J Real-Time Image Proc
DOI 10.1007/s11554-013-0372-z

SPECIAL ISSUE PAPER

OUB: a scalable grid-based surface-representation for realtime high-resolution rendering

JaeMoon Choi · SangHyun Seo

Received: 19 May 2013 / Accepted: 20 August 2013

Abstract In this paper, we present a scalable solution for high-resolution surface representation of a 3D surface. To achieve this, we introduce an Orthogonal Unified Buffer (OUB) which is an extension of the Layered Depth Cube as an alternative to the Orthogonal Frame Buffer (OFB). The OUB re-samples the surface uniformly while conserving data locality build on previous approaches. Compared to the OFB, the OUB achieves significant improvement in scalability, which enables further high-resolution representation of 3D models having various depth-complexities. It also guarantees plausible memory efficiency, independent of an object's shape or topology. Our method is built and performed on the GPU and it only uses atomic operation of modern GPU, thus, it is well suited for real-time application. In addition, since the OUB can be is generally used in various graphics applications, we briefly show high-resolution 3D painting, curvature estimation and particle system based on the OUB.

Keywords Realtime rendering · Orthogonal unified buffer · Frame buffer · UHD · Computer graphics

1 Introduction

Since the early days of computer graphics, data structures storing sparsely defined color or 3D geometric information onto the memory have been important. Such data structures have been employed by various graphics applications, such as surface texture, 3D painting, surface fluid simulation, and collision detection. In this paper, our main focus is on texture mapping.

There are several kinds of methods for texture mapping of 3D surfaces. Vertex coloring is one of the traditional and intuitive ways to store the 3D spatial data of surfaces, and it is still used in many graphics applications. However, this method requires additional geometric information to keep the color detail of the surface. Using intermediate geometry like a cube or a sphere is also a commonly used method for representing the surface detail of a 3D model [8], but it does not guarantee a one-to-one mapping between the 3D model and the texture information.

2D parametrization of 3D surfaces is typically used in texture mapping for representing surface detail, since this method shows controllable memory efficiency and scalability. It does, however, require considerable pre-computation time for satisfactory parametrization. Moreover, mapping distortion and seam discontinuity are not completely avoidable. Grid-based sampling of spatial data such as Octree texture introduced by Benson and Davis [3], can address these problems. However, there still remains memory efficiency, scalability, and performance issues among these approaches.

In the past decade, scalable graphics algorithms have received considerable attention among the graphics community, especially because of developing trends in high definition display devices, and more, recently, there is a way to represent Ultra-High Definition (UHD: 7, 680 $\times$ 4, 320) images with a single device. For 3D rendering that is well suited for such devices, a texture mapping method that provides both high resolution and uniform quality over the surface must first be attained. Unfortunately, few research efforts have considered such a data structure.

J. Choi
InusTech Inc, Seoul, South Korea
e-mail: jaemoon.choi@rapidform.com

S. Seo (✉)
Creative Contents Research Lab., Electronics and Telecommunication Research Institute (ETRI), Daejeon, South Korea
e-mail: shseo@etri.re.kr

Published online: 05 September 2013