

## Course

# Network Traffic Flow Operations, Management and AI

Novel perspectives on network traffic flow theory for transportation networks

<b>Date:</b>	<b>24 - 26 July 2023</b>
<b>Time:</b>	<b>09.30 – 12.30 h.</b>
<b>Location:</b>	<b>AMS Institute (Amsterdam)</b>
<b>Course leaders:</b>	<b>Prof. Serge Hoogendoorn &amp; Prof. Hans van Lint</b>
<b>Lecturers:</b>	<b>Dr. Marco Rinaldi, Dr. Panchamy Krishnakumari and Guests</b>
<b>Days:</b>	<b>3</b>
<b>ECTS:</b>	<b>1 (attendance only)   2 (attendance + passing assignment)</b>
<b>Course fee:</b>	<b>free for TRAIL/Beta/OML members, others please contact the TRAIL office</b>
<b>Registration:</b>	<b><a href="http://www.rstrail.nl">www.rstrail.nl</a></b>

### Objectives

- Remember and understand the key (definitions of) characteristics and phenomena of traffic flow in networks; analyze data revealing relations between different flow characteristics.
- Understand and apply advanced data analysis techniques, and analyze their application on network traffic flow data.
- Learn how to apply AI techniques for microscopic and macroscopic model estimation, identification, clustering, prediction, and visualization, specifically for traffic operations.

### Course description

This course is about the empirics of traffic flows in multimodal networks and how to better understand and predict these using state-of-the-art AI techniques. Starting from the fundamentals of traffic flow, we will jointly investigate simple and complex relations between the variables describing the operations in a network via advanced statistical methods.

### Program

Empirics of network traffic flow theory:

- Data collection for multi-modal network traffic flows
- Empirical relations in network traffic data (e.g. fundamental diagram (for networks))
- Active modes traffic empirics

Short recap of Fundamentals of traffic flow theory:

- Inductive vs deductive science
- Microscopic models, macroscopic models, and their relations (multi-scaling)
- A multi-modal perspective to traffic flow theory

Applications of AI in network traffic flow operations

- AI and traffic flow theory: two peas in the same pot?
- Structures in data, identification of dynamic relations
- Examples of AI and model-based data assimilation (estimation, prediction, control)
- Examples of AI for model identification
- AI and traffic flow prediction
- AI and traffic management
- Visualisation techniques

**Assignment**

During the course, participants get to work on different datasets and apply the various methods taught. More specifically, we will look at PT network data, microscopic data from controlled cycling experiments (gap acceptance modelling), data from train platforms from the Smartstation system, data from the Outdoor Mobility Digital twin, and freeway network data. It is also possible to bring your own dataset.

**Methodology**

We will use a combination of lectures and assignments.

- Lectures (12 hours)
- Practical using Matlab or Python (12 hours)

**Prerequisite**

- Understanding of traffic flow theory fundamentals
- Understanding of statistical techniques (e.g. multivariate regression theory)

**Course material**

- Papers
- Lecture slides