

Following presentation file is produced under the Central Baltic project IntelTrans 2020 - 2022. The aim of the project is creating a joint Intelligent Transport and Traffic Management study module (15 ECTS) and pilot it with multinational groups of students, together with methodology and materials that are applicable and replicable outside current partnership.

The review of software designed to simulate traffic flows at the micro level.

Software for modelling traffic flows is usually divided into programs related to micro-mesa and macro levels of modelling and software that supports several levels at once. At the micro-level, vehicles are considered as individual entities with their characteristics and behaviour. Here, the "reasonable driver" models prevail, in which the acceleration of a car is described by some function of the speed of this car, the distance to the vehicle in front, and the speed relative to the flow leader. At the meso-level, individual vehicles are not modelled, but the behavioural characteristics of drivers are considered. This level includes cluster models that operate with groups of vehicles moving at approximately the same speed at a short distance from each other and models that use probability distributions to describe the speeds of vehicles on certain road sections. At the macro level, the transport network is considered a single whole, and the flows of cars are regarded as flows of particles in the liquid.

In the context of this review, only complexes of micro-level modelling of traffic flows are considered. The table of reviewed software packages is presented below.

Number:	Software:	Country:	Released:
1	Aimsun	Spain	1997
2	TSIS-CORSIM	USA	1970
3	DYNASIM	France	1994
4	MATsim	Switzerland	2016
5	Quadstone Paramics	United Kingdom	1990
6	Sidra Intersection	Australia	1984
7	TransModeler	USA	2005
8	SUMO	Germany	2001
9	VISSIM	Germany	1992
10	AnyLogic	International	2003

Packages for macro-and mesomodelling make it possible to solve such problems as planning of transport infrastructure and public transport, graphical processing of a network, analysis and assessment of transport networks, forecasting of planned activities, and creating a platform for transport information systems. Traffic micro modelling packages are developing intensively due to the growth of computing power, 3D visualization capabilities and processing of the large amount of available data collected from millions of vehicles. This allows users to receive and take into account data on the speed and routes of vehicles.

1. Aimsun traffic simulations software

Aimsun Live is a one-of-a-kind solution that combines artificial intelligence technology with real-time simulation data. This software and its functionality can be easily integrated into traffic control centres, simulating the movement of vehicles and pedestrians filling a transport network of any size, from several highway lanes to the scale of an entire city. The Aimsun software package can compare different change strategies (scenarios) thanks to the ability of Aimsun Live to synthesize a vast number of analytical and simulated results, offering as results a broad sector of unique performance indicators. This, in turn, allows the user to obtain important information with the help of which it is possible to choose favour of the best and most effective strategy. The powerful and unique combination of network modelling and advanced data analytics has tremendous benefits for:

- Incident management;
- Smart highway applications;
- Air quality management;
- Congestion pricing;
- Real-time transportation information;
- Multimodal rerouting.

2. TSIS CORSIM traffic simulation software

CORSIM (development began over 30 years ago through the efforts of the Federal Highway Administration). Traffic Software Integrated System – Corridor Simulation TSIS is an integrated modelling environment that enables users to conduct traffic operations analysis. Built using a component architecture, TSIS is a toolbox that allows the user to define and manage traffic analysis projects, model traffic networks, create inputs for traffic simulation analysis, run traffic simulation, and interpret the results of those models. CORSIM is a microscopic traffic simulation capable of modelling surface streets, freeways, highways, and integrated networks, including segments, weaves, merge/diverges, and intersection: stop/yield sign, traffic signals. With the help of the software complex, it is possible to simulate traffic and traffic control systems using proven and research-based models of the behaviour of vehicles and drivers in the transport flow.

CORSIM is a microscopic traffic simulation tool, which replicates driver behaviour and the interaction between vehicles individually in small time steps within a model network. In a microsimulation tool, many parameters are stochastic and realistic, and the tool can simulate the interaction between different network elements, such as urban arterials and freeways.

