Towards Integrating Feature Surface Properties into 3D GIS

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Extended Abstract

In 3D GIS, 3D objects represent first-class objects and constitute the main category of components of 3D geovirtual environments. In general, analysis and simulation uses geometry and topology of these objects as well as semantics and application-defined data assigned on a per-object basis. However, more and more applications demand for a general functionality regarding arbitrary properties assigned on a per-surface basis. Examples include physical properties such as temperature or noise values defined for surfaces of 3D objects, generated by simulation and analysis processes. Further example include appearance data such as materials and textures, which become more and more available even for massive 3D geovirtual environments due to cost-effective, automatic capturing techniques such as facade texture extraction based on oblique imagery.

This development has been acknowledged with the inclusion of surface properties in CityGML, the new international standard for exchanging and storing virtual 3D city models issued by the Open Geospatial Consortium (OGC). To 3D GIS, surface properties still represent a relatively new category of data, which are not supported by generic functionality. Nevertheless, they need to become as accessible and flexibly useable as 2D raster objects due to their importance for 3D analysis and simulation applications.

In this contribution, we investigate the principal challenges for 3D GIS regarding the management and usage of general surface properties assigned to 3D features. In particular, we discuss how general surface properties impact and enhance the core components of a GIS:

- Capturing: How to define and create surface parameterizations.
- Storage: How to store massive surface property data.
- Retrieval: How to filter features based on their surface properties.
- Analysis: How to implement analysis operations for surface properties.
- Portrayal: How to visualize surface properties and how to apply them for advanced rendering techniques.

In our discussion, we exemplify solutions from other subject areas, such as computer graphics or computational geometry, and we identify existing GIS functionality that can be extended to cover surface properties.

We demonstrate a prototypical 3D geovisualization system that supports virtual 3D city models with multiple, massive surface properties assigned to 3D objects. The surface properties are stored by raster representations. As an example, we show how generic functionality regarding surface properties supports visualization and analysis of quality values of photorealistic facade textures, automatically derived from oblique images. Finally, we sketch how potential applications could benefit from the proposed general surface property functionality in future 3D GIS.