VIEW SYNTHESIS USING UNCALIBRATED CAMERAS

by

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1. Cameras
2. Uncalibrated Cameras

Certificate

This is to certify that the thesis titled **"View Synthesis Using Uncalibrated Cameras"** being submitted by Geetika Sharma (Nee Agarwal) to the Department of Mathematics, Indian Institute of Technology, Delhi, for the award of the degree of Doctor of Philosophy, is a record of bona-fide research work carried out by her under our guidance and supervision. In our opinion, the thesis has reached the standards fulfilling the requirements of the regulations relating to the degree.

The results contained in this thesis have not been submitted to any other university or institute for the award of any degree or diploma.

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To my parents, Dilip and Deepa Agarwal
and my husband, Ashutosh Sharma

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Abstract

This thesis addresses the problem of synthesizing novel views of a scene from multiple input images taken by uncalibrated cameras. The internal parameters of the cameras are assumed to be unknown and varying. The motion of the cameras is also unrestricted. The scene may consist of only static objects or may have some moving objects undergoing rigid motion. The number of input images of the scene may vary and we have also considered the problem of view synthesis of objects that are affinely repeated in a scene from a single input image.

Using the principles of Multiple View Geometry, we have developed transfer based techniques for view synthesis from images of static scenes. These techniques compute z-buffer values that can be used for resolving changes in visibility in the new view without rectifying the input views. We also propose a reconstruction based technique for view synthesis of static scenes from images taken by cameras undergoing general motion. This technique reconstructs the scene in an affine space with the knowledge of three vanishing points in a single input image. We present a method to specify a completely new camera in the affine space of the reconstruction and synthesize new views corresponding to it.

We also propose a technique to reconstruct dynamic scenes with objects undergoing rigid motion in an affine space with the assumption of three vanishing points in a single view which may come from parallel lines on the static background. This is used to synthe-

size new views of the scene corresponding to new cameras with user chosen rigid motions for the moving object.

As the reconstruction and transfer based methods are point-based, the extent of the renderable portion of the scene is limited by the availability of point correspondences. We explore the problem of building a voxel model of static as well as dynamic scenes from images taken by uncalibrated cameras using their affine reconstructions. The voxel model can then be used to synthesize new views in which a larger portion of the scene is visible.

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