The VISGRAF Laboratory

Luiz Velho   Paulo C. P. Carvalho

IMPA – Instituto Nacional de Matemática Pura e Aplicada
Estrada Dona Castorina, 110
22460-320, Rio de Janeiro, RJ, Brazil
{lvelho, pcezar}@impa.br

Abstract

The Visgraf Laboratory, at the Institute of Pure and Applied Mathematics – IMPA, does research and development in all aspects of Computer Graphics, focusing the field as an applied area of Mathematics. The laboratory also emphasizes education in Computer Graphics, offering graduate courses and publishing books on the subject.

The laboratory is supported by FINEP, CNPq and FAPERJ and also by IBM Brasil.

Keywords

Computer graphics, research, development.

1. HISTORY

The Visgraf Lab was created in 1989 with the purpose of developing research in Computer Graphics at the Institute of Pure and Applied Mathematics - IMPA. The laboratory develops activities in three different and interconnected areas: education, research and development.

2. INTEGRATED VIEW

When manipulating images on the computer we are faced with different viewpoints: image analysis, image synthesis, image processing and modelling.

The research and education program on computer graphics at the Visgraf Lab considers the techniques of these areas from an integrated point of view.

3. RESEARCH

The main research areas of the Visgraf Project are Conceptual Issues, Modelling, Vision and Image Processing.

From a conceptual point of view we consider Computer Graphics as an area in Applied Mathematics. Therefore we are concerned with the mathematical foundations of Computer Graphics.

In the area of modelling, we are interested both in geometric and procedural modelling. We have made an effort to obtain a unified view of these two different aspects of modelling. Our research in modelling has close connections with Computational Geometry. Besides the on-going work on model representation based on space decomposition, we have done substantial research on implicit models. More recently, we have been working on image-based modelling and three-dimensional photography.

In image processing we are mainly interested in algorithms for halftoning, and also in post-production filtering techniques for special effects. In particular we have developed research on warping and morphing techniques.

4. EDUCATION

The academic activities of the Visgraf Project concentrate mainly on the graduate and post-graduate levels: master and doctoral degrees, and a post-doctoral program.

In accordance with our view of Computer Graphics as an applied area of Mathematics, the student is required to take the master or doctoral degree in Mathematics, concentrating in Computer Graphics. For that purpose, we maintain a calendar of courses during the three periods of the academic year. This program include the following disciplines: Introduction to Computer Graphics, Computational Geometry, Image Processing, 3D Graphics Systems Design, Mathematical Methods for Computer Graphics and Image Synthesis.

5. COLABORATION

We have a long-term colaboration program with the TeCGraf laboratory, at the Pontifical Catholic University in Rio (PUC-Rio). We also have an international cooperation project, sponsored by CNPq and NSF, with the Media Research Lab of New York University. More recently, we have maintained an exchanging program with the Ecole Polytechnique in France.

6. PEOPLE

The permament researchers at VISGRAF are Jonas de Miranda Gomes (on leave), Luiz Velho, Paulo C. P.

Carvalho, Luiz Henrique de Figueiredo and Roberto Beauclair Seixas. Currently, there are about 15 students at the master and doctoral levels at the lab, working in a variety of projects.

7. ON-GOING PROJECTS

We describe below some of the current projects as VISGRAF. For more details, please see the laboratory web-site, at http://www.visgraf.impa.br.

7.1 Visorama

This projects involves the development of special purpose hardware and software for virtual reality applications. The equipment developed in this project is a virtual binocular that uses multiresolution image-based rendering for creating panoramas (Figure 1).
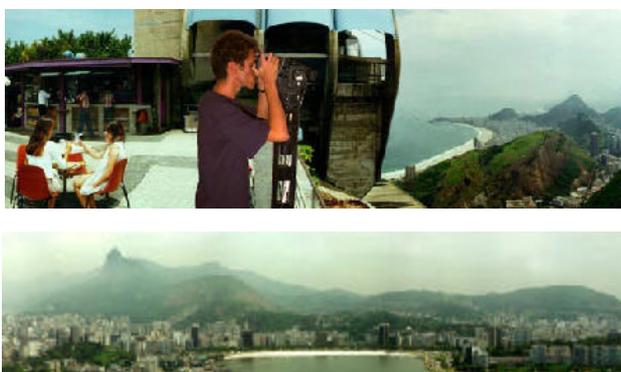

Figure 1 – The Visorama Project

7.2 VisMed

In this project, techniques for analyzing 2D and 3D medical images are studied. The analysis of lung images, for diagnosing tumors, receives special attention in the project. Figure 2 shows an example of a visualization technique developed to emphasize internal tumor structure.
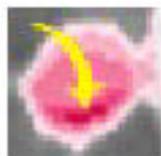

Figure 2 – Visualization of internal structures

7.3 Virtual Referee

This projects uses image-based modelling techniques to build three-dimentional scenes from images of soccer plays. Automatic calibration of the camera is done by using the lines of the field (Figure 3).
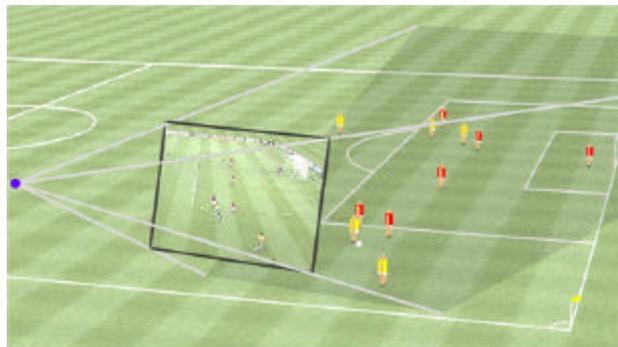

Figure 3 – The virtual referee project

7.4 3D Photography

Recently, the problem of recovering geometry and texture from photos has received considerable attention at the Visgraf lab. In particular, work has been developed at the lab on schemes for structured light coding and on methods for creating meshes from point samples. Figure 4 shows an example of an object illuminated by complementary light patterns, that help recovering depth and texture information.
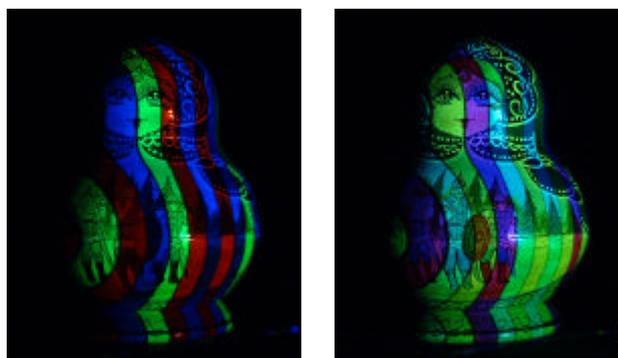

Figure 4 – Structured light patterns