Integrating Sensors on a Smartphone to Generate Texture Images of 3D Photo-realistic Building Models

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KEY WORDS: Three-dimensional Building Modelling, Photo-realism City Model, Texture Rendering, Direct Georeferencing, Automation, Digital Close-range Photogrammetry, Virtual Reality

ABSTRACT: A 3D photo-realistic building model which can represent the real appearance of the building should be composed by precise geometric model and realistic façade images. There are a number of approaches to reconstructing the geometric model from photogrammetric images and LiDAR points cloud. However, the façade texture generation still relies on massive labor works, therefore, are still the bottle neck in the photo-realistic building modeling process. The emphasis of this paper will be put on the integration of sensors on a smartphone. While the camera is collecting the realistic photo of the building façade, the built-in GPS receiver and G-sensors are recording the approximate 3D coordinates and 3 rotation angles of the exposure station. However, these data are not accurate enough for the texture image generation. A semi-automated approach is proposed to improve the accuracy of the position and orientation data and to generate the precise façade texture images. The reconstruction of 3D realistic building models consists of three major issues: (1) geometrically modelling the object; (2) determining the image orientation; (3) generating the realistic façade texture from photographs. By introducing the "Floating Model" concept, the object modelling and image orientation problems can be solved efficiently through the semi-automated procedures based on the Least-squares Model-image fitting (LSMIF). A friendly human-machine inter-acting interface is designed for an operator to choose suitable model. Then the operator can move, rotate, or resize the model to approximately fit among all of the images. An *ad-hoc* LSMIF algorithm is developed to solve the optimal fitting between projected model line segments and extracted edge pixels. Since the object model can be extracted and the photo orientation can be determined, the creation of realistic texture image, which is also called inverse mapping, can be automated by coordinate transforming and image resampling. For better understanding the camera characteristics on a smartphone, a series of camera calibration process has been executed to derive interior orientation parameters before taking façade pictures. Three representative buildings in NTNU campus are selected for the experimental tests. The geometric models are reconstructed by fitting floating models to aerial photogrammetric images. The façade photos are taken by smart phones on the ground. The result shows that the proposed approach is practicable, but the lens distortion must be corrected before creating texture image. Since the iterative LSMIF algorithm requires initial parameters, the position and pose derived from built-in sensors must fall in the pull-in range.