A deterministic method to integrate triangular meshes of different resolution

As a result of new sensors and methodologies that allow for faster and more accurate data acquisition, the production of highly detailed 3D models is becoming part of the standard workflow in many disciplines – architecture, cultural heritage, urban planning, and others. At the same time, new related problems have emerged concerning the management of the resulting large datasets and the integration of data coming from different sources. Data integration among heterogeneous datasets can lead to a variety of errors, and the reasons for these errors are multiple including geometric, topological or semantic incompatibilities, different resolutions and accuracies, and data acquired at different times. To overcome such errors, the integration of heterogeneous datasets requires appropriate homogenisation techniques. This article presents a new deterministic approach for the integration of a high resolution surface model and a lower resolution surface model, both given as triangular meshes embedded in 3D space, by means of a transition surface. The method can be applied after both datasets have been aligned. The derivation of the transition surface exploits extra data that are typically available in the high resolution model. These extra data (e.g. quite common when using a laser scanner) must be 2.5D and located around the high resolution model, they represent a sort of planimetric buffer around the high resolution model.
resolution object that can be thought as a “collar”. The proposed method generates a geometrically and topologically sound and continuous 2.5D surface that integrates the two models using the data contained in the collar. It takes into account the different quality aspects of the low and high resolution models such as point height, point density, and height gradient, and then creates a transition surface that interpolates these aspects between the embedded high resolution model and the surrounding low resolution model. The article also presents some experimental results, obtained from real datasets, and concludes with some remaining issues and possible improvements to the method.

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