3D indoor navigation: One algorithm for walking, driving and flying actors

Martijn Koopman
Geomatics, Faculty of Architecture, Technical University of Delft

Abstract:

Research and developments on indoor path finding has been commonly conducted on 2d floor plans and for one specific mode for navigation (usually walking). Such 2D applications are sufficient for most outdoor and indoor applications, but many indoor cases require true 3d solutions. For example when the size and shape of the actor is of importance or when different moving modes are needed (e.g. flying).
There are multiple ways to represent 3D environments and one of them by voxels. A voxelized model is a 3d uniform grid in which each grid cell (voxel) has information if it is 'empty' of belongs to an object (i.e. 'non-empty'). This representation has the advantages of being uniform and easy to perform neighbourhood operations, which are needed for path computation. This representation is also quite appropriate to identify which 'empty' space is most appropriate for a given user. A walking actor would be using the space above the floor voxels only, while flying actor would use the voxels above the vloor and all obstacle voxels However voxel representations could result in large data especially if the size of the voxels is small. For example, a building of 100x50x40 meters, represented with voxels of 20x20x20 cm, would results in 25 million voxels.
This research has investigated a voxel-based method that is applicable for all kind of actors and can be executed in almost real-time. The developed algorithm consist of two steps: pre-processing and path computation. The pre-processing step groups the voxels in larger cells. These cells are used to quickly identify which are the parts of the building, which are of interest for the specific actor. The detailed navigation on a voxel level is then performed within the selected cells. This approach allows almost double improvement of the performance compared to a path computation on the original vowelized model.

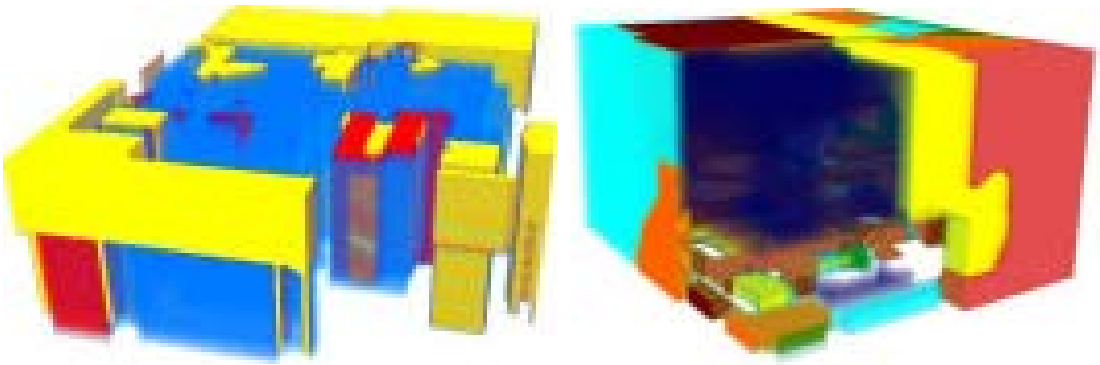

Figure 1: Spaces availble for different users (left) and cell unification for rough path computation (right)