According to the Federal Highway Administration (FHWA), TSIS-CORSIM has been used by FHWA for conducting research and applied by thousands of practitioners and researchers worldwide over the past 30 years, embodying a wealth of experience and maturity. The results of reviews in scientific publications establish the need for detailed model analysis and the importance of the model validation procedure. Three types of objects were compared during the simulation: motorways, interchanges, and highways with matching indicators. It is concluded that CORSIM is the most mature and widely used package. It was also found that the software under study cannot model traffic in congestion conditions.

3. Dynasim traffic simulation software.

Dynasim is the leading multi-mode micro modelling software. Dynasim allows users to quantify, simulate, and visualize 2D and 3D movements by displaying user behaviour (cars, trucks, buses, trams, bicycles, pedestrians, trains, ships, etc.). The user, guided by an intuitive and user-friendly graphical interface, quickly simulates all types of road development, from basic to complex. Numerous engineering consulting firms and communities worldwide have retained Dynasim since 1994.

Using this software package, it is possible to perform testing procedures for various transport planning strategies by checking many assumptions (network, flow, synchronization of traffic signals), avoiding file copying, redundant model editing, and managing and updating simulation results. Include directly flow data (counts, matrices, third party software). The functional advantage of this software is the ability to copy simulation results (tables, shapefiles, graphs), then insert and link the files directly with your documents, automatically taking into account each update of the simulation results.

4. MATsim traffic simulation software.

MATSim provides a framework for implementing large-scale transport simulations based on modelled agents (vehicles, pedestrians) acting in the system. The framework consists of several modules that can be combined or used separately. Modules can be replaced with custom scripts to test specific aspects of user work.

- Simulate whole days within minutes;
- Both private cars and transit traffic can be simulated;
- MATSim can simulate millions of agents or massive, detailed networks.

5. Paramics Microsimulation

Paramics Modeller (Quadstone Paramics, Great Britain). Initially developed by SIAS Ltd, Paramics Microsimulation has been at the forefront of microsimulation since the 1990s. S-Paramics (the original) and Paramics Discovery (the new) have been used on thousands of transport planning projects for over 20 years.

Paramics Microsimulation is the state of the art traffic modelling software to enable transport professionals to design, evaluate and present solutions. Paramics Microsimulation offers fast network construction, editing, visualization and simulation. Fewer parameters are required for calibration than other products. Streamlined workflow to match users project workflow. Easy to understand outputs for users.

6. Sidra Intersection traffic simulation software.

Realistic traffic analysis of closely spaced intersections requires driver lane use behaviour modelling. This is lacking in software that uses traffic modelling based on lane groups.

SIDRA INTERSECTION is a unique lane-based model that can identify the backward spread of congestion, midblock lane changes and unequal approach lane use at closely-spaced

“Intelligent Transport and Traffic Management study module (IntelTrans)”



intersections. Capacity and performance results presented in detailed output reports and graphical displays provided by SIDRA INTERSECTION help you assess the accuracy of your convergence and network models.

Lane use of traffic is a fundamental factor affecting the model estimates of capacity and level of service, delay, queue length, stop rate, fuel consumption and emissions, travel time and network efficiency, and signal timing results.

7. TransModeler traffic simulation software.

TransModeler is a powerful and versatile traffic simulation package applicable to many traffic planning and modelling tasks. TransModeler can simulate all kinds of road networks, from freeways to downtown areas, and analyze wide area multimodal networks in great detail and high fidelity. Users can model and visualize the behaviour of complex traffic systems in a 2-dimensional or 3-dimensional GIS environment to illustrate and evaluate traffic flow dynamics, traffic signal and ITS operations, and overall network performance.

TransModeler breaks new ground in ease-of-use for complex simulation applications and integrates with TransCAD, the most popular travel demand forecasting software in the U.S., to provide a complete solution for evaluating the traffic impacts of future planning scenarios. Moreover, the TransModeler mapping, simulation, and animation tools allow the user to present study findings to decision-makers clearly and compellingly.

