Navigational Challenges in an Expanding Urban Space

A. Vanclooster[1,2], Ph. De Maeyer[1] and V. Fack[3]

[1] Department of Geography, Ghent University, Krijgslaan 281 (S8), 9000 Ghent, Belgium,
Ann.Vanclooster@UGent.be
[2] Fund for Scientific Research - Flanders
[3] Department of Applied Mathematics and Computer Science, Ghent University, Krijgslaan 281 (S9), 9000 Ghent, Belgium

The increase in population, especially the massive urban expansion creates an enormous pressure on the available space. To counter this, a more intelligent use of urban space is often proposed, resulting in increasingly complex buildings. However, this evolution puts a strain on the simplicity of way finding and indoor navigation. The 3D modelling of these indoor environments as well as the difficulties in guarantying efficient evacuation scenarios are also becoming much more challenging.

In the last decennium the interest in navigation applications, especially outdoor navigation, has greatly increased. The development of new technologies - including Wi-Fi, Bluetooth and RFID's - has shifted the focus of research more and more to the expansion of navigation systems to building interiors. As technological problems of indoor positioning slowly are being tackled, the three-dimensional modelling of indoor environments for analysis is lagging behind.

In research environments two approaches are currently being applied for indoor navigational analysis. 1) Originating from 3D modelling world, navigation and evacuation is based on graph networks, while the visualisation of 3D problems is achieved by CityGML. 2) In the evacuation simulation world crowd simulation modelling methods (originating from psychological research) have been developed for the prediction of emergency situations and the evaluation of interior design in planning. Despite their shared interest in analysing evacuation situations, both approaches have been developed largely separate from each other. Since they arise from different points of view, both are incomplete in one or more particular interests of urban planning. Existing indoor navigation models are often limited to networks without a connection to the actual building structure, while evacuation simulation models lack a thorough semantic model of urban space. At the moment there are therefore no or a limited number of models that can perform analysis, storage and visualization of three-dimensional information, leaving a major gap in today's 3D world. An analysis is made of the specific problems and research holes, exposing some key points and major deficits, such as network structures, the use of semantic attributes and visualisation efficiency.

With the development of these 3D approaches for, a wide range of new questions and challenges emerge on their particular use and benefits. These has to be solved before twining these approaches in an integrated model, moving towards a more sustainable spatial policy.

Key words: 3D modelling, urban space, navigation