

### **3D URBAN TERRAIN MODELLING WITH BRIDGES AND HOLES**

Ms Rebecca, O.C. Tse, PhD Candidate  
Professor Christopher Gold

Hong Kong Polytechnic University, and

University of Glamorgan, Pontypridd, Wales, UK CF37 1DL  
Phone: 44 (0) 1443 483617 Email: rtse@glam.ac.uk

Terrain modelling is more and more frequently being used to include man-made objects, such as high-rise buildings, bridges and tunnels as well as the natural terrain. However, most current GIS systems appear to use a Triangulated Irregular Network (TIN) for the terrain modelling, and then use a Computer Aided Design (CAD) system to construct buildings, which are then superimposed on the TIN. This approach has significant limitations. Firstly, as the buildings are not topologically connected to the landscape, any analysis of adjacency or flow is not readily implemented. Secondly, features that produce topological holes or handles on the surface models, such as bridges and tunnels, may not be incorporated.

This problem may be resolved by combining the “boundary representation” (b-rep) structure of CAD systems with the triangulation structure of TINs. This is achieved by rephrasing both in the form of the “Quad-Edge” structure derived from Computational Geometry, developing CAD-type Euler Operators for the TIN model, and then expanding these to include an operator for the construction of bridges or tunnels. This gives a coherent unified data structure that permits the extrusion of buildings, the formation of bridges and tunnels, and the development of topological queries and analysis, such as runoff modelling. The result is a simple and reliable method for many applications in spatial analysis. The work is illustrated with examples of interactive modelling of part of the city of Hong Kong.