



D&T SimuGENS

Crowd Simulation: a Railway Station example

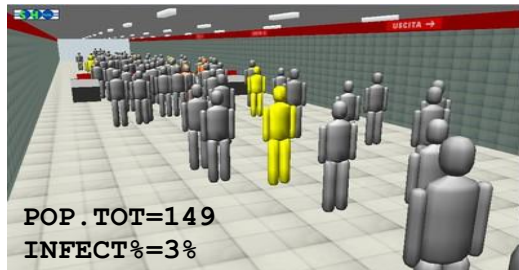
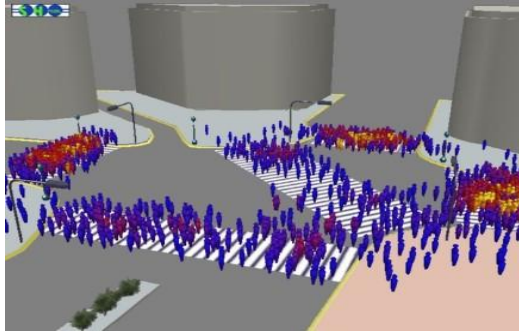


Crowd Simulation: a Railway Station example

- ▶ **Crowd Dynamics: why simulation?**
- ▶ **SimuGENS: intro and features**
- ▶ **Application examples: Venezia, Tokyo, Milano**
- ▶ **Milano Cadorna: a railway station test case**
- ▶ **Milano Cadorna: normal and emergency condition**
- ▶ **Milano Cadorna: infection simulation and airflow**
- ▶ **Conclusions**



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Crowd Dynamics: why simulation?

Crowd dynamics: a critical safety topic

- 1985: 39 casualties, Heysel stadium
- 1990: 1426 casualties, Mecca
- 2017: 1672 injured, Torino

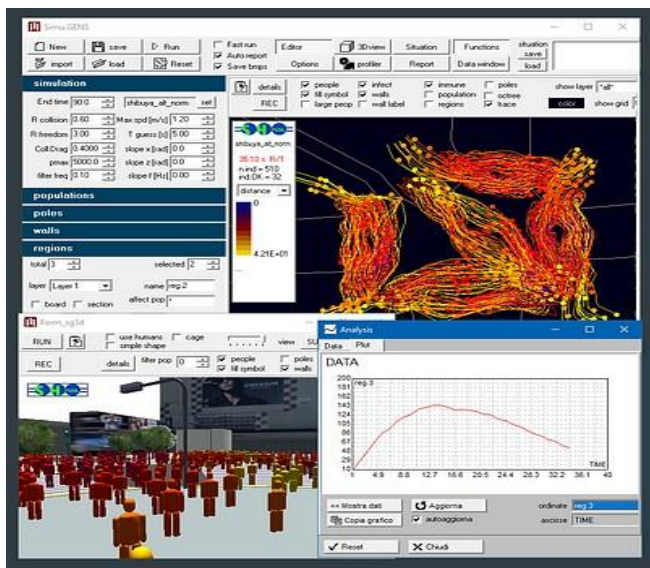
Crowd dynamics: can be an opportunity for

- design of public spaces and buildings
- improvement of the services
- assessment of commercial spaces

In 2014 D&T/SHRAIL, an Italian Company specialized in railway simulation, developed SimuGENS, a software for crowd analysis, able to represent large number of individuals in normal and emergency situations.

In 2020, following the outbreak of the COVID-19 virus, SimuGENS has been expanded with a set of functionalities focused on the dynamics of the infections in large crowds, also in presence of airflow

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SimuGENS intro and features

Proprietary software developed by D&T for crowd simulation

Large groups of individuals (up to 10000's) in the 3D continuous space

Real-time simulation capable

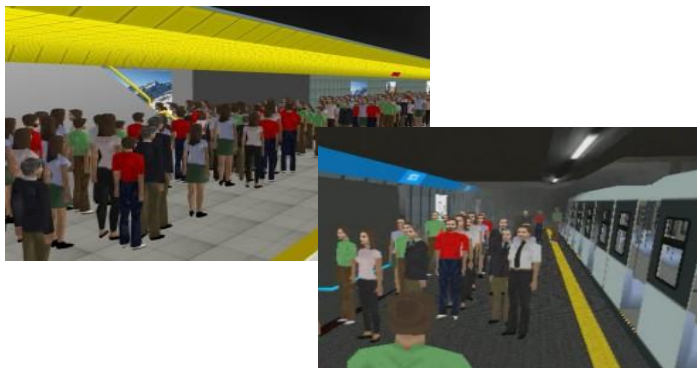
Modelling of walls, signs, fires, smoke

Easy import maps and floorplans from CAD

Powerful 2D and 3D view of crowd behavior

Effective analysis tools including charts, tables, colormaps, vectors and path tracing

