PEDESTRIAN DYNAMICS®

Pedestrian Dynamics® crowd simulation software is the ultimate tool to model, analyze, optimize and visualize pedestrian crowds in any infrastructure.

APPLICATION AREAS

Pedestrian Dynamics® is applicable in a wide scale of domains:

- Stadiums & Arenas
- Museums & Exhibitions
- Events
- Theme Parks
- Shopping Malls
- Cities
- Airports
- Railway Stations
- Passenger ships

Pedestrian Dynamics® Crowd Simulation Software

INTRODUCTION

Pedestrian Dynamics® is an extensive and user friendly crowd simulation software application. It is designed for the creation and execution of large crowd simulation models in complex infrastructures. It can be used to evaluate the performance and safety of your environment in every phase of the life cycle; from design to operations.

Pedestrian Dynamics® enables you to:

- Offers a rapid model building environment which saves time and costs. Only a few steps are required to model most complex operations.
- Is flexible, robust and easy to use.
- Has been used widely in many large scale projects in most critical infrastructure environments including stadiums, airports, public transport terminals, mega events and urban planning.

Contact us for more detailed information or a demonstration of Pedestrian Dynamics®.

- www.pedestrian-dynamics.com
- www.twitter.com/pedestriandynam
- siminfo@incontrolsim.com

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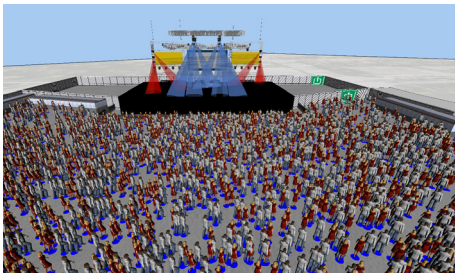
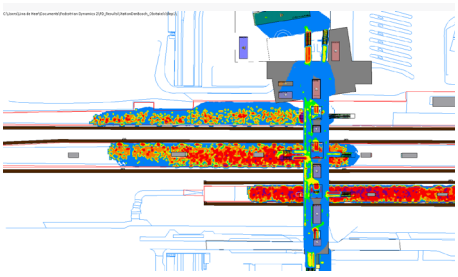
1. BENEFITS & KEY FEATURES





With Pedestrian Dynamics® you can easily simulate large crowds and determine the density within the infrastructure.

BENEFITS

Pedestrian Dynamics® crowd simulation software has a proven track record to analyze and optimze large crowd flows. Crowd simulation enables you to:

Decrease costs: by optimizing the infrastructure during the design phase, high additional costs can be avoided during the operations.
Regulation compliance: help evaluate and address regulatory compliance with local and international safety mandates and norms.
Predict & anticipate: the model enables you to predict the crowd flows and anticipate.
Analyze the risk: analyze the risk and the safety of people and infrastructures in every phase of the life–cycle; from design to operation.
Optimize Evacuation: Develop, test and optimize evacuation and data–driven response plans.
Answer "What If": Quickly compare alternative designs and scenarios on–the–fly.
Improve commerce: Increase customer satisfaction by improving pedestrian flows, experiences and comfort and identify the commercial attractiveness of locations by flow measurements.
Present & convince: Effectively communicate with all stakeholders in the decision making process.
Operate efficiently: Optimize and increase operational efficiency within the given environment and with available resources.

KEY FEATURES

Pedestrian Dynamics® offers:

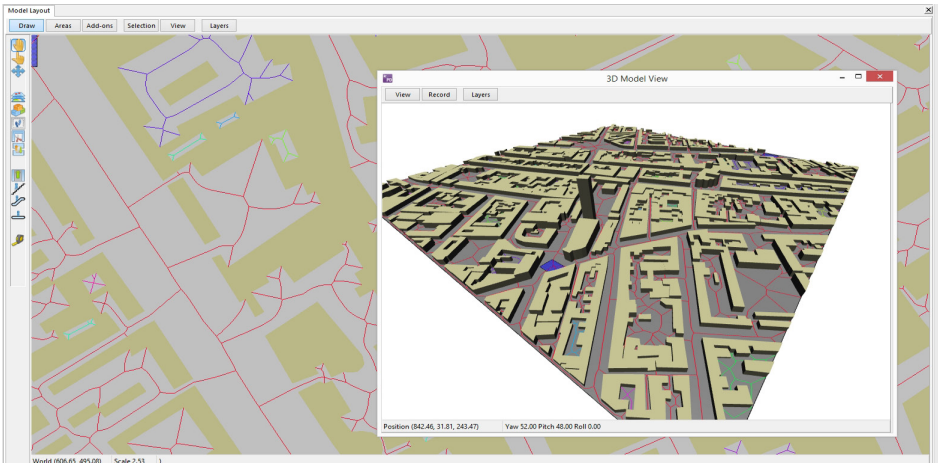
- Import of industry standards (CAD/CAD 2015, XML, CityGML and many more)
- Integrated 2D&3D models
- Fast simulation runs
- Simulation of large realistic crowds up to 100,000
- Explicit Corridor Mapping (ECM)
- Extensive set of model drawing tools
- Unique agent properties
- Domain specific elements
- Easy scenario definition
- Intelligent dynamic routing
- Microscopic and mesoscopic
- Integrated output module with automatic report generation.
- Easy movie playback and recording

2. FEATURES

USING PEDESTRIAN DYNAMICS®

When the scope and purpose have been defined, performing and evaluating a crowd simulation can in general be divided in four phases. The following unique features of Pedestrian Dynamics® support you in each of these phases.

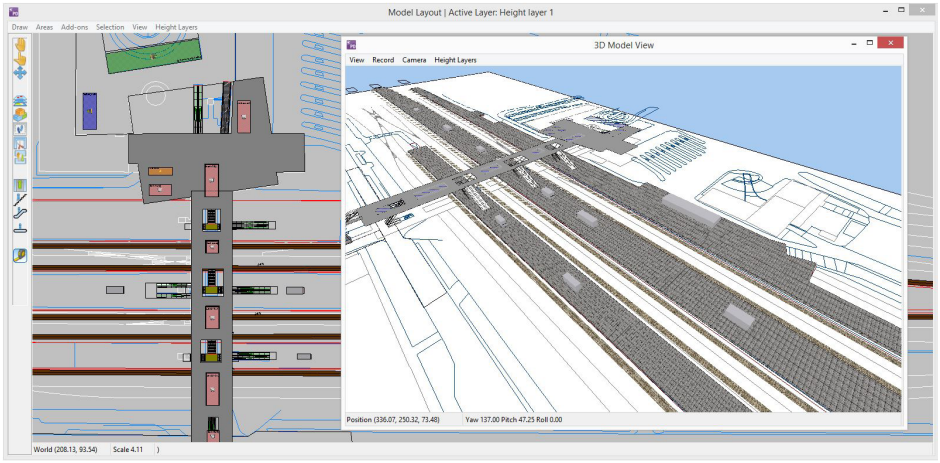
FAST MODEL CREATION



Quickly generate an environment by applying Exact ECM.

ECM

By applying Explicit Corridor Map (ECM) technology the software automatically creates a unique innovative data structure which represents the continuum walkable space of a multi-layered environment. This state-of-the-art technology originates from the advanced gaming industry and allows Pedestrian Dynamics® to quickly steer and generate paths for a large number of people.



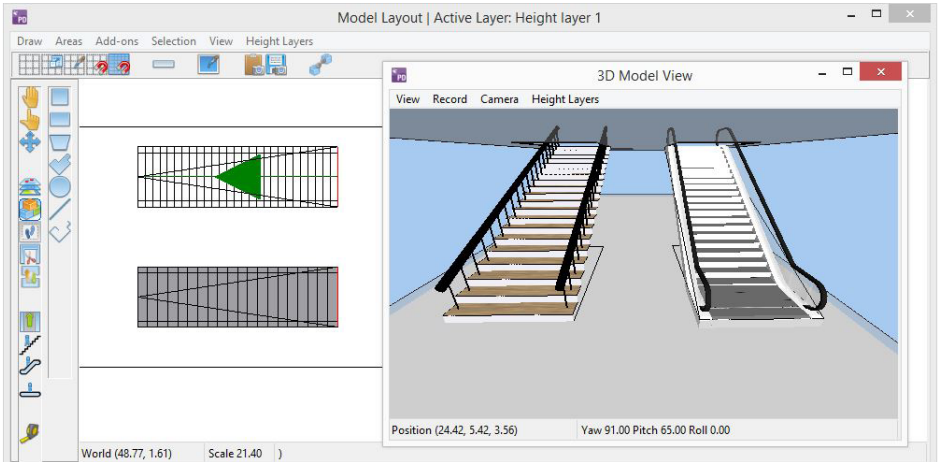
Import industry standards, for example CAD.

MODEL IMPORT

Object import enables you to build your environment automatically from a file, e.g. CityGML, CAD/DXF, XML, ADO, ActiveX, 3DS and many other industry standards. This significantly reduces the time to build up your model.

VISUALIZATION

Integrated 2D and 3D modelling and viewing.



Pedestrian Dynamics® contains an extensive set of drawing tools.

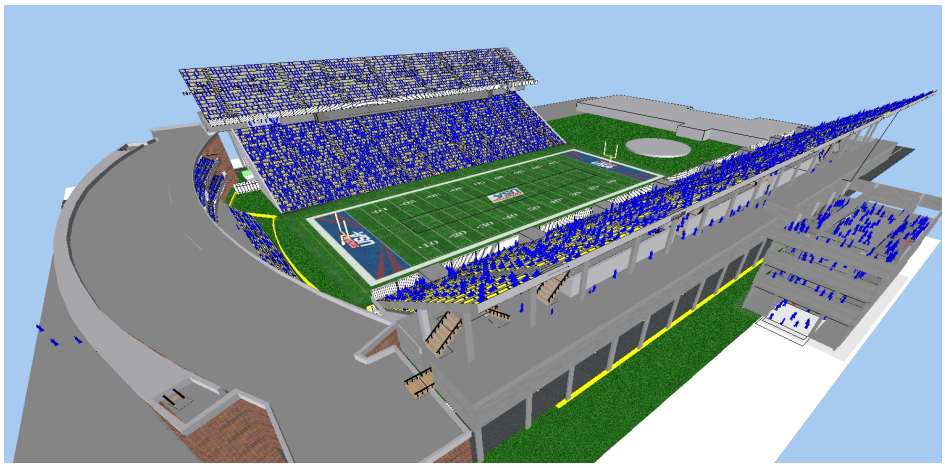
DRAWING TOOLS

Contains an extensive set of drawing tools to create, modify and classify infrastructural elements and activity locations within an environment. Graphical user interfaces are used to modify specific properties.

