Chapter 13
Visualization and Analysis of 3D Images Using Data Mining Approaches

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ABSTRACT

With the recent advancements in supercomputer technologies, large-scale, high-precision, and realistic model 3D simulations have been dominant in the field of solar-terrestrial physics, virtual reality, and health. Since 3D numeric data generated through simulation contain more valuable information than available in the past, innovative techniques for efficiently extracting such useful information are being required. One such technique is visualization—the process of turning phenomena, events, or relations not directly visible to the human eye into a visible form. Visualizing numeric data generated by observation equipment, simulations, and other means is an effective way of gaining intuitive insight into an overall picture of the data of interest. Meanwhile, data mining is known as the art of extracting valuable information from a large amount of data relative to finance, marketing, the internet, and natural sciences, and enhancing that information to knowledge.

INTRODUCTION

The advent of innovative 3D technology and accruing sales of 3D consumer electronics, has accompanied an increase in demands of more and more 3D technology. This has led to wide interest in conversion of the already existing two-dimensional (2D) contents to three-dimensional (3D) contents in the field of image processing. This is a great issue in emerging 3D applications because the conventional 2D content do not provide the depth information which is required for the 3D displays. So 3D displays enhance visual quality more than two-dimensional (2D) displays.

The 2D to 3D conversion adds the binocular disparity depth indication or cue to the digital images perceived by the human brain. Therefore, if it is done appropriately, it significantly improves the immersive effect while one is viewing this stereo video in comparison to the original 2D video. However,

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in order to be successful, this conversion needs to be done with sufficient accuracy and correctness, that is, the quality of the original 2D images should not deteriorate, and also the introduced disparity cue should not contradict to the other cues used for depth perception by the human brain. If this is done properly and thoroughly, the conversion produces stereo video of similar quality to "native" stereo video which is shot in stereo and accurately aligned and adjusted in post-production.

It has been found that the manual conversion of 2D - 3D image have been the most effective but then again are costly in terms of time. Many automatic conversion techniques have thus been proposed but each of these techniques consider assumptions that are not met in the real world.

The main difference between 2D and 3D images is clearly the presence of depth in 3D images which makes calculation of depth the most important factor during conversion of images from 2D to 3D. Several methods have been proposed for the same. Out of these we shall study mainly two methods. First, calculating the depth using the edge information of the existing 2D image and second, depth map evaluation by kNN based learning from training set of images. To compare these two methods, we use the generation of a depth map. A depth map is an image or image channel that contains information relating to the distance of the surfaces of scene objects from a viewpoint.

Data mining is defined as "extracting nonself-evident information from data". Included among the various analysis techniques available to suit specific data characteristics and objectives are pattern extraction, regression analyses, class separation and clustering. Another such technique is visual data mining intended to provide cutting-edge visualization to large volumes of data that are difficult to understand when visualized in a simple manner, thereby allowing heuristic analysis

Techniques aimed at analysis data in a 2D plane, such as wavelet analyses and pattern recognition, are commonly known means of applying visual data mining to numerical simulation data in the fields of natural sciences. Conversely, visualization and data mining techniques that target data in a 3D space have yet to be established regarding the extraction of information from 3D data. We have thus pursued visual data mining techniques capable of extracting information from 3D data and 3D time-varying data, and analyzing it heuristically. In this paper, we introduce various techniques for visual data mining for 3D time-varying data generated from 3D simulations for solar-terrestrial physics, and related applications.

Conversion of 2D to 3D Images

Calculating the depth using the edge information and second, depth map evaluation by kNN based learning. Using examples and with parameters, we compare these techniques to find out the optimum approach for conversion of 2D images to 3D images by introducing depth in the latter. Depth generation algorithms for 2D to 3D conversions face two major challenges. First is the depth uniformity inside the same object in the image. Because the image consists of 2D pixel arrays, information about the object grouping relation of pixels is lacking. A better grouping of pixels implies a better outcome for the depth uniformity inside the object. An effective grouping method should consider both color similarity and spatial distance. The other challenge involves figuring out an appropriate depth relationship among all the objects in an image.

To overcome these two challenges, algorithm can be designed that uses a simple depth hypothesis to assign the depth of each group rather than retrieving the depth value directly from the depth cue. Firstly, an effective grouping method is chosen which involves grouping pixels that have similar colours and spatial locality. Now the depth values are assigned according to the hypothesis depth value. To enhance the visual comfort, a cross bilateral filter can be applied.

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