Similarities and Differences Between Outdoor and Indoor Space from the Perspective of Navigation

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Indoor Space

The terms "**outdoor space**" (**O-space**) and "**indoor space**" (**I-space**) here both refer to **built** rather than natural **environments**.

I-space covers the enclosed **interiors of buildings above the ground** and spaces **underneath the ground** that afford platforms for human activities.

Traditional geospatial science focuses on O-space. However, **humans spend most of their time in indoor environments**. Studies show that the average percentage of time spent indoors is **87%**.

I-space needs to be explored as well as the transition between O-space and I-space.

fuse

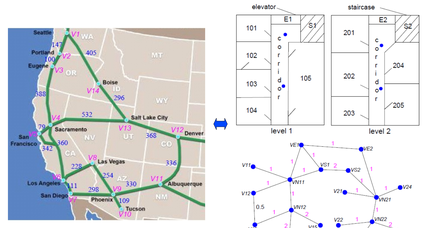
seamless

Structure of Spaces

Geometry and Topology:
Many **geometric and topological constructs** can be used to **represent** the **structure** of both **O-space** and **I-space**.

However, **I-spaces** generally have more "**regular**" geometries.

In **O-space**, distances, angles and coordinates play essential roles (e.g., latitude and longitude), so **Euclidean** concepts are important. In **I-space**, **topology** plays a more prominent role, for example, **connectivity** becomes more important than **direction**.



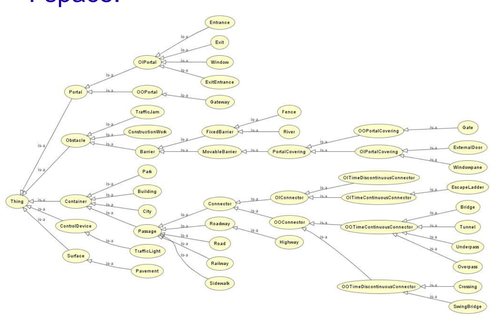
Scale and Dimension:
The **scale** of **O-space** is generally **larger** than I-space.

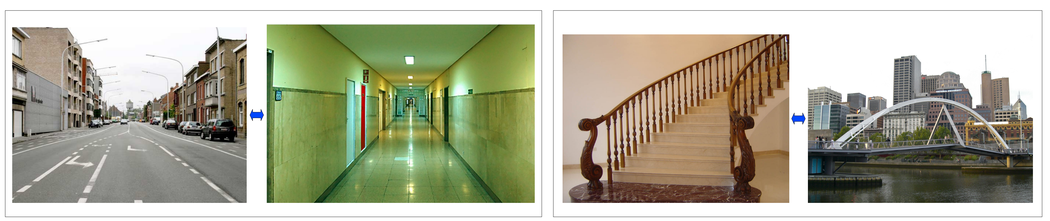
Structurally, **O-space** is usually represented in **two dimensions**, whereas **I-space** uses **three dimensions**.

Ontologies

The concepts involved in **ontologies of O-space and I-space** are **different**.

We use their **affordances** to **make connections** between entities in O-space and I-space.





Navigation

Landmarks:
Landmarks play the **same role** in both O-space and I-space, with **similar principles** and **characteristics**.

In **O-space**, both **distant** and **local landmarks** are recognizable. However, landmarks used in **I-space** are generally **local** ones.

Outdoor landmarks are often more **permanent** than indoor landmarks.

Routing Information:
Egocentric and allocentric cues can be used in both spaces.

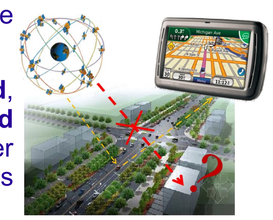
I-space is **multi-layered**, and so verbal directions like "go up to the 4th floor" are used. This is not the case in O-space.

Navigation Agents:
The navigation agents in **O-space** are **pedestrians** and **vehicles**, whereas in **I-space**, indoor navigation is currently mostly for **pedestrians**.

Positioning Technologies

GPS has become indispensable for navigation in O-space.

Because **I-space** is **enclosed**, GPS **signals cannot be received well** and we need to resort to other positioning technologies, such as Wi-Fi and RFID.



Future Work

Future work will be on development of **a unified model** of **O-space** and **I-space** focusing on navigation.

This will be achieved by extracting the common concepts and using the relationships between the two spaces.

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