DOMAIN SPECIFIC ELEMENTS

STADIUM ELEMENTS

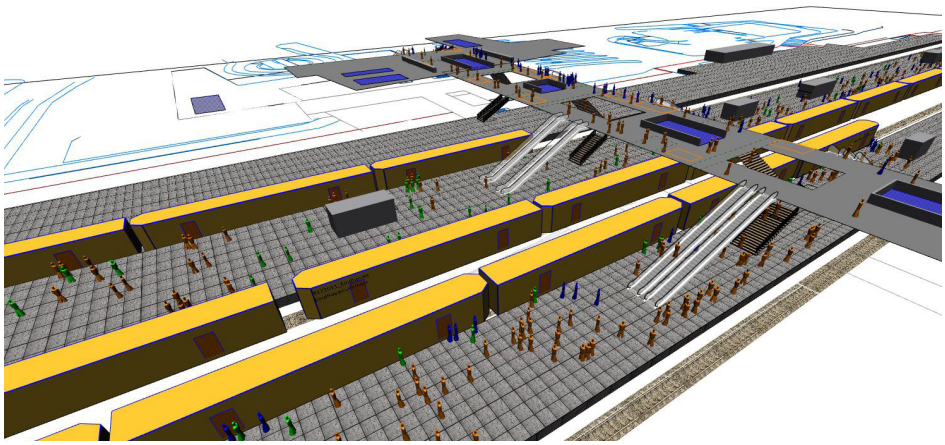
The stadium elements enable you to model tribune stands. You can develop a complete stadium model, by analyzing the crowd flows from the entrance to the seats.



Stadium elements.

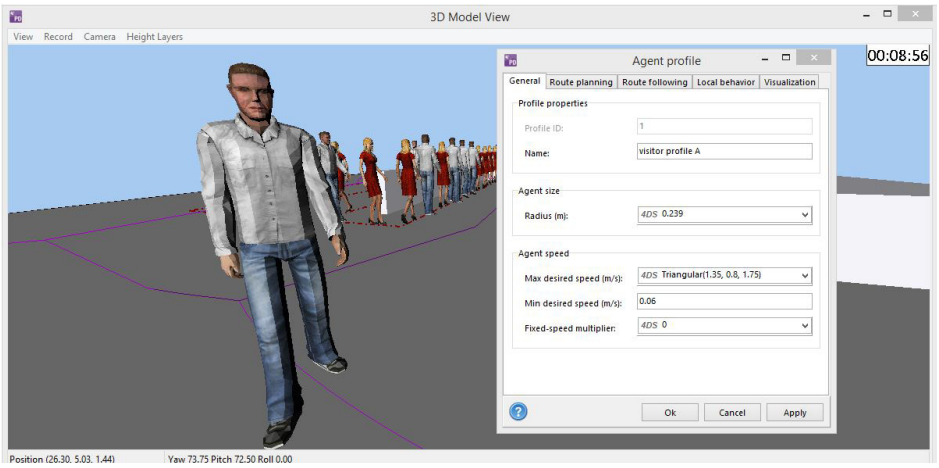
TRANSPORTATION ELEMENTS

Transportation elements enable you to model the arrival and departure of transportation objects like trains, buses, trams. Including the boarding and disembark behaviour of the passengers. You can develop complete railway station models.



Transportation elements.

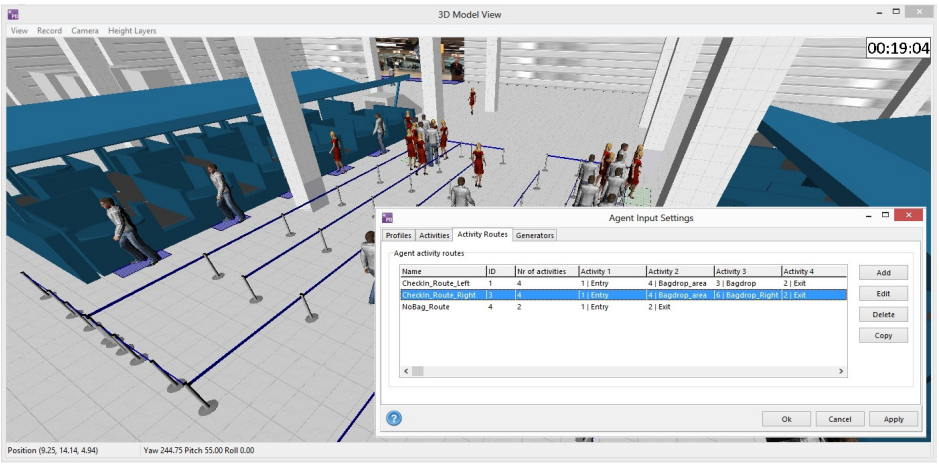
SCENARIO PREPARATION



Each agent contains unique properties.

AUTONOMOUS AGENTS

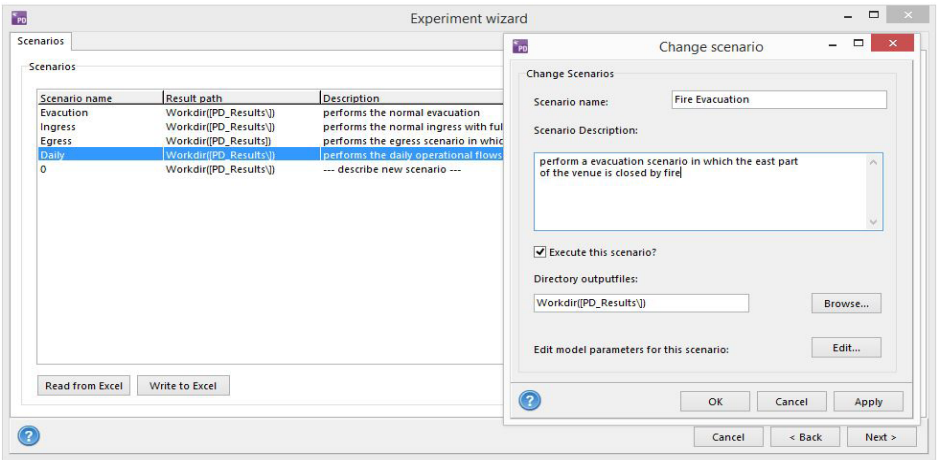
People are represented by autonomous agents. Each agent contains unique properties and preferences which are generated from a group profile. The intuitive graphical user interface makes it easy to define group profiles with predefined rules as well as user defined rules.



Activity planning and scheduling.

ACTIVITY PLANNING AND SCHEDULING

The global routing of people is based on activity planning and scheduling. Within the simulation people are routed between an activity goal and a destination.



Experiment wizard.

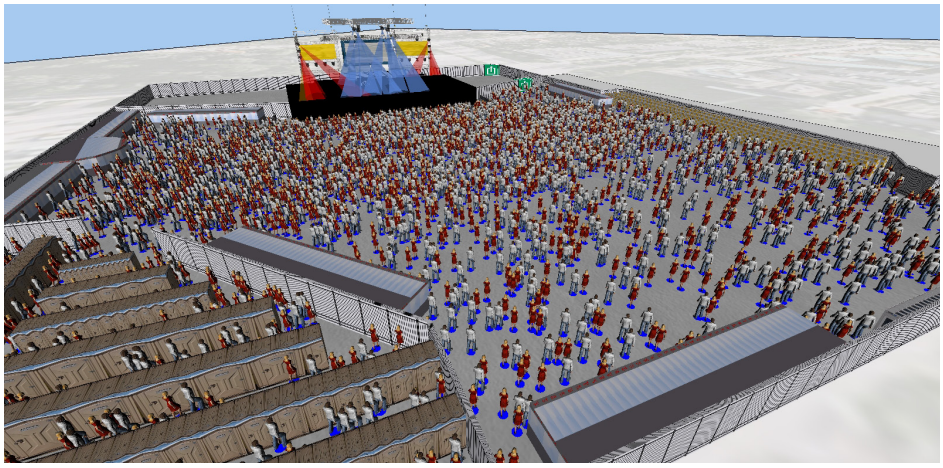
EXPERIMENT WIZARD

The experiment wizard for setting up multiple scenarios with different properties saves you valuable experimentation time. The scenarios can be run subsequently.

4D SCRIPT

Besides a large number of predefined rules all settings are fully customizable. A powerful and easy to use scripting language gives you the possibility to easily define your own rules and settings.

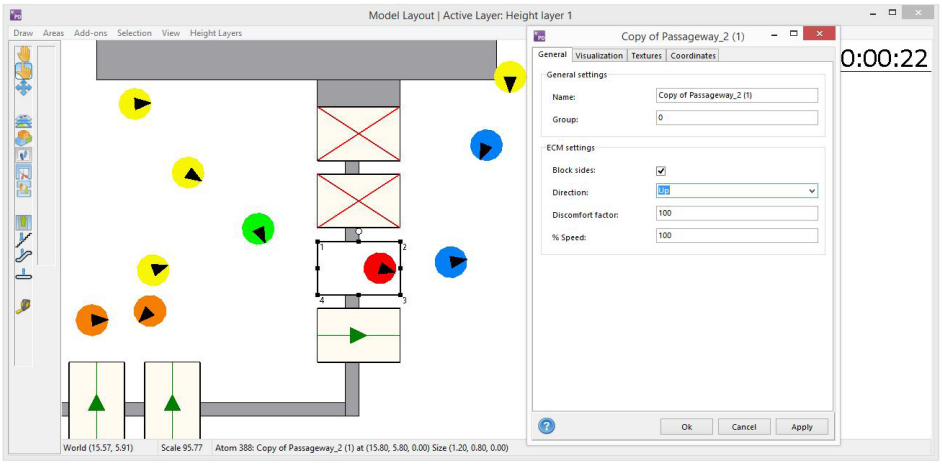
SIMULATION AND VISUALIZATION



Simulation of large crowds.

