

Dyna-Eye: A dynamic 2D-3D Stereo Viewer

Project Management and Software Development
for Medical Applications

General Info

Project Title: Dyna-Eye: A dynamic 2D-3D Stereo Viewer

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Project Abstract

Using a free-viewing cross-eyed rendering technique, the goal of this project is to build a first prototype that combines stereo vision with dynamic focus rendering. Two views are rendered in a binocular fashion on a usual 2D monitor to create a virtual 3D image without the need of a head mounted display. By adjusting the virtual focus point, the user experience is experimentally evaluated.

Background and Motivation

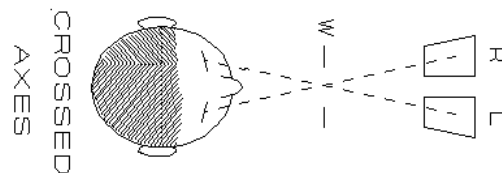
3D perception is an integral part of many surgical interventions. In particular for minimally invasive surgery, an understanding not only of left and right but also of the depth inside the body is substantial to smoothly perform a surgery.

Modern robotic systems such as the da Vinci Surgical System (Intuitive Surgical, Inc.) use stereo vision together with a head mounted display (HMD) or a stereo control cabinet to let the physician immerse into the 3D view within the body. These systems make use of the natural way humans perceive depth and project the left and right camera view from the end of an endoscope individually to both the left and the right eye.

However, these methods always suffer from the fact that the user is bound to the display and interaction with the medical team is difficult – or not possible at all before the HMD is taken off. Moreover, the user always focuses on the same plane regardless of the actual depth of the scene.

The first issue can be addressed with solutions such as 3D screens and AR glasses, but such hardware parts also bring drawbacks and need to be purchased additionally to the existing systems. The latter point is oftentimes not considered although inevitable in the human perception pipeline.

To overcome this issue a first prototype shall be designed and tested that produces a 3D view without glasses by using a common 2D monitor.



[Donald Simanek](#). How to view 3D without glasses.

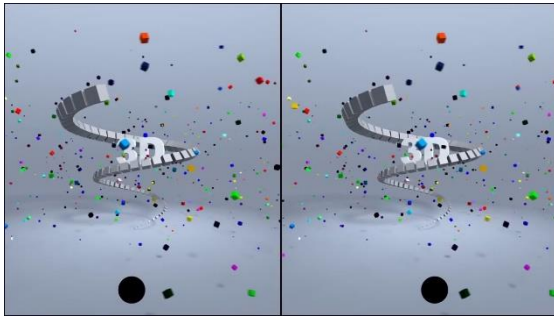
While the user focuses on a virtual point in front of the screen, the views are rendered as a cross-eyed pair (depicted in the image) such that a virtual 3D image is perceived in the middle. Simultaneous adjustments of the focus point and the depth-of-focus of the rendered images mirrors the biological perception process.

Student's Tasks Description

After getting familiar with stereo vision, the first target for the student is to study rendering from different camera poses in a 3D scene and image pairs are tested for several static scenarios.

Please send the completed proposal to b.busam@framos.com. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.

Previous experiments with different methods to ease the focusing process for the user have been performed. One method is to overlay a 2D shape such that the two balls in the image below fall together in the virtual image in the middle. The student decides for a focus helper and designs a series of experiments for on-the-fly focus adjustments.



[YouTube](#). 2017-04-25.

A system prototype is set up to show the results and perform the experiments with different users. And this study is finally evaluated.

After this project, the student can work with stereo vision and cross-axes free-viewing. Some experience with real-time rendering and stereo perception has been achieved. Moreover, the constant coordination with FRAMOS gives some insight into the working procedures in the industry.

Technical Prerequisites

- Basic knowledge of MATLAB / C++
- Basic skills in linear algebra

Optional requirements that can also be learned during the project are:

- Basic knowledge of image processing and some experience with OpenCV
- 3D computer vision / multi-view expertise
- Basic understanding of projective geometry
- Ability to work with versioning tools such as GIT

References

- Hartley, Zisserman. "Multiple View Geometry in Computer Vision". Cambridge University Press. 2003.
- Zhang, Zhengyou. "A flexible new technique for camera calibration". PAMI 2000