Automatic Texturing of 3D Citymodels from Aerial Images

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In the recent years, several national mapping authorities started with projects for countrywide generation of 3D building models. As a result, more and more 3D city or regional models become available, typically with generalized roof geometry. An efficient way for increasing detailing, at least for visualisation in "flyover" mode, is mapping photo-realistic texture onto roofs and facades of the building models. In our work, we demonstrate how texturing can be done automatically from aerial images for large regions.

The pre-requisites for automatic texturing are: 3D building models and geo-referenced aerial images captured at high overlap, at least 60% along and 60% across flight axis. At first, we implemented an algorithm which seemed to be quite straight forward: Identify the optimum aerial image for texturising a specific polygon and do this for each individual roof or wall element. However, the first results were disappointing because the texturised buildings looked too inhomogeneous. For that reason, the algorithm which we finally implemented into our CityGRID software is optimised for homogeneous appearance by defining clusters of neighboring facade and roof elements and by trying to texturise each cluster from just one aerial image.

So far, our algorithm has been used for texturising from nadir images as well as from oblique images. Nadir images are fine for texturing roof elements, but they look quite steeply at the wall elements of the building resulting in blurred texture. However, looking steeply is advantageous at city center areas with high buildings standing close to each other, because it´s the only way to see the entire wall element from the top to the ground. Another argument for texturing from nadir images is low extra costs: We can re-use images taken for orthophoto production, with just additional flight strips for getting a side overlap of 60%.

At suburban or low density areas better facade textures can be generated from oblique images. Typical oblique image flight configurations offer a higher overlap: a wall element might be mapped in up to 10 images. This high overlap is prerequisite for consideration of visibility in the course of automatic texturing. In case a wall element is hidden by a neighboring building, our algorithm for visibility analysis tries to find a better qualified image.

The largest project we performed so far, was automatic texturising of Berlin city model from Microsoft Osprey nadir and oblique images. 550.000 building models have been texturised within 3 months employing 5 computers simultaneously. In average, it took 10 seconds for texturising one building or 30 seconds respectively, when visibility analysis has been switched on.

In summary the benefits of automatic texturing from aerial images are: fast computation time, applicable for large urban or regional models and significantly increased value of the building models.