Export still pictures and digital videos



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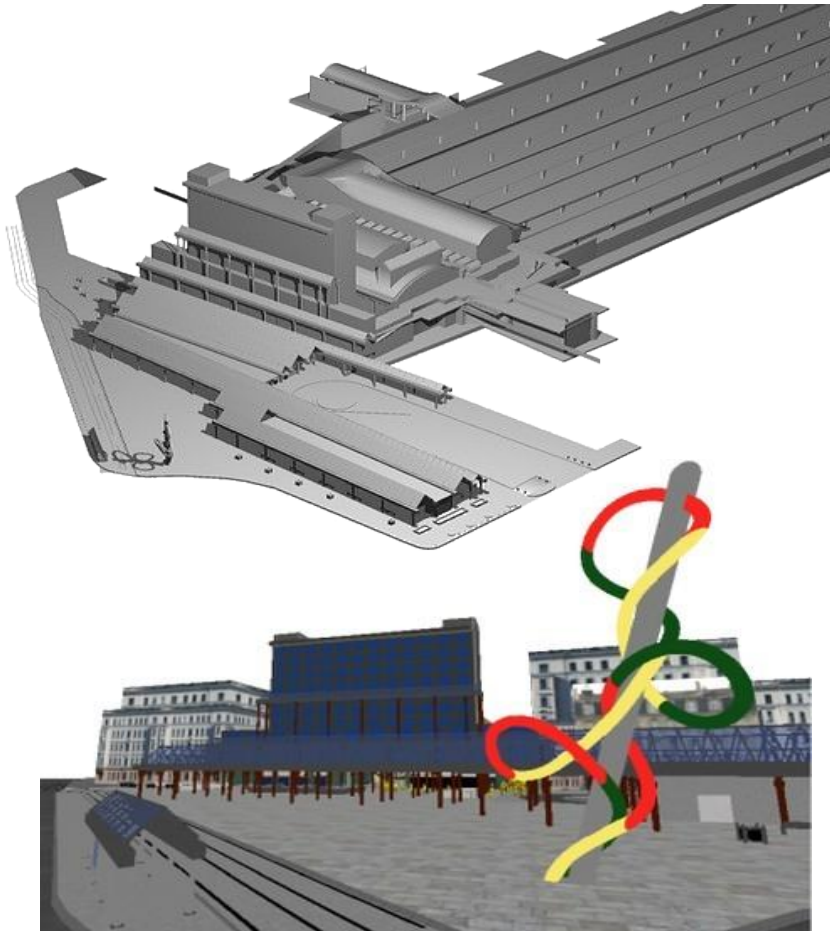


SimuGENS application examples

SimuGENS has been used for a number of studies, ranging from small areas to large city neighborhoods, including

- ▶ Milano Centrale Railway Station
- ▶ Venice Railway Station
- ▶ Tokyo Shibuya Crossing
- ▶ Milano Fiera exhibition center
- ▶ Milano Subway
- ▶ Salerno Light Festival
- ▶ Dubai Expo 2020
- ▶ Milano “Expoferroviaria”

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Milano Cadorna:

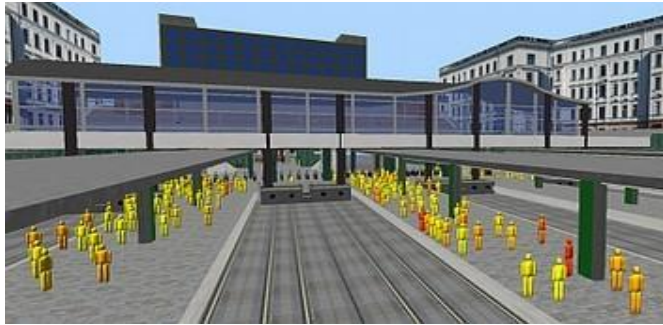
a railway station test case

- ▶ Hub of Milan suburban lines
- ▶ Airport shuttle terminal
- ▶ Connection with 2 subway lines
- ▶ Connection with 5 bus/tram lines
- ▶ 40 million people/year

