The Summer Undergraduate Research Fellowship (SURF) Symposium
3 August 2017
Purdue University, West Lafayette, Indiana, USA

Image-Based Compression Method of Three-Dimensional Range Data with Texture

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ABSTRACT

Recently, high speed and high accuracy three-dimensional (3D) scanning techniques and commercially available 3D scanning devices have made real-time 3D shape measurement and reconstruction possible. The conventional mesh representation of 3D geometry, however, results in large file sizes, causing difficulties for its storage and transmission. Methods for compressing scanned 3D data therefore become desired. This paper proposes a novel compression method which stores 3D range data within the color channels of a regular 2D output image. Our method encodes the 3D range data's respective normalized phase map, generated by a virtual stereovision system, into two of the output image's color channels using space filling curves. The remaining color channel is used to store a texture image. Once the data is encoded within the 2D output image, lossless or lossy 2D image and video compression techniques can be taken advantage of to further compress the data. The compressed image/video can later be decoded to reconstruct original 3D range data using the calibration parameters of the virtual stereovision system. Experiments verify that the proposed method accurately recovers both geometry and texture information, while achieving high compression ratios. For example, comparing with the OBJ mesh format, lossless PNG storage of our method's encoded image achieved a 98:1 compression ratio with almost no loss of quality; lossy JPEG with 85% quality achieved a 618:1 compression ratio with a slight loss of quality; and H.264 video compression achieved a 1421:1 compression ratio for a sequence of consecutively recorded frames. As the proposed encoding and decoding process can be applied to most of the current platforms, this novel compression method can help make 3D data storage and transmission immediately available for many different devices.

KEYWORDS

Three-dimensional scanning, data compression, image processing, digital fringe pattern, space filling curve