LARGE CROWDS

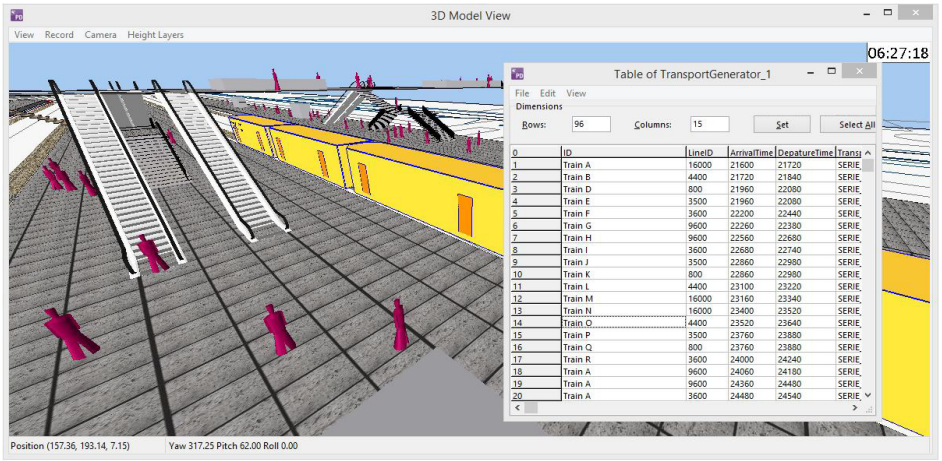
Dynamic routing and steering of a high volume of people.



Change models on the fly.

MODIFY ON THE FLY

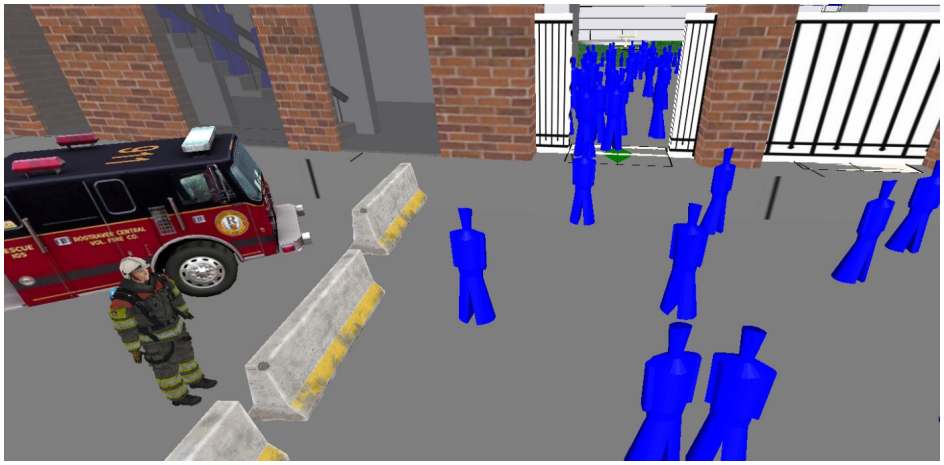
Change the settings of your model on the fly during the simulation.



Combines agent based and discrete event simulation.

AGENT BASED AND DISCRETE EVENT SIMULATION

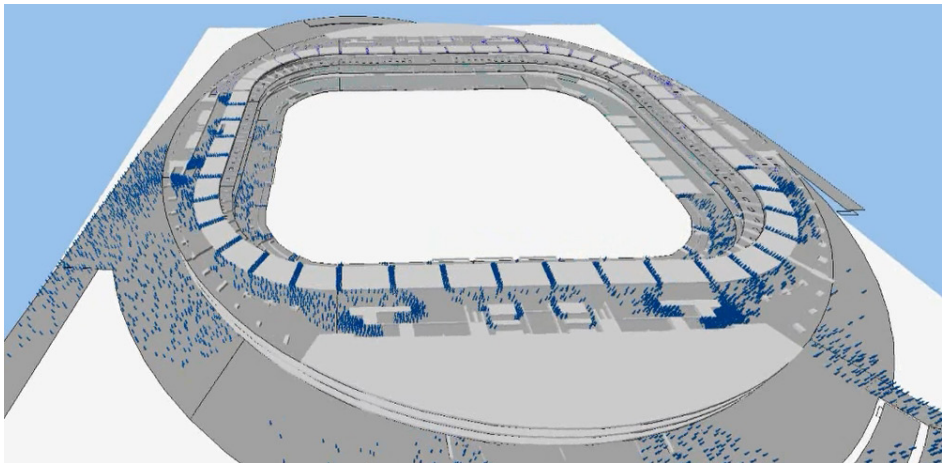
Combines agent based and discrete event simulation. Autonomous agents are routed through a continuum space while discrete events are used to control other occurrences like activity properties, train arrivals and incidents.



Change conditions dynamically.

DYNAMICALLY CHANGING CONDITIONS

Adaptation to dynamically changing (local) conditions. As in reality the situation can change during the simulation. The ECM data structure can be updated locally in real time. This allows the modelling of changing weather conditions like rain, collapse of a part of a building, spreading smoke, incidents, partly blocked routes and many other incidents or situations that can occur during the simulation run.



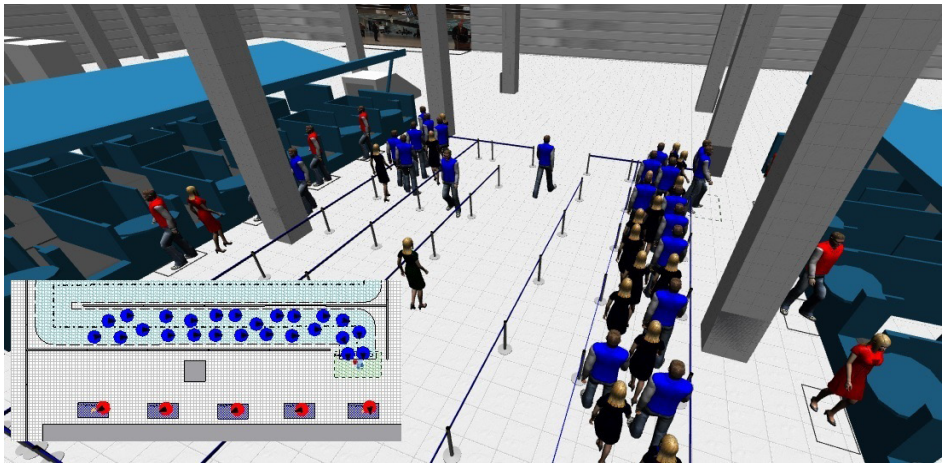
Fast simulation runs

MICROSCOPIC AND MESOSCOPIC

Use different levels of detail by using a combination of a microscopic and mesoscopic simulation approach.

FAST SIMULATION RUNS

Fast simulation runs by taking advantage of multi-threaded computing and with a 64-bit simulation engine, you are able to run 50.000 agents in real time.

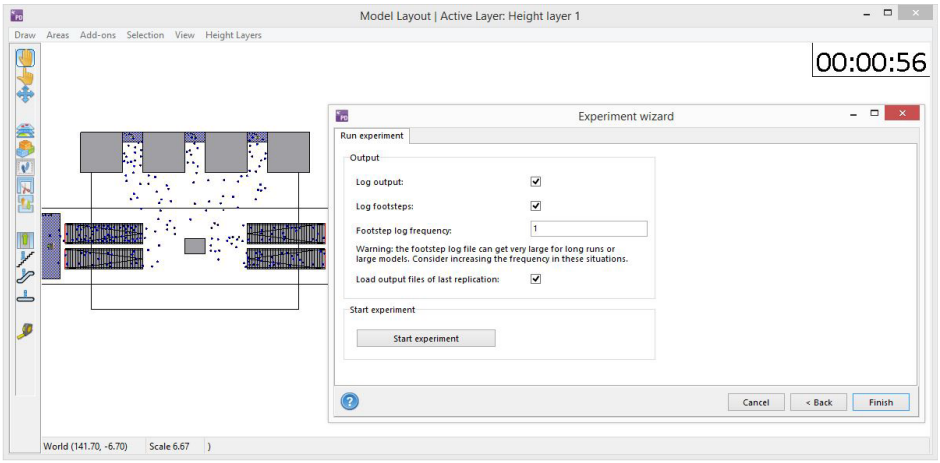


2D and 3D modeling.

2D & 3D VISUALIZATION

Instant 2D & 3D visualization showing you results right away.

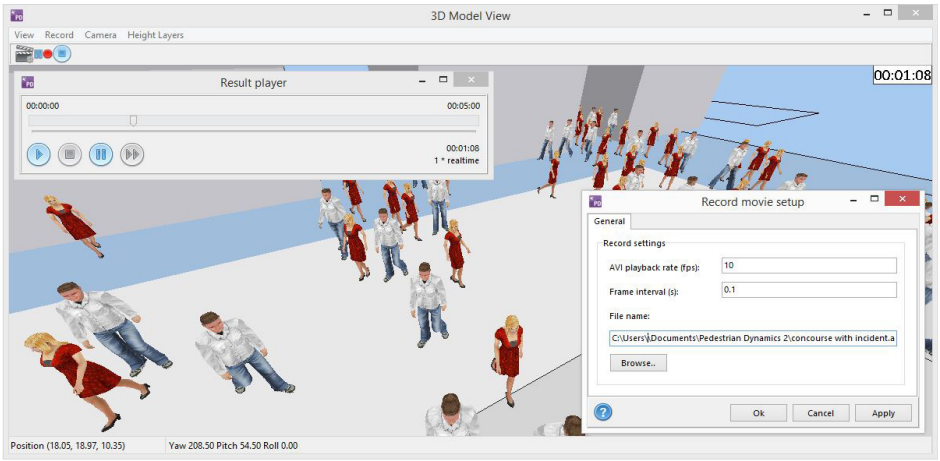
ANALYSIS



Save a great number of statistics including footstep logs.

