

# UU Crowd Simulation Research & Development

## Towards making a city smarter

The increasing urbanisation of the world population presents new challenges for decision makers. Real-time crowd simulation is crucial in addressing these challenges, including determining evacuation times in complex buildings, avoiding overcrowded areas during mass events, and improving the crowd flow in cities. Based on our research, we have developed a simulation framework with unique features that aim at realism, speed and accuracy. Our software is available for research and commercial use. We welcome researchers and companies to collaborate, e.g. to write joint project proposals or to integrate our framework into their products.



### Our contributions

Our crowd simulation framework can deal with huge 3D multi-layered virtual environments. A filter pipeline extracts an efficient and flexible representation of the walkable areas which are then converted to a navigation mesh. This mesh is used by our framework through a generic five-level planning hierarchy. This enables the simulation of at least 15.000 autonomous and social pedestrians in real-time. The framework can be easily extended with new features, such as bicycles and density-based planning, thus allowing us to address current and future challenges in crowded cities.

#### Planning hierarchy

1. High-level planning
2. Global route planning
3. Route following
4. Local movement
5. Animation

#### Pipeline

1. Input environment
2. Simplification filter
3. Slope filter
4. Layer filter
5. Navigation mesh
6. Simulation

#### Features

- Arbitrary agent sizes
- Dynamic updates
- Visibility queries
- Weighted regions
- Social groups and coordination

#### Recent projects

Tour de France 2015, Grand Départ, Utrecht:  
(collaboration with Movares)

Noord/Zuidlijn 2015, Amsterdam:  
(collaboration with Movares)

#### Vision & current research

- Crowd prediction
- Crowd validation
- Model improvements

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