TransModeler employs advanced methodological techniques and software technology to bring traffic simulation into a new era based on the latest research. TransModeler models drivers' dynamic route choices based on historical or simulated time-dependent travel times and models trip based on origin-destination trip tables or turning movement volumes at intersections. It simulates public transportation and car and truck traffic and handles many ITS features such as electronic toll collection, route guidance, and traffic detection and surveillance. TransModeler works with travel demand forecasting software to provide an integrated capability to analyze transportation projects and plans. Traffic simulation results can also be fed back in travel demand forecasting.

8. SUMO traffic simulation software.

SUMO (Germany; package for modelling broadband backbones) The source code is available for download, modification, and there are versions of the package for several popular operating systems.

SUMO is a free and open-source traffic simulation suite. It has been available since 2001 and allows modelling of intermodal traffic systems - including road vehicles, public transport and pedestrians. Included with SUMO is a wealth of supporting tools that automate core tasks for creating, executing, and evaluating traffic simulations, such as network import, route calculations, visualization, and emission calculation. SUMO can be enhanced with custom models and provides various APIs to control the simulation remotely.

- SUMO has been used within several projects for answering a large variety of research questions;

- Evaluate the performance of traffic lights, including the evaluation of modern algorithms up to the assessment of weekly timing plans;
- Vehicle route choice has been investigated, including the development of new methods, the evaluation of eco-aware routing based on pollutant emission, and investigations on network-wide influences of autonomous route choice;
- SUMO was used to provide traffic forecasts for authorities of the City of Cologne during the Pope's visit in 2005 and during the Soccer World Cup 2006;
- SUMO was used to support simulated in-vehicle telephony behaviour to evaluate GSM-based traffic surveillance performance.

9. Vissim traffic simulation software.

PTV Vision (PTV Group, Germany; the main components of PTV Vision - software products VISUM and VISSIM), the source code is not available for modification or research. These packages are implemented for the Windows operating system.

PTV Vissim has established itself as the global standard for traffic and transport planning: it provides the user with a realistic and detailed overview of the current state of traffic flow and the consequences of planned changes, with the ability to define multiple "what if" scenarios. With the embedded modelling concept (link and connector) in PTV Vissim, the user can display the transport network in detail and model various geometric shapes - from a standard node to complex intersections. As part of the PTV Traffic Suite, you can seamlessly connect the traffic simulation software to other PTV software solutions (VISSIM, VISUM, VISTRO etc.). In addition, the common COM interface also allows you to interact with external applications. PTV Vissim is a flexible software that helps turn microscopic simulation and planning into a stable test environment for traffic simulation.

This traffic simulation software is easy to use and requires no additional programming skills. PTV Vissim is the most reliable software for microscopic, mesoscopic and even combination (hybrid modelling). PTV Vissim has over 16,500 users worldwide (companies and organizations). PTV has more than 40 decades of experience in transport strategies and transport solutions.

During repeated studies and reviews by the scientific community, the choice of many authors, in comparison with the CORSIM and Quadstone Paramics packages, settled on the VISSIM package, which supports the vast possibilities of 3-D visualization of traffic flows. Three types of objects were compared during the simulation: highways, interchanges, and highways with signal matching. It is concluded that VISSIM is the most powerful and versatile. The study also showed that VISSIM has a minor user-friendly interface and does not require additional effort to presentation of post results.

10. Anylogic traffic simulation software.

AnyLogic Simulation provides a traffic library to simulate traffic flows, providing the most efficient traffic design and analysis. Clear visualization in traffic modelling, density maps, congestion highlights, and animation showing traffic flow and bottlenecks facilitates productive work and subsequent analysis of results. The freedom to experiment and optimize accurate models with traffic simulation software provides the best platform for successful traffic planning and design. AnyLogic is used for:

- a) traffic planning, the simulation of changes, additions, or subtractions to a road network;

“Intelligent Transport and Traffic Management study module (IntelTrans)”



- b) throughput analysis, including generating statistics for congestion and traffic jams;
- c) traffic light timing and sequencing to develop comprehensive system optimization;
- d) integrating shared objects and buildings into road networks, traffic impact assessment.