 1: Introduction	Heather Kaths
15.04.2025	Exercise 1 (10 am – 12 pm)	Daniel Muthmann
22.04.2025	Exercise 2 (10 am – 12 pm)	Daniel Muthmann
29.04.2025	Lecture 2: Microscopic traffic simulation models	Heather Kaths
06.05.2025	Exercise 3 (10 am – 12 pm)	Daniel Muthmann
13.05.2025	Lecture 3: Simulation experiments and data / Simulating pedestrians and cyclists	Heather Kaths
20.05.2025	Lecture 5: Simulating intersections / Traffic assignment and route choice / intro to homework	Heather Kaths
27.05.2025	Exercise 4 (10 am – 12 pm)	Daniel Muthmann
03.06.2025	Lecture 6: Calibration and validation	Heather Kaths
17.06.2025	Open office (work on homework assignment)	Danil Belikhov

24.06.2025	Lecture 7: Alternative analysis	Heather Kaths
01.07.2025	Open office (work on homework assignment)	Danil Belikhov
08.07.2025	Lecture 8: Simulation software / Exam review	Heather Kaths
15.07.2025	Open office (work on homework assignment)	Danil Belikhov
TBD	EXAM	

Important resources (on Moodle)

1. Barceló J (2010) *Fundamentals of Traffic Simulation*. New York: Springer-Verlag.
2. Bungartz H-J, Zimmer S, Buchholz M, et al. (2009) Modellbildung Und Simulation: Eine Anwendungsorientierte Einführung. Springer-Verlag.
3. Forschungsgesellschaft für Straßen- und Verkehrswesen, Hinweise zur mikroskopischen Verkehrsflusssimulation: Grundlagen und Anwendung, vol. 388. FGSV Verlag, 2006.
4. R. Dowling, A. Skabardonis, and V. Alexiadis, “Traffic Analysis Toolbox Volume III : Guidelines for Applying Traffic Microsimulation Modeling Software,” Rep. No. FHWA-HRT-04-040, U.S. DOT, Fed. Highw. Adm. Washington, D.C, vol. III, no. July, p. 146, 2004.

Additional materials will be made available for each of the lecture topics.