Simugens Model:

- ▶ Up to 2500 people
- ▶ All ground floor and platforms
- ▶ 750 walls and obstacles
- ▶ Exits and turnstiles

Crowd Simulation: a Railway Station example



Milano Cadorna railway station

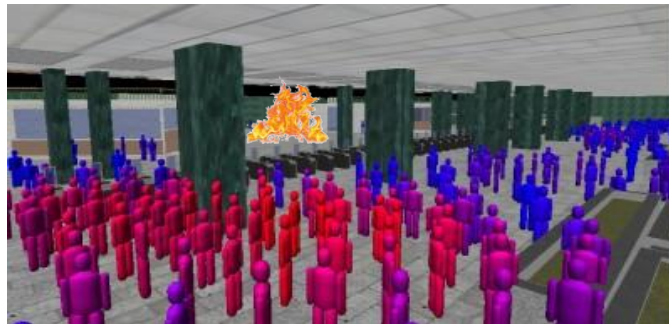
Normal conditions

- ▶ 600 people getting off 2 trains
- ▶ Exit towards subway station



Peak time conditions

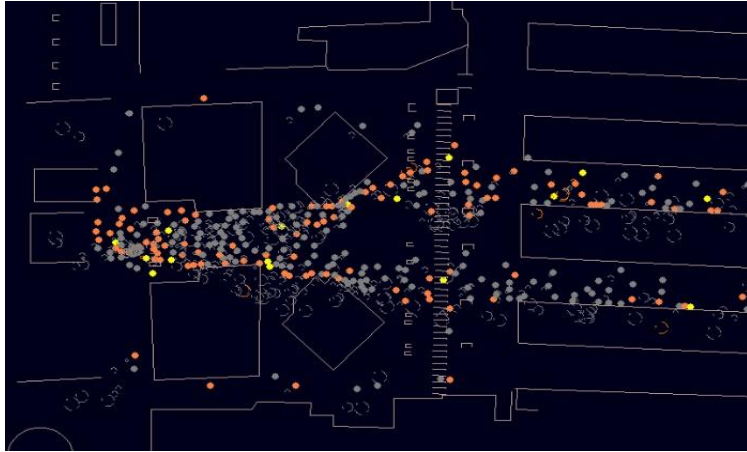
- ▶ 1200 people getting off 2 trains
- ▶ Exit towards subway station



Emergency conditions

- ▶ 600 people getting off 2 trains
- ▶ Fire outbreak in the main lounge

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Milano Cadorna railway station

Infection simulation

- ▶ 3% of infected people
- ▶ Proximity infection
- ▶ Resulting infection rate

Infection+airflow simulation

- ▶ 3% of infected people
- ▶ Airflow representation (wind, A/C)
- ▶ Proximity infection
- ▶ Breathing infection
- ▶ Resulting infection rate

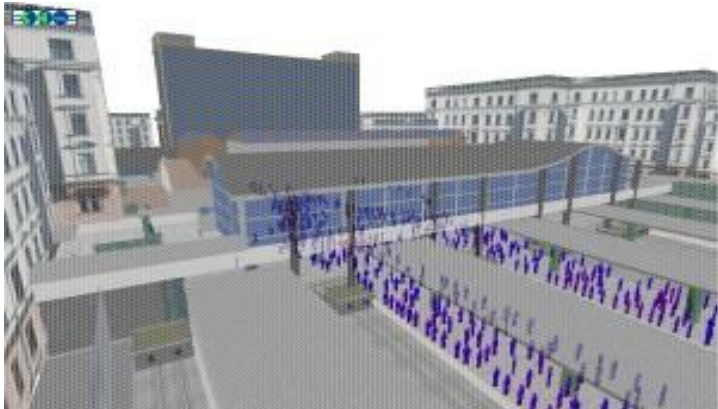
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Conclusions

SimuGENS is a D&T software simulating the crowd dynamics for safety and design purposes

Proven applications include urban areas as well as buildings and railway stations

The Milano Cadorna example shows the SimuGENS capabilities for the crowd simulation under normal or emergency conditions as well as for infection dynamics
The D&T SimuGENS VR demo provides a 3D immersive experience of a crowd simulation



Thanks for your attention

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