

A MODIFIED SFS ALGORITHM BASED ON STEREO IMAGES FOR THE-DIMENSION RECONSTRUCTION OF URBAN BUILDINGS

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Abstract: During recent years, the need for three-dimensional information of urban buildings has increased. This three-dimensional information is needed for a variety of applications such as urban planning, architecture, land resources investigations or transmitter placement in telecommunication. All these different applications need three-dimensional city models, but of course the requirements concerning the model vary for different applications. At present, the approach of three-dimensional reconstruction utilizing the stereo pair in photogrammetry has been well known, and scholars have deep study on three-dimensional model reconstruction for photogrammetry in recent years.

The blind areas (non-overlapping areas) of two adjacent aerial images are usually large in Urban Remote Sensing, in order to reconstruct three-dimensional information of the building in these blind areas, this paper proposes a new algorithm combining the SFS (Shape from shading) algorithm in the field of computer vision. The SFS algorithm is shaping the object from the shading information of a single image. Because of the limitation of single image information, the stereo model which is reconstructed from the general SFS algorithm can just be used for displaying, and the distorted degree is relatively great, can not meet the basic requirement of urban buildings' three-dimensional reconstruction. So a modified SFS algorithm based on stereo images is proposed, this paper utilizes the stereo images of which relative orientation and absolute orientation has been already finished to reconstruct the three-dimensional information of the building in these blind areas. The designed procedure is described as follows:

Step1: Get the relative elevation information of GCPs (Ground Control Points)

Surface reconstructed from both of the stereo pair images by the traditional SFS algorithm, and we can get the relative elevation information of the ground object.

Step2: Calculate the surface appearance gradient of Ground Control Points

The surface appearance gradient of the corresponding object is got from inverse calculation according to elevation information of the ground object and the grey value of its corresponding pixel.

This step sets the constraint for Step3.

Step3: Modify image gradient constraint

The image gradient constraint is modified by the object surface appearance gradient.

Step4: Reconstruct the three-dimensional information

Reconstruct the three-dimensional information of the building in these blind areas by the new algorithm with the modified image gradient constraint.

The experiment result by using the stereo pair of Shilong City's high-resolution aerial remote sensing data reveals that the stereo models reconstructed by the modified algorithm are much better and have lower distortion compared with those reconstructed by the general SFS algorithm, and the three-dimensional information of the building in the blind areas can be restored by this new SFS algorithm.

Keywords: Shape from shading; building three-dimensional reconstruction; high resolution image; stereo pair;

REFERENCES:

- [1] Emmanuel Prados, Olivier Faugeras, Shape From Shading, In Mathematical Models of Computer Vision, Springer, 2005.
- [2] Durou J, Falcone M, Sagona M. A survey of numerical methods for shape from shading [R], Falcone: IR IT Uni2, Versity Technical, 2004.
- [3] Prados E, Camilli F, Faugeras O, A viscosity solution method for shape from shading without boundary data[J]. Submitted to ESA IM: Mathematical Modelling and Numerical Analysis, 2006, 40 (2), 392--412.
- [4] Ruo Zhang, Ping-Sing Tsai, James Edwin Cryer and Mubarak Shah, Shape from Shading: A Survey, IEEE Transactions on Pattern Analysis and Machine Intelligence, 1999, vol.21, Pages: 690--706