Stereoscopic high-definition video monitor using wavelength-multiplex projection

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Introduction

The bad quality of the steroscopic monitors prevented routine application in endoscopic surgery. Together with the research center Karlsruhe we developed a first shutter-based system in 1992. However principle limitations of the shutter technology caused a dark and low-contrast image. Later, autostereoscopic systems came on the market that allow to see 3D video without glasses. Some of them require a fixed viewer position or complex tracking systems that are not adequate for clinical use. The new Philips WOWvx system up to now doesn't support a stereoscopic online input. None of these systems effectively supports full high definition.

Fig. 1: functional model

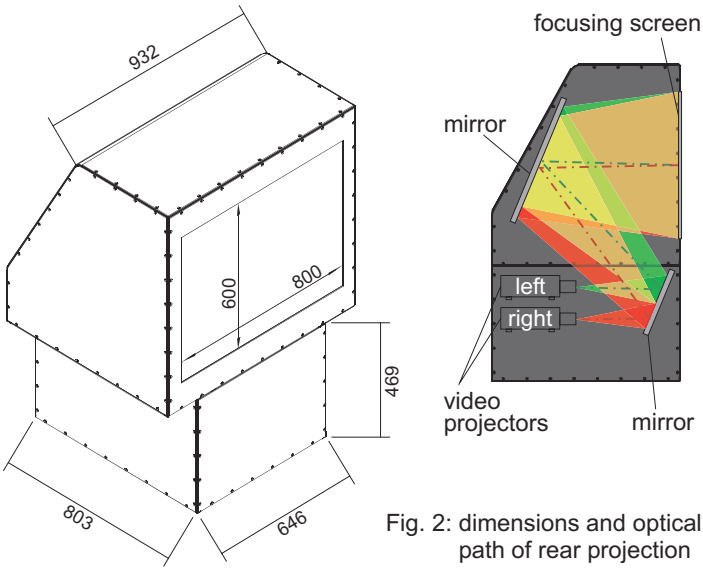

Fig. 2: dimensions and optical path of rear projection

Material and methods

Together with Infitec company we designed a functional model (fig. 1) that uses triple-band colour filters (wavelength multiplex principle[1]) and rear projection (fig. 2).
This was combined with a TEM-rectoscope (stereo basis = 6,6 mm), 2 endoscopic high definition video camera systems (Lemke Vision HDC 905, SXGA) and 2 C-mount zoom lenses (f = 16-34mm).
The function was tested in a phantom model with animal organs (cholecystectomy, TEM) and judged subjectively.
In addition the stereoscopic parameters (stereo base, disparities on screen) were measured.

Results

Triple band multiplex technology allows stereoscopic viewing conditions with **good color reproduction**, **good sharpness** and **outstanding perception of depth**. In contrast to autostereoscopic monitors multiple users can have a good 3D-impression.
The TEM optic works best with the zoom set to f = 16mm focal length. Stereoscopy was fine when the working distance was at least 45mm. The aspect ratio of 4:3 matches well with the circular TEM image.
Under these viewing conditions the instruments can be **manoeuvred very precisely in space** e. g. when grasping a thread end.

Discussion

A special 3D-telecope with a larger diameter of the rod lenses would supply an **even better** resolution. It would also allow shorter working distances.

Now, it's the scientific challenge to **prove in detail the surgical benefit** of the new stereoscopic display technology.

After such a final proving stage, the question arises, how to **realize** an affordable and for surgery optimized **commercial system**.

[1] Jorke H, Fritz M: Infitec - A new stereoscopic visualisation tool by wavelength multiplex imaging, 1-7, online 08/2008: