Procedural Facade Textures for 3D City Models

Jürgen Bogdahn, Volker Coors

HFT Stuttgart – University of Applied Sciences, Stuttgart, Germany
{juergen.bogdahn;volker.coors}@hft-stuttgart.de

The use of 3D city models has been introduced into a variety of fields from urban planning to disaster management. These models are no longer regarded as 'simple' visual representations of the real world; they act as an information space and as semantic models for urban environments as they represent much more than the visual appearance of the real world. For users of these 'rich' models the Level of Detail (LoD) in which the information is presented is essential for the ability to fulfil their specific task. Photo-realism is not always required or appropriate and non-photorealistic appearance [1] (e.g. artificial transparency, etc.) can be a much better support for users. One example is pedestrian navigation where 3D renderings help users to navigate. In this scenario visual similarity of objects is sufficient for the navigation task. Therefore a LoD is not always a representation of the capabilities of the data provider, but even more an appropriate rendering for the specific scenario in which the model is used [4]. These LoDs are well represented for geometry in standards like CityGML [2], but textures are still static and fixed, although they can carry a vast amount of information without increasing the geometrical complexity of the model. In this paper we will present a flexible procedural concept for façade textures that is based on tiles. These tiles are arranged according to a description to rebuild the façade texture. The description in our case is composed by 'pulse functions' [6] arranged in layers to define 'active zones' in the façade where specific elements need to be placed. The layers allow to group elements of same type, like windows, doors, etc. and to integrate specific layers into the façade description in order to built appropriately detailed façade textures. Besides the definition of the 'active zones' the description can also include additional attributes in order to define certain behaviour. One example would be to change the texture according to the distance of the user in a specific context. Another benefit of the procedural approach is that the texture can be rebuilt using modern graphics hardware with programmable rendering pipeline (shader).

Fig 1: Prototype implementation: 3D city model of Munich on mobile device using tile based textures.
© HFT Stuttgart, data provided by Tele Atlas

Therefore, the workload for arranging the textures is handled by the graphics sub-system, and also the additional intelligence for context sensitive changes can be handed over to the GPU. This might result in ‘intelligent façade textures’ and might enable applications to hand over visualization of semantic information or context sensitive renderings to the graphics unit.

Procedural tile based textures might also provide new approaches for data acquisition as the texture consists of a description and texture tiles. The two parts might be generated in a different way and data might come from different sources. It needs to be investigated how new approaches can be realized and if they might also simplify the acquisition of façade textures. Another question that needs to be investigated is the integration of the presented approach for façade texturing into data management tools of 3D-SDIs and how open interfaces like the W3DS can handle these textures providing new capabilities. The test scenario in which we want to test the procedural texture approach is the MoNa3D project. MoNa3D investigates the use of 3D city models for pedestrian navigation systems [3][5]. This scenario seems to be a good test case as the user needs to fulfil a task, rather than only watching a 3D visualization and the LoD and context based rendering can be useful in this scenario as well. Hardware restrictions on mobile devices can also be used to investigate performance issues using texture tiles instead of complete façade textures.

References

[1] Buchholz, H., Döllner, J., Nienhaus, M., Kirsch, F., *Real-Time Non-Photorealistic Rendering of 3D City Models*, 1. International workshop on Next Generation 3D city models, Bonn, 2006

[2] Gröger, G., Kolbe, Th. H., Czerwinski, A., Nagel, C. , *CityGML*, OGC Standard , 2008

[3] Baur, M., Coors, V., Schulz, T., Zipf, A., *Zur Nutzung von 3D-Stadtmodellen für mobile Navigationssysteme*, GI Days 2008, Münster, 2008

[4] Ferwarda, J., *Three Varieties of Realism in Computer Graphics*, Proceedings SPIE Human Vision and Electronic Imaging 2003, 2003

[5] Schilling, A., Lanig, S., Neis, P., Zipf, A., *Integrating Terrain Surface and Street Network for 3D Routing* , Proceedings of 3D Geo-Info ‘08, Seoul, South Korea , 2008

[6] Parish Y., Müller,P., *Procedural Modeling of Cities*, Proceedings of ACM SIGGRAPH 2001, 2001

Intended form of presentation/submission: traditional academic paper + presentation