Workshop on Image Based Graphics
Relatório Final

1. **Organizadores**
   Paulo Carvalho e Luiz Velho, IMPA

2. **Data e Local**
   O workshop foi realizado no IMPA, nos dias 7 e 8 de março de 2006 e contou com recursos do Instituto do Milênio (AGIMB). O Workshop deu prosseguimento a atividades de colaboração envolvendo o IMPA, a UFRGS, a UNICAMP e a Universidade de Washington, refletidas em publicações conjuntas e participação em orientação de teses (como a Asla Medeiros e Sá (IMPA), defendida no dia 9 de março, com a participação de Michael Goesele e Manuel Oliveira na banca).

3. **Palestrantes**
   - Michael Goesele, Universidade de Washington
   - Manuel Oliveira, UFRGS
   - Siome Goldenstein, UNICAMP
   - Marcelo Bernardes, UFJF
   - Paulo Carvalho, IMPA
   - Luiz Velho, IMPA

4. **Programação**
   7 de março
   13:00 - Abertura
   Luiz Velho e Paulo Carvalho, IMPA
   13:30 - Modeling and Rendering of Surface Details Using Relief Mapping
   Manuel Oliveira, UFRGS
   15:00 - Correspondences for Vision and Graphics
   Siome Klein Goldenstein, UNICAMP

   8 de março
   10:30 - Real time 3D video using (b,s)-BCSL code
   Marcelo Bernardes, UFJF
   13:30 - (Re-)Visiting Two Vison Problems
   Michael Goesele, University of Washington
   15:00 - Panel: Perspectives on Image-Based Graphics
   Moderadores: Luiz Velho e Paulo Carvalho, IMPA

5. **Resumo das Palestras**

Modeling and Real-Time Rendering of Surface Details Using Relief Mapping
Manuel Oliveira, UFRGS

I will present three related image-based techniques for mapping surface details to polygonal models. First, I will describe a technique for mapping relief textures onto arbitrary polygonal models in real time. In this approach, the mapping of the relief data is done in tangent space. As a result, it can be applied to polygonal representations of curved surfaces producing correct self-occlusions,

interpenetrations, shadows and per-pixel lighting effects. The approach can be used to consistently add surface details to geometric models undergoing deformations, such as in the case of animated characters commonly found in games. The technique uses an inverse formulation (i.e., pixel driven) based on an efficient ray-height-field intersection algorithm implemented on the GPU. It supports extreme close-up views of the surfaces, mip mapping and anisotropic texture filtering. Also, contrary to high-dimensional representations of surface details, the low memory requirements of the proposed technique do not restrict its use to tiled textures.
Next, I will show how to extend this first technique to render correct silhouettes. For this, each vertex of the polygonal model is enhanced with two coefficients representing a quadric surface that locally approximates the object's geometry at the vertex. Such coefficients are computed during a pre-processing stage using least-squares fitting and are interpolated during rasterization. Thus, each fragment contributes a quadric surface for a piecewise-quadric object-representation that is used to produce correct renderings of geometrically-detailed surfaces and silhouettes.
In the end, I will show how to extend the previous techniques to support the mapping of non-height-field surface details. It generalizes the notion of relief mapping to support multiple layers. This technique can also be used to render realistic impostors of 3D objects that can be viewed from close proximity and from a wide angular range. Contrary to traditional impostors, these new one-polygon representations can be observed from both sides, producing correct parallax and views that are consistent with the observation of the 3D geometry they represent.
This work was done in collaboration with Fabio Policarpo and Joao Comba

Correspondences for Vision and Graphics

Siome Klein Goldenstein, UNICAMP

Nesta palestra, abordamos a importancia do problema de estabelecer correspondencias entre imagens tanto para visao como para computacao grafica. Classificamos os tipos de situacoes para o calculo das correspondencias, e analisamos tres tecnicas ja estabelecidas para sua determinacao. Distinguimos os erros de precisao e erros grosseiros e como os aplicativos podem contorna-los. Finalmente, descrevemos e validamos o UKLT, uma nova tecnica facil de implementar e utilizar que desenvolvemos recentemente. Alem de calcular correspondencias, o UKL prove melhor informacao a respeito da precisao e elimina de forma mais eficiente erros grosseiros (outliers).

Real time 3D video using (b,s)-BCSL code

Marcelo Bernardes, UFJF

In this paper we describe the first phase of the fourth generation video, a project to investigate the next digital video format. Our system is a complete platform for 3D video, including acquisition, encoding, transmission and exhibition. The system consists of an acquisition device, data processing, transmission and visualization modules. It generates 3D video in real-time (30 fps) from a wide range of scenes.
The acquisition device employs active stereo and is composed of calibrated, synchronized video camera and projector. The data processing module extracts depth information from structured light code. The transmission module performs I/O as well as data stream compression and decompression. The visualization module renders 3D video using dynamic point-based geometry. Here, we emphasize the 3D video capture aspects of the system using a câmera projector setup.

(Re-)Visiting Two Vison Problems

Michael Goesele, University of Washington

I will present results from two recent projects:
First, I will describe a simple and robust method for surface mesostructure acquisition. The method builds on the observation that specular reflection is a reliable visual cue for surface mesostructure perception. In contrast to most photometric stereo methods, which take specularities as outliers and discard them, the proposed progressive acquisition system captures a dense specularity field as the only information for mesostructure reconstruction. The method can efficiently recover surfaces with fine-scale geometric details from complex real-world objects with a wide variety of reflection properties, including translucent, low albedo, and highly specular objects.

In the second part of the talk, I will present an extremely simple yet robust multi-view stereo algorithm and analyze its properties. The algorithm first computes individual depth maps using a window-based voting approach that returns only good matches. The depth maps are then merged into a single mesh using a straightforward volumetric approach. I will present results for several datasets, showing accuracy comparable to the best of the current state of the art and rivaling more complex algorithms.

Rio de Janeiro, 3 de novembro de 2006

Paulo Cezar Pinto Carvalho