FOOTSTEP LOGS

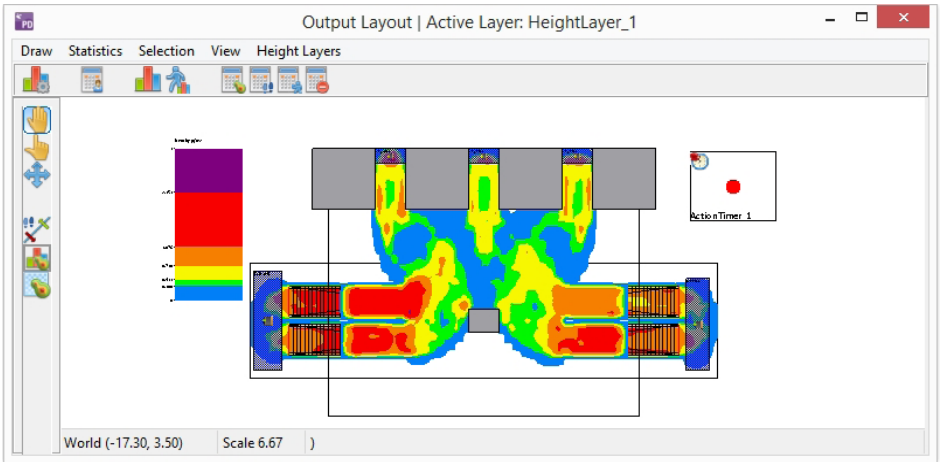
Automatically save a great number of statistics including footstep logs. Consequently, results can be defined, analysed and compared even after a scenario has been completed without having to re-run scenarios.



Easy movie playback and recording.

MOVIE

Easy movie playback and recording.

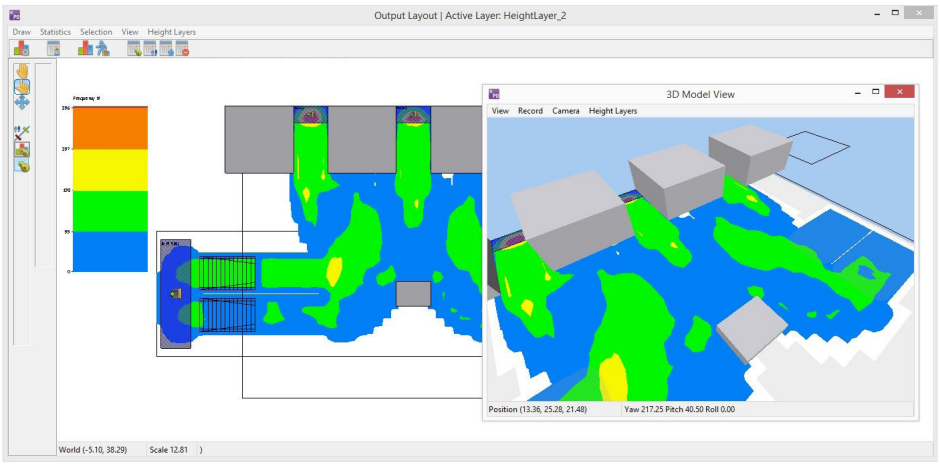


Define statistics with the output module.

OUTPUT MODULE

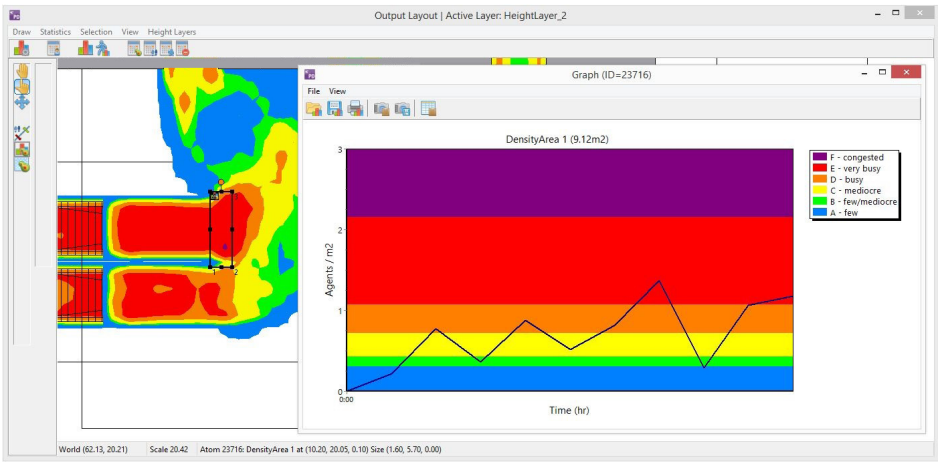
The integrated output module allows you to create more detailed results and so a better understanding of the safety and experience of the crowd.

The following output can be generated:



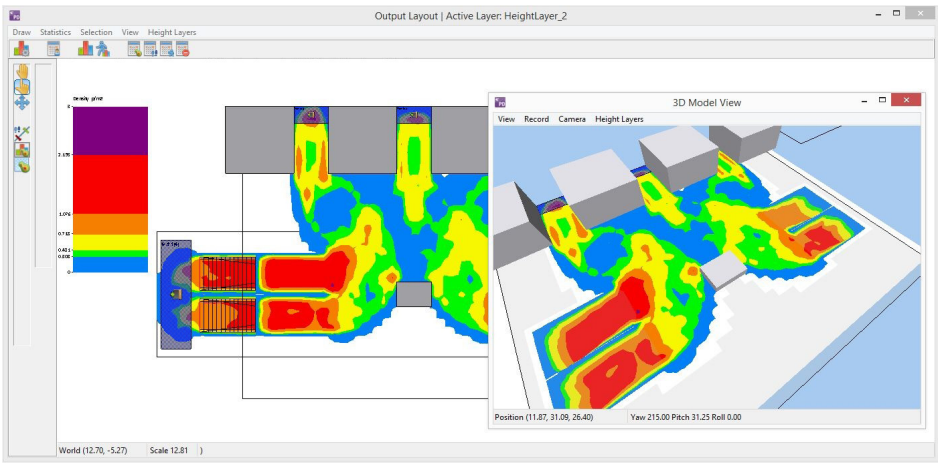
2D and 3D frequency maps.

A frequency map is a chart showing the number of agents that passed a certain area.



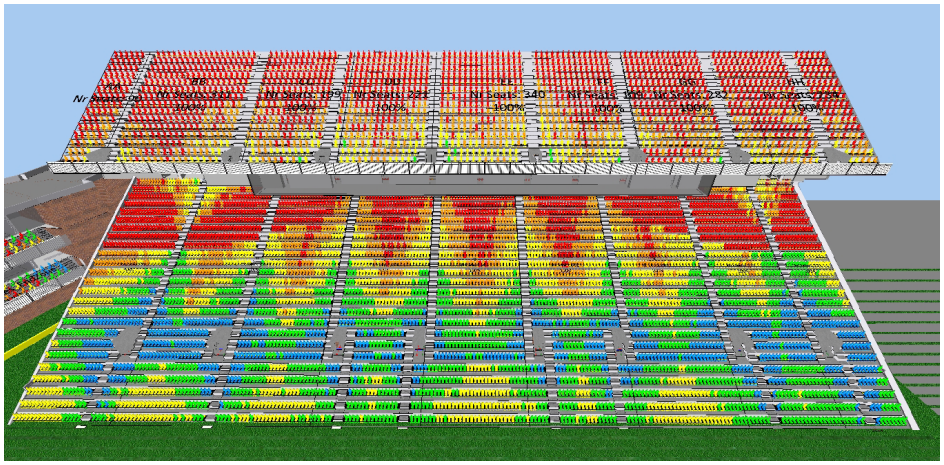
Density graph.

A density graph shows the density experienced for a chosen period of time for a specific area.



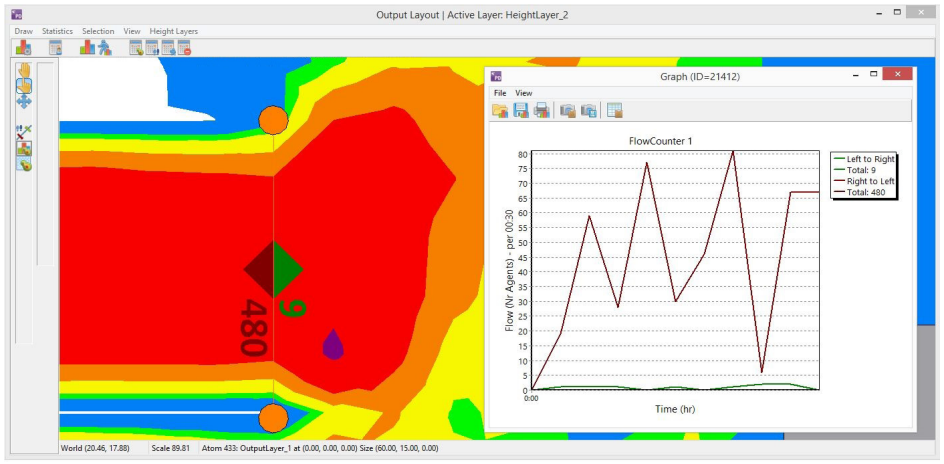
2D and 3D density maps.

A density map is a chart showing the maximum average density per time interval. It shows the crowdedness of your design.



