Camera calibration and shape recovery from videos of two mirrors

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Camera Calibration and Shape Recovery from Videos of Two Mirrors

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A thesis submitted in partial fulfilment of the requirements for the degree of Master of Philosophy

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March 2015

DECLARATION

I hereby declare that this thesis represents my own work which has been done after registration for the degree of MPhil at Hong Kong Baptist University, and has not been previously included in a thesis or dissertation submitted to this or any other institution for a degree, diploma or other qualifications.

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Camera Calibration and Shape Recovery from Videos of Two Mirrors

Abstract

Mirrors are often studied for camera calibration since they provide symmetric relationship for object which can guarantee synchronization in multiple views. However, it is sometimes difficult to compute the reflection matrices of mirrors. This thesis aims to solve the problem of camera calibration and shape recovery from a two-mirror system which is able to generate five views of an object. It firstly studies the similarity relationship of the motion formed by the five views in two-mirror system with the circular motion. It is shown that the motion formed by the five views can be regarded as two circular motions so that we can avoid computing the reflection matrices of mirrors.

This thesis then shows the most important problem which is to recover the vanishing line of rotation plane and the imaged circular points by two unknown equal angles via metric rectification. After that, it is easy to recover the imaged rotation axis and the vanishing points X-axis via imaged circular points. Different from the state-of-the-art algorithm, this thesis avoid computing vanishing points X-axis at first because it will cause accumulative error

when recovering the imaged rotation axis. By now it is enough to compute the camera intrinsics which is the main objective of this thesis. At last, a 3D visual hull model of object could be reconstructed once all the projective matrices of views were computed.

This thesis uses a short video instead of static snapshots so that the reconstructed 3D visual hull model of each frame can be put together based on the motion sequence of object to make a 3D animation. This animation can help to boost the accuracy of action recognition in contrast to 2D video. In general, the action recognition by 2D videos always distinguishes action according to the side of human taken by videos but cannot do for the side does not appear in videos. It then requires to store every direction for human actions of video into database which causes redundancy. The 3D animation can deal with this problem since the reconstructed model can be seen in every direction so that only one 3D animation of human action is needed to store in database. The experimental results show that the more frames are used, the less error of camera intrinsics will occur and the reconstructed 3D model shows the feasibility of the approach.

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