Example of hybrid (indoor & outdoor routing) based on use of IndoorGML for smarter city services.

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’classic’ navigation
Current Outdoor Solutions
How do you do when indoor?
Indoor...
Heterogeneous solutions
Heterogeneous solutions
The basic idea

Room A

Room B

wall

Primal 3D space

Primal 2D space

Dual space

room A

room B

wall
(Jules Henri) Poincaré duality (1854-1912)
In practice

topographic space

adjacency graph in dual space

connectivity graph in dual space
Cell Space

• 2D space -> A surface (ISO 19107)
  – No Cell Space overlapping
  – Union does not need to be the entire indoor space

Geometry of CellSpace (door)  Geometry of CellSpace (room)
State

State as a panoramic spot

Navigation arrow

State as a panoramic spot
Transition

- As a straight line

- As a polyline: more properly reflects the path geometry
If the thickness of doors and walls are to be represented, then thick door model is better. If only simplified indoor structures are to be represented, then thin door model is better.
Connectivity (Thick)

Original Space

Adjacency Relationship of Transformed Graph

- Non-Navigable Space (wall)
- Navigable Space (room)
- Connection Space (door)
- Anchor Space (gate)
Connectivity (Thin)

topographic space

adjacency graph in dual space
Anchor Node

- Connect indoor and outdoor
- Define meta-data of the indoor space
- To define the CRS transformations
"an object is at any given time exactly in one cell (named state) in each layer simultaneously. This overall state is thereby denoted by the combination of active states from all space layers"
Subspacing as subgraphs

(a) Geometry model

(b) Original NRG

(c) Subspacing
Support different navigation patterns

- Different connectivity graphs at the same time
  - Walking user
  - Wheelchair user
  - Robots
  - Etc.
Out/Indoor navigation
Further examples
JOSM Plugin
It can get complex
Very complex
Conclusions

STANDARDS

MAY THE FORCE BE WITH YOU
Thank you

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