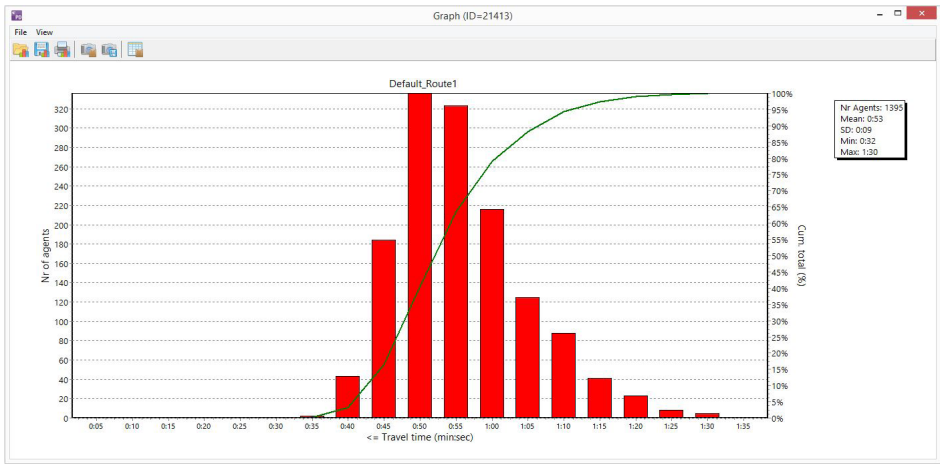
Travel time visualization.

A travel time map is a chart showing the travel time of each agent from its starting location using a colored scale.



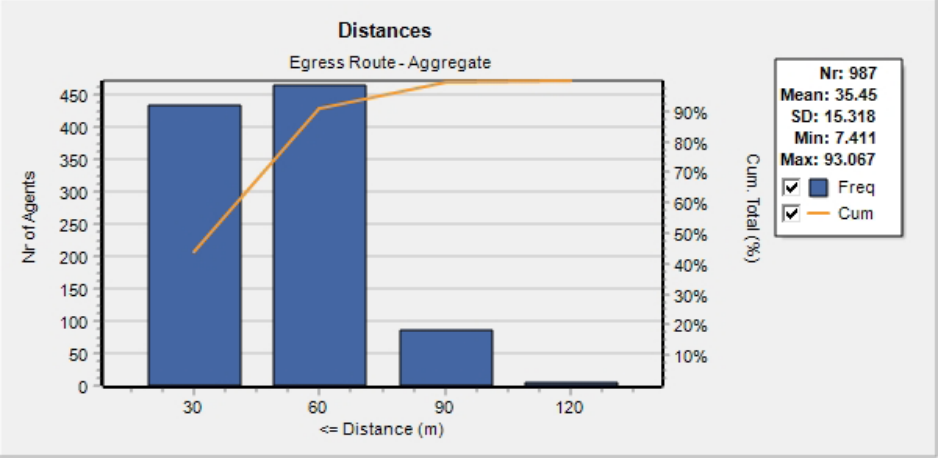
Flow counter graph.

A flow counter graph is a line that shows the number of agents that have crossed this line for both directions.



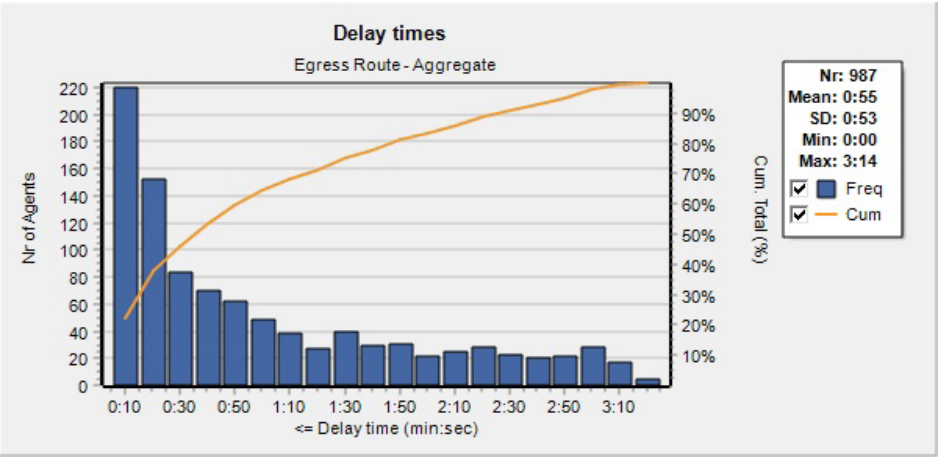
Travel evacuation times graph.

Travel evacuation time histogram shows the travel time between two locations. This can, for instance, be used for analyzing the evacuation time.



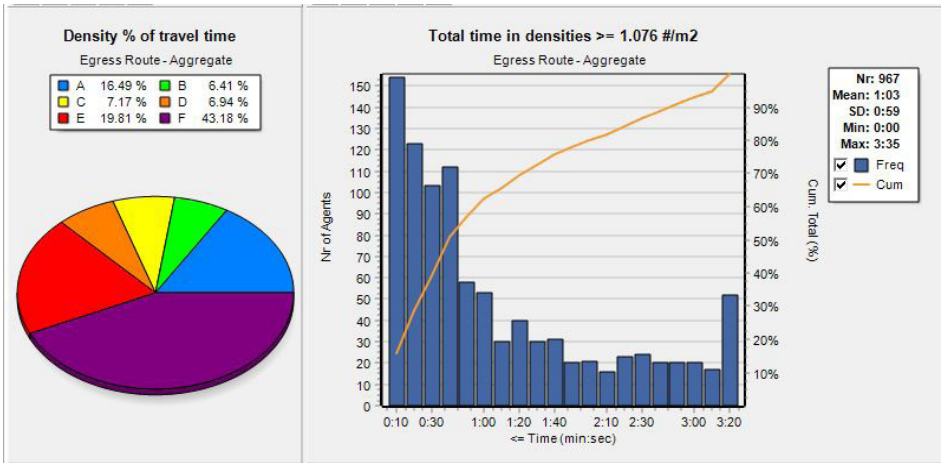
Distance Statistics.

Walking distance statistics show the walking distance of agents.



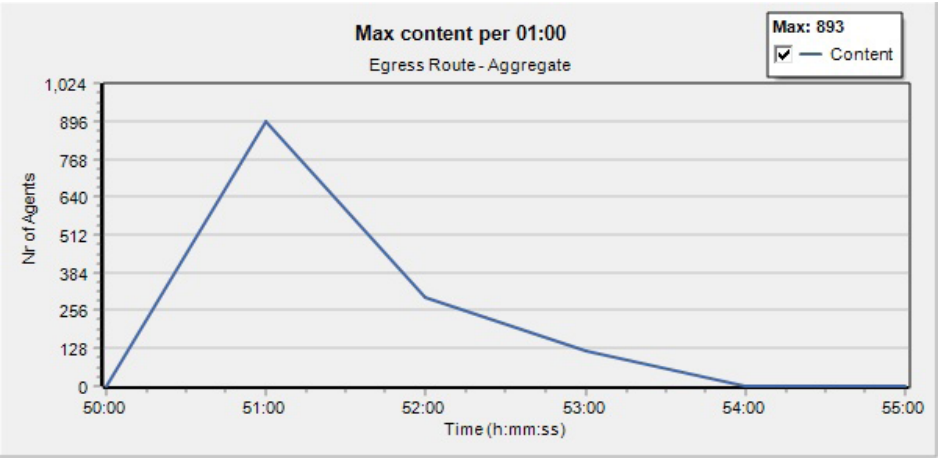
Delay time Statistics.

Delay times statistics show you how much delay and waiting time agents experience on a route and in queues.



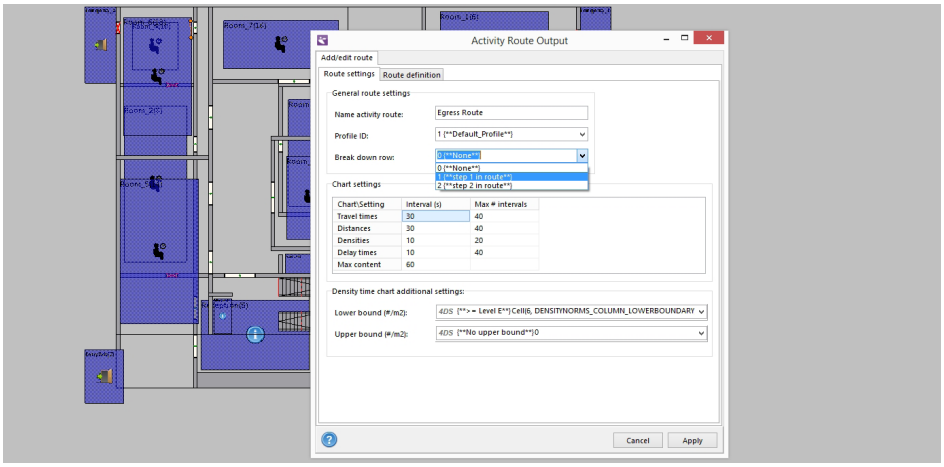
Desity of travel time statistics.

Travel experience statistics show you the percentage of the total walking time that an agent experienced within a certain local density.



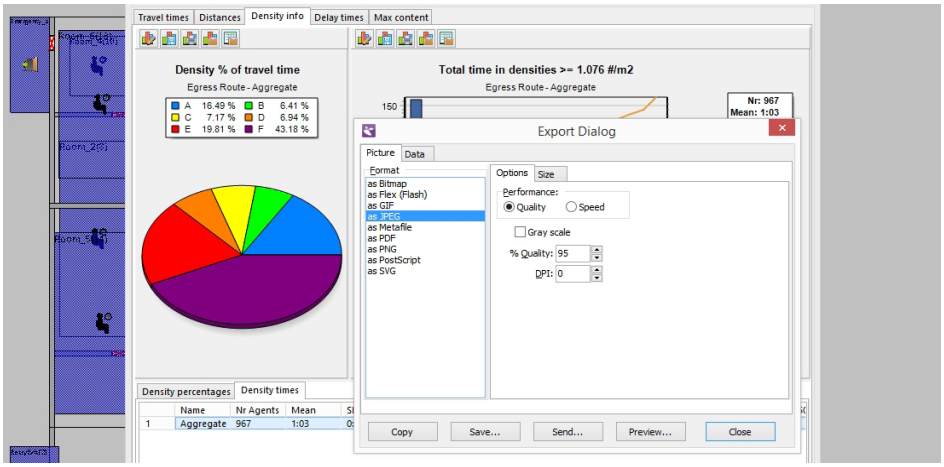
Maximum content statistics.

Maximum content statistics show you the maximum number of agents on a route.



Filters and breakdown of results.

