Simulation of the Neuschwanstein castle

Egress of a fairy castle

Hefei, 19th October 2016, Angelika Kneidl
King Ludwig II and the Neuschwanstein Castle

In former times ....

1868  King Ludwig II. designed the castle as an idealized idea of knights castle in the Medieval.
1869  Corner stone was laid.
1884  Castle has been built.
172   Days King Ludwig lived in the castle.
King Louis and the Neuschwanstein Castle

Today ....

2013, more than 1.52 million visited the castle. Up to 6,000 visitors a day, at peak times up to 10,000 visitors.
The Neuschwanstein castle at a glance

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Challenges

Situation:
› Every five minutes, a guided tour starts with 60 visitors.
› Around 700 visitors are inside the castle at the same time.
› Daily up to 10,000 visitors.
› Eight floors which are accessible by visitors.

Challenges to be addressed by simulation:
› How long does it take to get all visitors out of the castle?
› Where do bottlenecks occur?
› Can we adjust /optimize the escape route assignment?
Sample floor plan

Escape Routes:

- Four stair cases, two of which are spiral staircases – connect floor 4 to 0
- One stair case connecting floor 0 to floor -3
- Three exits on three different levels
Available exits

E1: Exit on level 1

E0: Exit on level 0

E-3 Exit via tunnel
Simulation Model
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- Simulation Tool: crowd:it
- Locomotion Model: Optimal Steps Model used for most realistic stepping behaviour modelling [1,2] in combination with dynamic floor fields [3]

Potential field for next step

radius = step width
disk

Simulation model on stairs

- Modelling of stairs based on the Optimal Stair Model [2]:

- Step width of pedestrian is predefined by tread width
- Pedestrian is implicitly slowed down by its reduced step length

Modelling of the stairs

Straight stair cases:
› Optimal stair model

Spiral stair cases
› Scaled velocity areas
Simulation Setup

Requirements:
› Escape routes towards moving direction.
› Stair cases should be utilized equally.

Population:
› 750 agents.
› Distribution of agents on each level upon consultation with building authorities.
› Different pre-movement times depending on the level (guided tours vs. free flow areas).
Screenshot of first and second iteration

Measurement area

Time spent in area

Length of stay in [s]

Arrival time in [s]

Simulation of the Neuschwanstein castle – Evacuation of a fairy castle. Angelika Kneidl
Results and Summary

› Resolving of spatial-temporal relationships.
› Improvement of evacuation times.
› Less congestions due to better distribution to different stair cases.
› Groups can be evacuated in moving direction.
I’m looking forward to your questions or comments!