Chapter 31

Image Based 3D Modeling and Rendering from Single View Perspective Images

S. Mohan
N.G.P Institute of Technology, India

S. Murali
Maharaja Institute of Technology, India

ABSTRACT

In computer vision, 3D modeling refers to the process of developing 3D representation of the real world objects with systematic procedure. The 3D models can be built based on geometric information about the object or scene to be modeled using CAD/CAM software. However, this approach needs prior knowledge of the objects in the scene like dimension, size of objects, distance from the object to camera, et cetera. To make the 3D models more photo realistic and convenient, images of the objects can be used to build the 3D models. In this chapter, the authors propose a method to extract 3D model from single view perspective image. The approach is based on edge length and exploiting symmetric objects in the scene. Later, an application of touring into picture is discussed with the proposed method.

INTRODUCTION

There are mainly two reasons for the diversion from stereovision – 3D modelling with multiple images, to monocular vision – 3D modelling with a single image. Firstly, it allowed researchers to clearly understand the importance of monocular cues and how useful it would be when combined with binocular cues. 3D reconstruction will be more visually pleasing when monocular cues are combined with binocular cues. Secondly, it allowed researches to elucidate what sorts of monocular cues are useful for depth perception. Monocular cues are interesting and important. Further, monocular cameras are cheaper, and their installation is less complex then stereo cameras. Using single view images, reconstruction of 3D works well even at larger distances. But in stereo vision, the accuracy is limited by the baseline distance between the two cameras. When the distance...
between the cameras becomes large, surfaces in
the images exhibit, different degrees of occlusion,
large disparities, etc, all of which makes it more
difficult for a computer to accurately determine
the depth of the scene. Due to all these reasons,
recent work on 3D reconstruction is done mainly
using single view images. It is called as Single
View Modeling (SVM).

SVM refers to building three dimensional
models from single image. It is inferred from the
literature (Seitz, 2001, Criminisi, 1999, & De-
bevec, 1996) that 3D reconstruction from a single
image must necessarily be through an interactive
process in which the user provides information
about the scene structure. Such information may
be in terms of vanishing points or vanishing lines,
co-planarity, spatial inter-relationship of features,
surface normal, and camera parameters. Some of
the traditional approaches based on shape, shading
and texture have complicated user interaction in
terms of specifying the inputs.

Recent works deal with various kinds of 3D
modeling methods – a little user interactivity is ef-
ective in reconstructing a 3D model (Seitz, 2001)
were high quality results were obtained on images
with limited perspective distortion but only visible
surfaces in an image could be modelled in the 3D
thus leading to holes near the occluded boundaries.
Another algorithm was introduced later by Feng
Han which reconstructed 3D shapes and scenes
of an object with prior experience or knowledge
using Bayesian reconstruction (Han, 2003). Derek
Hoiem later proposed a fully automatic method
for creating virtual walkthroughs from a single
photograph. Though the algorithm proposed did
not work on every single image, surprising results
were obtained on a wide range of images (Hoiem,
Derek, 2005). The approach proposed by Tal Has-
sner was interesting as 3D reconstruction was done
with the help of a database of 2D images. Hassner’s
approach also provided accurate results but did not
do well on unstructured objects (hands). A large set
of probable images (Hassner, & Basri, 2006) were
stored in the database with their depth maps. The
input image is compared with the images in the
database and the most probable match is selected
and the probable depth is estimated. Another re-
construction technique was proposed recently by
A. Saxena were the Markov Random Field (MRF)
algorithm was used given only the 2D image as
input. No particular assumptions were made in this
approach which was beneficiary (Saxena, & Ng,
2007). This approach created 3D models which
were visually pleasing to the user’s eye.

Perspective image in simple terms is an ap-
proximate representation of an image as seen by
the human eye. A point in the perspective image
to which the parallel lines not parallel to the image
plane appear to converge is called the vanishing
point. Hence, in the single view perspective im-
ages, parallel lines converge at vanishing point.
The line which is passing through more than one
vanishing points and parallel to the ground plane
is known as the horizon line (Criminisi, 1999),
(Hartley, 2003). The lines perpendicular to the ho-
rizon line may contribute a vanishing point which
may be very far from the image boundary (Figure
1). In Figure 1, the edges 1, 2 and 3 are of equal

Figure 1. Visual clues in terms of edges in perspective image
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