Filters and breakdown of results show you the results for specific profile ID's, height layers or route steps. This enables you to do a more detailed analysis of specific routes and agent profiles.



Data export features.

Data export features enable you to export pictures and other results to enhance your reports.

RESULTS AND BENEFITS

Based on the results of your analysis you are now able to make validated decisions regarding the design and operations of your infrastructure or potential risks with subsequent plan of engagement for events involving large crowds. Due to the amazing visualization you are also able to convince all stakeholders of your infrastructural solution or plan of engagement.

INCONTROL Simulation Solutions offers you Pedestrian Dynamics®, a state–of–the–art crowd simulation software application for every need. Don't speculate: Simulate!

3. LICENSING

Pedestrian Dynamics® is offered in complete all-in-one packages without add-ons or other additionally required software. All in one box!

Pedestrian Dynamics® is offered in different license types for different purposes:

PEDESTRIAN DYNAMICS® STUDIO: DESIGN, ANALYZE & OPTIMIZE
Pedestrian Dynamics® studio offers:

- Development of crowd simulation models of any infrastructure;
- Evaluation of the infrastructure in the complete lifecycle; from design to operation;
- Crowd scenario analysis;
- Optimization of infrastructure and process design;
- Clear communication via 2D and 3D models, movies and output.

PEDESTRIAN DYNAMICS® DEVELOPER: DEVELOP, INTEGRATE & DISTRIBUTE
Pedestrian Dynamics® Developer offers:

- All the functionality of Pedestrian Dynamics® Studio;
- A crowd simulation platform with an open architecture;
- Development and distribution of own end-user applications;
- Integration of the crowd simulation platform within your system.

PEDESTRIAN DYNAMICS® RUNTIME: RUN CUSTOMIZED AND INTEGRATED APPLICATIONS
Pedestrian Dynamics® Runtime offers:

- A runtime license for the end-user application developed with Pedestrian Dynamics® Developer;
- The use and distribution of your integrated solutions to 3rd parties.

The table on the following page provides an overview of the technical capabilities of the available Pedestrian Dynamics® licenses.

TECHNICAL CAPABILITIES OF THE AVAILABLE PEDESTRIAN DYNAMICS® LICENSES

Pedestrian Dynamics® Crowd Simulation Software	TRIAL	STUDIO	DEVELOPER	RUNTIME
Time limit	30 days	subscription	subscription	subscription
Maximum model size	infinite	infinite	infinite	infinite
Develop models with automatic network creation	x	x	x	
Running simulations	x	x	x	x
Online updates, maintenance & support		x	x	x
Model import (CAD/CAD 2015, CityGML and more)	x	x	x	
Instant 2D & 3D Visualization	x	x	x	x
Output Manager (Read)	x	x	x	x
Output Manager (Write)	x	x	x	
Movie Recorder	x	x	x	
Model architecture view			x	
Library architecture view			x	
Object, Application & GUI developer tools			x	
Debugging			x	
ArcGIS			x	x
External connections			x	x

4. TECHNOLOGY

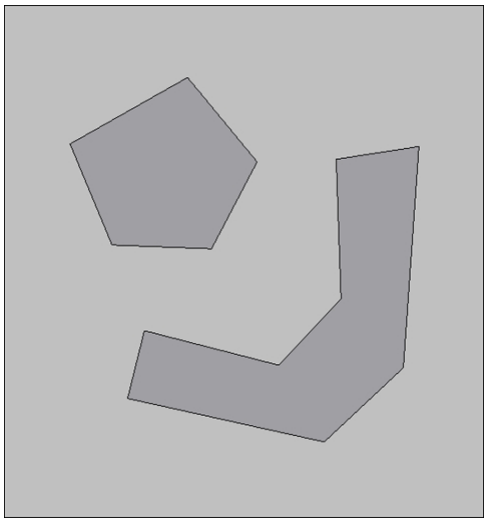


Figure 1:(a) environment

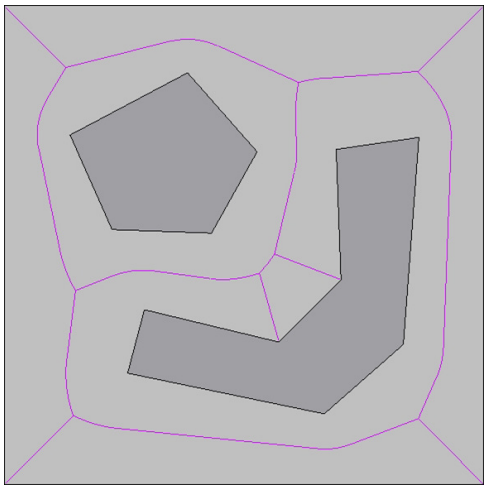


Figure 1: (b) medial axis

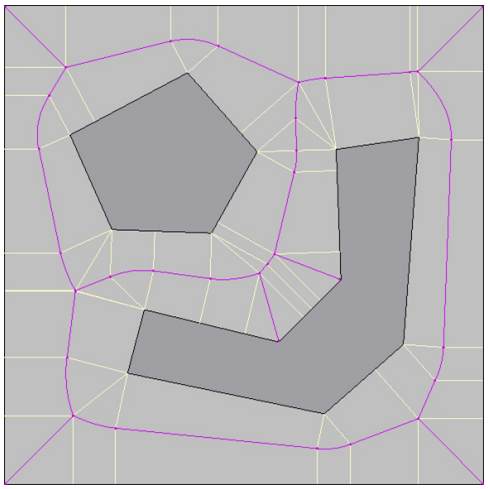


Figure 1: (c) Explicit Corridor Map

ACADEMIC RESEARCH & VALIDATION

Pedestrian Dynamics® can model large crowds of virtual pedestrians (agents) in real–time. To achieve these results, Pedestrian Dynamics® uses efficient crowd simulation algorithms and software, developed together with the Utrecht University (UU) in Utrecht, The Netherlands [1]. The following text gives an introduction to this crowd simulation framework. Interested readers can find more details in the referenced scientific publications.

NAVIGATION MESH – EXPLICIT CORRIDOR MAP

During the simulation, agents should be able to efficiently find a path from their current position to any other position in the environment. A data structure that can answer these path planning questions is called a navigation mesh: a subdivision of the entire walkable space into connected polygonal areas.

One example of a navigation mesh is the Explicit Corridor Map (ECM) . The ECM is essentially a network (or a graph) consisting of vertices and edges. Hence, Pedestrian Dynamics® often refers to this data structure as the "ECM network". The edges of the ECM form the medial axis: a set of curves describing the middle of the walkable space. Figure 1a for an example environment; Figure 1b shows its medial axis.

Each ECM edge consists of nodes annotated with closest points, which induce a subdivision of the walkable space into polygonal areas. Hence, the closest–point annotations turn the ECM from a regular graph into a navigation mesh. Figure 1c shows the closest–point data in our running example. Observe that the yellow line segments completely subdivide the free space into sub–areas.

(a) Environment (b) Medial axis (c) Explicit Corridor Map

Figure 1: (a) A simple environment with two obstacles, shown in dark gray. (b) The medial axis, shown in pink, runs through the middle of the walkable space. (c) Closest–point annotations, shown in yellow, turn the medial axis into the ECM navigation mesh.

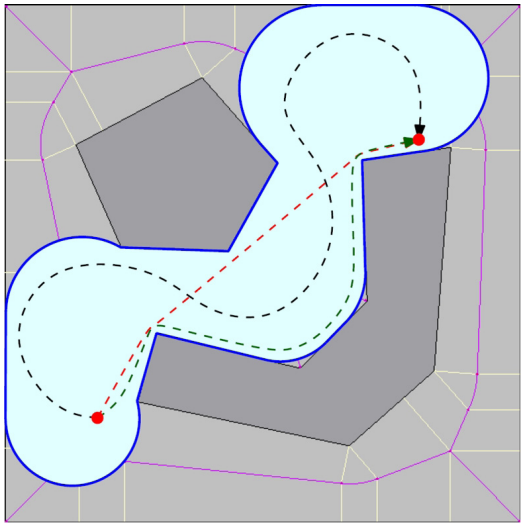


Figure 2: (c) Path Following

When planning a path to some goal position, an agent tries to find a route along the network's edges (i.e. along the medial axis) by using a modified A* algorithm. Thanks to the ECM's closest–point annotations, the resulting route is actually a corridor: a set of polygons and circle segments, describing the free space that the agent can use around the route. Agents can move flexibly and efficiently through a corridor (see "Path following"), and they can use the free space to avoid other agents (see "Local collision avoidance").Figure 2 shows an example of a corridor.

ADVANTAGES OF THE EXPLICIT CORRIDOR MAP

Next to its corridor flexibility, the ECM has more useful properties:

- It can be constructed quickly and automatically, given a set of layers and their obstacles. In Pedestrian Dynamics®, users can quickly build an arbitrary environment and then generate the routing network by pressing a single button.
- it has a small memory footprint: its size is proportional to the complexity of the environment.
- It supports multi–layered environments, in which multiple two–dimensional layers are connected, e.g. through staircases [3].
- It can plan paths for agents of various sizes, by using only a single data structure. Agents can decide for themselves whether or not a passage (an ECM edge) is wide enough for them to use.
- It can be annotated with more information about the environment, such as the local density (see "Density–based crowd simulation"), special edge costs (e.g. for preferring escalators over staircases), or temporary changes (e.g. staircases that become unavailable, or emergency doors that open up).

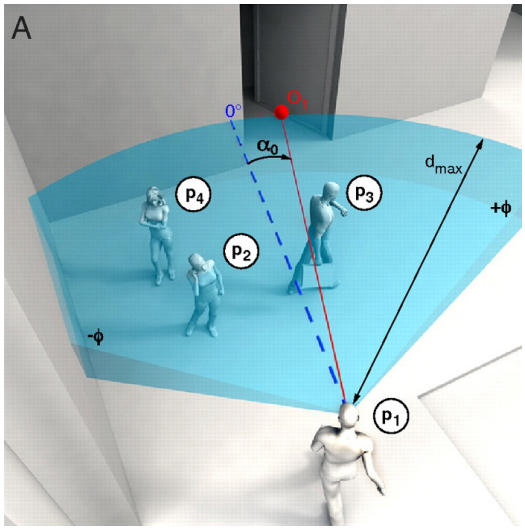
In short, the Explicit Corridor Map is an efficient and flexible navigation mesh for crowd simulation.

