ACCURATE POSE AND LOCATION ESTIMATION OF UNCALIBRATED CAMERA IN URBAN AREA

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Abstract:

Accurate 3D models of buildings in urban area are needed for a variety of applications, such as post-disaster assessment, urban planning, and tourism etc. Many methods for extraction of such 3D models from aerial images have been developed in recent years. Aerial images provide wide area coverage, however, the model extraction from aerial images is a time consuming process and cannot be real-time. So it is not fit for the sudden damage of urban area. On the other hand for aerial images, the walls of buildings are either not visible or seen at a very low resolution. We need to utilize images taken from the ground, helicopter or unmanned aerial vehicles (UAVs) to obtain accurate façade textures.

As we know, in the researches of scene recovery, it is important to obtain the post and location of each view taken by camera (i.e. orientation parameters). This paper presents a method of high-precisely estimating the pose parameters of images from common digital camera (also termed with uncalibrated camera). In urban area, there exist abundant geometric feature in the surfaces of buildings, such as horizontal, vertical parallel lines and orthogonal lines, planes. According to these special features, this paper addresses a novel algorithm based on vanishing points of multi-view to accurately solve the interior and exterior orientation parameters of each view. Thus, the pose and location of each image can be recovered. Finally, according to correspondence of lines, the outlines of buildings can be obtained rapidly by using geometric constraint based bundle adjustment. Moreover, based on these parameters, this paper also presents object-space based line matching algorithm. With this algorithm, we can recovery the outlines of buildings in building scene.

Although there are many studies based on vanishing points theory, this method still has several advantages of its own demonstrated as below:

1) The estimating precision of exterior orientation parameter is very high. Many studies about post estimation based on vanishing points ignored the distortion of lens that greatly affected and restricted the precision of result. While, this paper solves the problem resulted from the distortions of lens. The presented algorithm regards the radial distortion as a kind of factors, and calculates the parameters of distortions into the whole bundle adjustment system.

2) All of the processes are automatically and real-time. For those sudden building damage, it is important for a solution to have the property of rapid response. Therefore in this method, Automatically obtainable image features such as searching vanishing points and grouping geometric property that indicate the external and some internal parameters of camera are used to reduce user interactions for the correspondences.

Keyword: Pose estimation; Rapid response; Camera calibration; Bundle adjustment; Building scene recovery