ROUTE FOLLOWING – THE INDICATIVE ROUTE METHOD

Once an agent has planned a global route to its goal position (i.e. it has found a corridor), the agent should look for a way to move through its corridor. For instance, the agent can choose to stay on the left or right side of the corridor, or to follow the shortest possible path with some preferred clearance to obstacles. Figure 2 shows a number of options.

The so–called Indicative Route Method (IRM) [4] is a general framework that smoothly steers an agent through a corridor while following an indicated path (the indicative route). In each step of the simulation, the agent computes a desired velocity that will send the agent further along its indicative route. The agent may deviate from this desired velocity, e.g. when walking around other agents, as long as it does not leave its corridor.

In Pedestrian Dynamics®, users can set the options for this path planning phase for each agent profile. These settings can be found in "Agent input –> Agent profile –> Route following".



Collision Avoidance (Moussaïd, Helbing and Theraulaz [6])

LOCAL COLLISION AVOIDANCE

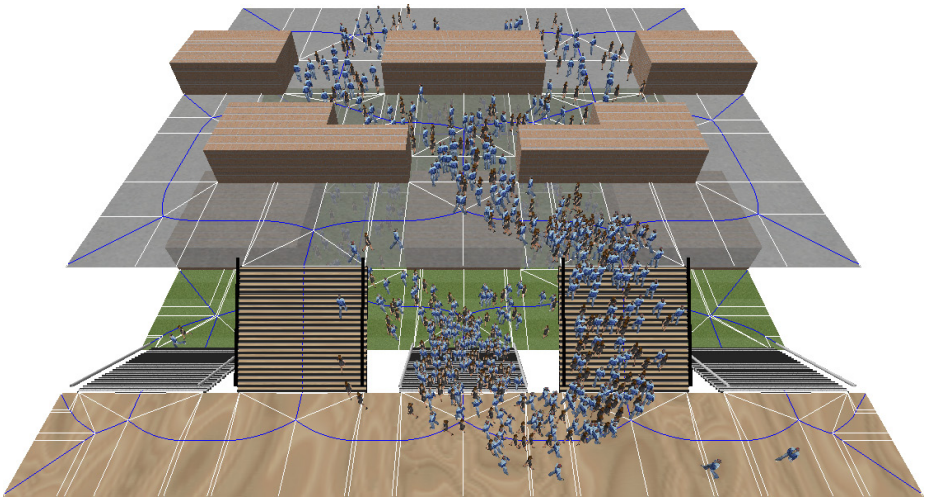
As mentioned, path planning in corridors gives the simulated agents a lot of flexibility. Next to the described variety of indicative routes, a corridor also supports collision avoidance between agents. Collision avoidance can be a time–consuming task, but it increases the simulation's realism.

Each agent uses vision to detect which obstacles, both dynamic and static, it has to avoid. The vision is modeled as a cone–shaped field of view (FoV). The collision–avoidance algorithm in the ECM crowd simulator lets each agent chooses a velocity that is close to its desired velocity (i.e. with a small difference in direction and speed), but that prevents them from colliding with others. Similarly, the agents can be blocked by local obstacles, such as temporarily closed doors. The collision avoidance algorithm is based on the vision based model developed by Moussaïd, Helbing and Theraulaz [6].

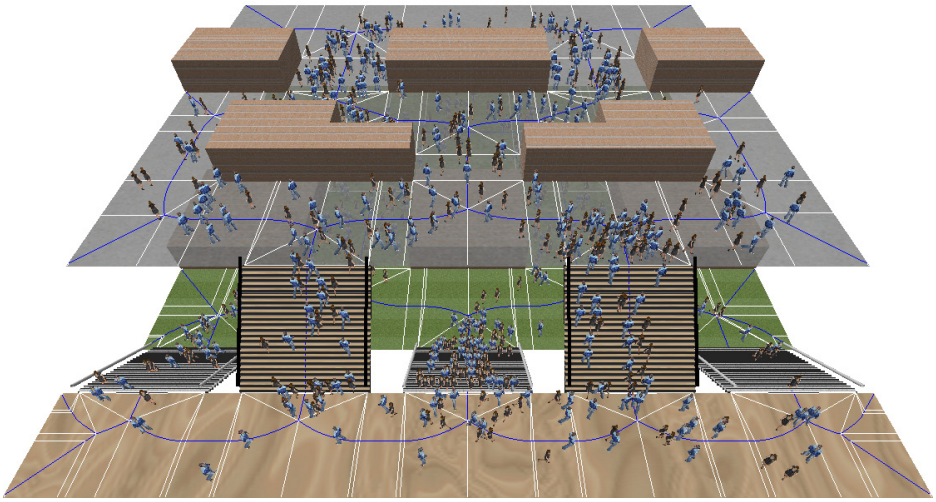
Newtonian force models are still not fully consistent with empirical observations and are often hard to calibrate. Therefore, Pedestrian Dynamics® uses a cognitive science approach, which is based on vision and behavioral heuristics. Guided by visual information, namely the distance of obstructions in candidate lines of sight, pedestrians apply two simple cognitive procedures to adapt their walking speeds and directions. For more detailed information see [6]. The model predicts the emergence of self–organization phenomena, such as the spontaneous formation of unidirectional lanes, stop–and–go waves, crowd compression, edge and wake effects and others.

In Pedestrian Dynamics®, users can switch agent collision avoidance on an off for the entire simulation, in "General settings –> Simulation". Other options (e.g. the size of the field of view) can be set for each type of agent. These settings can be found in "Agent input –> Agent profile –> Local behavior".

Note: Collision avoidance with "regular" obstacles (such as walls and buildings) can be computed very efficiently, because this information is stored in the corridors created by the ECM framework. A corridor is guaranteed to be walkable. As long as an agent stays inside its corridor, it cannot collide with stationary obstacles. The absence of finding the obstacles for collision checking is one of the reasons why ECM–based crowd simulation is efficient.



Crowd simulation based on short path



Density based crowds simulation for a better and more realistic distribution

DENSITY–BASED CROWD SIMULATION

For crowd simulation tools such as Pedestrian Dynamics®, crowd density is very important. Many researchers have shown that agents generally walk at a slower pace when the local density is high. This relation can be captured in a density formula. Pedestrian Dynamics® contains a number of commonly used formulas; users are free to change them. In literature, crowd density is often measured in persons per square meter (p/m2), assuming that all agents have a certain (average) size. However, Pedestrian Dynamics® supports agents of various sizes: larger agents have a larger contribution to the crowd density. In our framework, the density is simply a value between 0 and 1 denoting how much of an area is occupied. To ensure that Pedestrian Dynamics® can still use density formulas from literature, the "General settings –> Simulation" window contains a setting for the "average agent area".

The Explicit Corridor Map supports route planning based on density [5]. Recall that each edge of the ECM denotes a set of polygonal areas through its closest–point annotations. In other words, every edge is associated to a walkable polygonal region. By keeping track of the crowd density in these regions, we approximate the density around each edge. A density formula translates this density to an expected walking speed, and an expected traversal time for the edge. The agents can use these traversal times when planning a route: this density–based crowd simulation lets agents avoid crowded regions, and it spreads the crowd among alternative routes in a natural–looking way.

In Pedestrian Dynamics®, general density–related parameters can be found in "General settings", and the routing preferences can be set for each agent type in "Agent input –> Agent profile –> Route planning".

COMBINATION WITH PEDESTRIAN DYNAMICS®

Pedestrian Dynamics® includes a software module that builds the ECM and performs crowd simulation. In Pedestrian Dynamics®, the user can build an environment by defining layers and filling them with obstacles and infrastructural elements such as staircases (which are actually separate layers). The environment is then converted to a PRIX file: an XML description of the layers, their obstacles and their connections. The ECM generation software returns an ECMX file: an XML file describing the vertices and edges of the Explicit Corridor Map. Back in Pedestrian Dynamics®, users can visualize the ECM's edges, vertices, nodes and annotations in 2D and in 3D. When the simulation starts an ECMU file: an XML file describing specific edge properties is send to the crowd simulation module.

During the simulation, Pedestrian Dynamics® generates agents and determines their goals by using the activity locations and activity routes drawn by the user. Pedestrian Dynamics® sends the start and goal positions of agents to the crowd simulation module, which plans the actual routes in the ECM network. In each simulation step, the module returns a new velocity for each agent.

A model in Pedestrian Dynamics® can also contain incidents, which trigger changes in the availability of the ECM's edges. These changes are sent, again as an ECMU file, to the crowd simulator, so that agents can respond to them in real–time.

This decoupled approach is very powerful. Pedestrian Dynamics® generates agents and performs their global decision–making based on activities, without requiring knowledge of the ECM from the user. In turn, the ECM simulator computes actual paths and velocities, without having to bother about the "meaning" of the environment. Combined with hardware accelerations (such as multithreading), this simulation framework can model the movement of huge crowds in real–time.

REFERENCES

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[2]R. Geraerts. "Planning Short Paths with Clearance using Explicit Corridors." In IEEE International Conference on Robotics and Automation (ICRA'10), pp. 1997–2004, 2010.

[3]W.G. van Toll, A.F. Cook IV, and R. Geraerts. "Navigation Meshes for Realistic Multi–Layered Environments." In IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'11), pp. 3526–3532, 2011.

[4]I. Karamouzas, R. Geraerts, and M. Overmars. "Indicative Routes for Path Planning and Crowd Simulation". In The Fourth International Conference on the Foundations of Digital Games (FDG'09), pp. 113–120, 2009.

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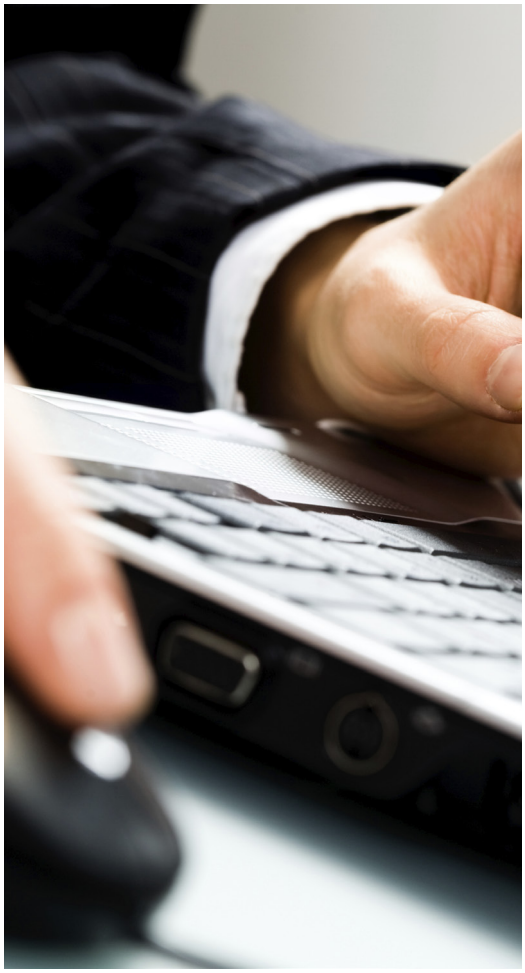
[6]M. Moussaïd, D. Helbing, G. Theraulaz. "How simple rules determine pedestrian behaviorand crowd disasters." Proceedings of the National Academy of Science(PNAS), 2011.

5. SYSTEM REQUIREMENTS



OPERATING SYSTEM

In order to run Pedestrian Dynamics®, you require a Microsoft Windows operating system on the application system. To run Pedestrian Dynamics® on an Apple Mac, Microsoft Windows needs to be installed on it. This can be achieved using Boot Camp (preferred). Pedestrian Dynamics® is proven compatible with:

- Microsoft Windows Vista
- Microsoft Windows 7
- Microsoft Windows 8
- Microsoft Windows 10

Pedestrian Dynamics® is a 32–bit application and will run without problems in 32–bit compatibility mode on a 64–bit version of a Windows Operating System.

HARDWARE

Pedestrian Dynamics® performs many heavy calculations to be able to find possible routes between the origin and destination of pedestrians. Some of these calculations are executed parallel over multiple processor cores in order to allow the user a smooth performance. A fast modern computer is there for required.
With Pedestrian Dynamics® it is possible to view the simulation in 2D and 3D, but visualizing many pedestrians require a good video card. Low–end or on–board video cards are too slow and will have a heavy impact on the overall performance of your simulation model. Both for calculations and for visualizations you need a more than average consumer computer. The required hardware depends on how the software is used. Users who will only use the standard components in small to medium sized models with a limited number of agents, require a different configuration then users who are exploring the limits the software's capabilities (most limitations on this level of usage are caused by hardware limitations). To give an idea which hardware configuration suits you best, we have listed two configurations: Minimum and Recommended.

Minimum

- Processor Intel 1.5 GHz Dual Core or i7 Quad Core
- Internal Memory 2 Gb
- Hard Disk space 500 Mb of Free Space
- Operating system Windows Vista
- Video Card** OpenGL® 4.0

Recommended

- Processor Intel 3.0+ GHz Octa Core (i7 Octa Core is highly recommended)
- Internal Memory 8 Gb+
- Hard Disk space 32+
- Operating system Windows 10
- Video card ** OpenGL® 4.5

****VIDEO CARD**

To use Pedestrian Dynamics® to its full extent, it is recommended that you use a laptop or desktop with a major brand (e.g. NVIDIA or ATI\AMD) 3D graphics card with at least 1 Gb, of (non–shared) RAM (for network creation, textures and frame buffer). Ask your hardware supplier for a chipset that supports native OpenGL® 4.0. If your OpenGL ®version is less then part of the 3D visualization might be unsupported, also the quality of the 3D lighting and transparency is inferior.

6. TECHNICAL SPECIFICATIONS

VERSION INFORMATION	
Current version	3.0
Year of release	2016

INSTALLATIONS	
Number of sold engine licenses	More than 11,000
Number of universities using simulation engine	More than 500

SUPPORT	
Annual Maintenance & Support contract	Yes
Maintenance & Support includes product updates	Yes
Support channels	Website Community Issue Tracker (JIRA) E–mail Phone • International: +31 (0)30 670 3798 • Germany: 0800 1802066 • USA: +1 601 266 61 83 Onsite
E–mail and Phone support times	08:30 – 18:00 CET

DOCUMENTATION	
Basic Tutorial	Yes
Advanced Tutorials	Yes
Help	Yes
Example models	Yes

TRAINING	
Available standard training courses	Studio and Developer
Training locations	Utrecht, The Netherlands Wiesbaden, Germany Hattiesburg, USA
Onsite training possible	Yes

SIMULATION OBJECTS	
Limit to max. number of simulation objects	No (depending on hardware specifications and license)
Ability to modify existing simulation objects	Yes (depending on license)
Ability to create simulation objects	Yes (depending on license)
Simulation objects contain spatial information	Yes

MODELING	
Adding simulation objects to model	Mouse click Ability to add objects via code
Modeling paradigm	Object–oriented
Ability to use layers	Yes (depending on license)
Availability of pre–defined rules	Yes
Integrated with visualization	Yes (2D & 3D)
Automatic network creation	Yes (Exact ECM)
Automatic route creation	Yes (IRM)

SIMULATION RUN	
Real–time	Yes
As fast as possible	Yes
Custom speed	Yes
Run until stop time	Yes

EXPERIMENTATION AND RESULTS	
Experimentation Wizard	Yes
Integrated output module	Distance statistics Delay time statistics Density of travel time statistics Density maps Density areas charts Maximum content statistics Frequence maps Travel times charts Travel times map Flow counter charts Filters and breakdown of results General statistics
Customized output	Yes
Result player	Yes
Report generator	Yes
Record movie (avi)	Yes

RANDOM GENERATOR	
Number of independant random generators	2,147,483,647
Repetitive	Yes
Antithetic	Yes
Generator algorithm	Wichmann–Hill

DISTRIBUTIONS	
Bernoulli	Yes
Beta	Yes
Binomial	Yes
dUniform	Yes
Emperical	Yes
Erlang	Yes
Gamma	Yes
Geometric	Yes
Logistic	Yes
LogLogistic	Yes
LogNormal	Yes
NegBinomial	Yes
NegExp	Yes
Normal	Yes
PearsonT5	Yes
PearsonT6	Yes
Poisson	Yes
Random	Yes
Triangular	Yes
TriangularTop	Yes
Uniform	Yes
Weibull	Yes
Custom distribution	Yes

VISUALIZATION & MODEL IMPORT	
2D	Yes
3D	Yes
2D graphic formats	Microsoft Windows Bitmap *.bmp, .rle, .dib* (Enhanced) Windows Metafile *.emf, .wmf* Joint Photograph Experts Group *.jpg, .jpeg, .jpe, .jfif* AutoCAD Drawing File *.dwg* Autodesk Design Web Format *.dwf* AutoCAD Drawing Exchange File *.dxf* CityGML *.gml*

continuation 2D graphic formats	Graphics Interchange File *.gif* Hewlett–Packard Graphic Language File *.hpgl, .hgl, .hpgl2* Targa Graphics Adapter File *.tga, .win, .vst, .vda, .icb* Portable Map Graphic *.pgm, .pbm, .ppm* Computer Graphics Metafile *.cgm* Scalable Vector Graphics File *.svg* Tag Image File *.tif, .tiff, .fax* Adobe Photoshop File *.psd, .pdd* Pointshop Pro File *.psp* Portable Network Graphics File *.pgn* Windows Icon *.ico* PCX, RLE encoded image *.pcx, .scr, .pcc* Autodesk Image *.cel, .pic* Kodak PhotoCD *.pcd*
3D graphic formats	VRML 1.0 and 2.0 *(.wrl)* 3D Studio *(.3ds)* CityGML *(.gml)* AutoCAD Drawing File *(.dwg)* Autodesk Design Web Format *(.dwf)* AutoCAD Drawing Exchange File *(.dxf)* Collada *(.dae)* Blender *(.blend)* 3ds Max 3DS *(.3ds)* 3ds Max ASE *(.ase)* Wavefront Object *(.obj)* Industry Foundation Classes *(IFC/Step) (.ifc)* XGL *(.xgl,.zgl)* Stanford Polygon Library *(.ply)* LightWave *(.lwo)* LightWave Scene *(.lws)* Modo *(.lxo)* Stereolithography *(.stl)* DirectX X *(.x)* AC3D *(.ac)* Milkshape 3D *(.ms3d*

Ability to control 3D meshes	Yes
Texture support	Yes
Ability to create materials	Yes
Support for all geomatric primitives	Yes
Custom camera positions	Yes
Perspective projection	Yes

Parallel projection	Yes
Camera settings	Field of view Near Plane Far Plane
Freehand camera	Yes
Target camera	Yes

DATABASE SUPPORT	
ODBC	Yes (depending on license)
ADO	Yes (depending on license)
Real–time database access	Yes (depending on license)

CONNECTIVITY	
XML	Yes
ActiveX Server	Yes
ActiveX Client	Yes
OPC Client	Yes
Text files (.txt, .csv)	Yes
Communications ports	Yes
DDE	Yes
Excel	Yes
Word	Yes
TCP/IP	Yes
UDP	Yes
SAP	Yes
IEEE 1516 (High Level Architecture) standard compliance	Yes
Custom DLL support	Yes

CUSTOMIZATION	
Programming language	4DScript
Ability to change application forms	Yes (depending on license)
Ability to add user forms	Yes (depending on license)
Ability to add new functions	Yes (depending on license)
Ability to add new attributes	Yes (depending on license)
Ability to use variables	Yes (depending on license)
Simulation Engine OEM ready	Yes (depending on license)

INTEGRATION	
ArcGIS	Yes (depending on license)

SYSTEM REQUIREMENTS RECOMMENDED	
Processor	i7 Quad Core or higher
RAM	8 Gb or more
Video Card	OpenGL®4.5
Hard disk	32 Gb or more free space