IEEE ISMAR 2024
GREATER SEATTLE AREA

Gaze-Contingent Layered Optical See-Through Displays

with a Confidence-Driven View Volume

Christoph Ebner
Graz University of Technology

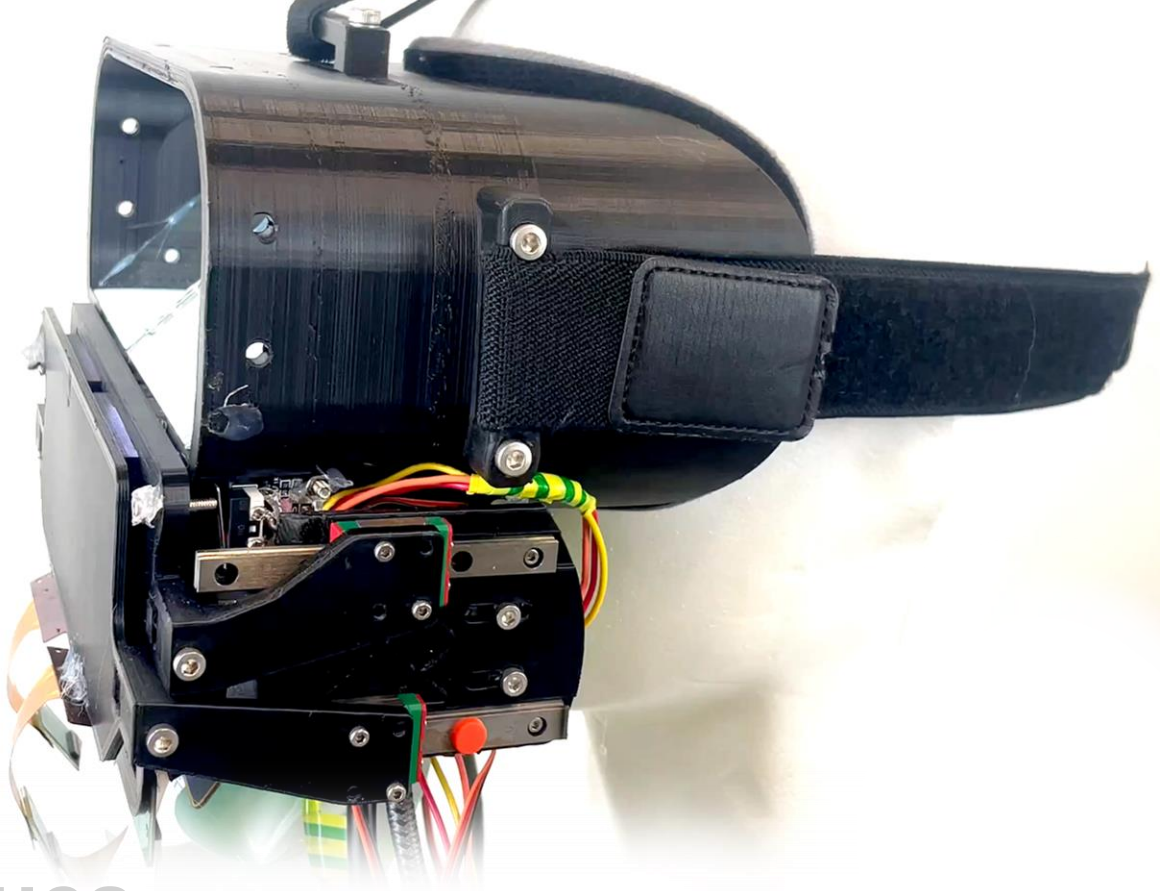
Alexander Plopski
Graz University of Technology

Dieter Schmalstieg
University of Stuttgart,
Graz University of Technology

Denis Kalkofen
Graz University of Technology

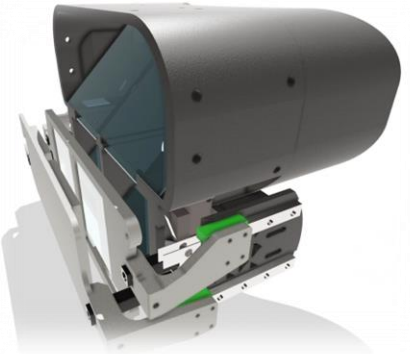
goals of this work

optical see-through HMD …

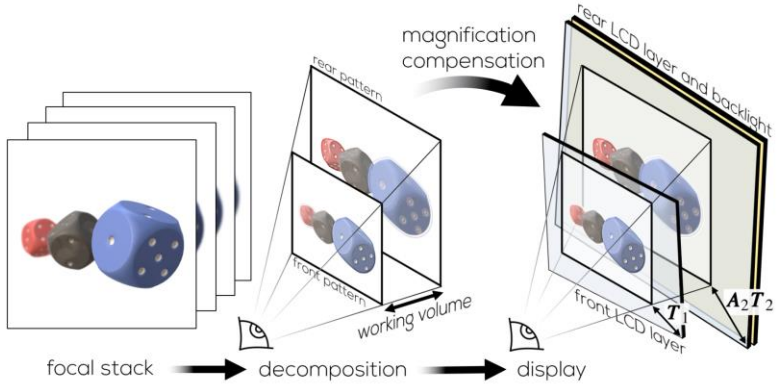


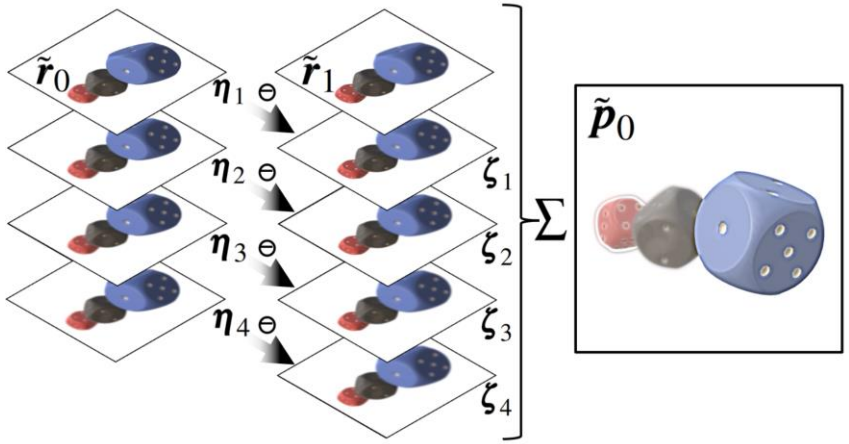
- … provides (near correct) **focus cues**
- **… solves** the vergence-accommodation conflict
- … shows content with **optimal contrast**

contributions



- **first HMD to dynamically adjust position and working volume based on eye tracking confidence**
- first automatic multilayer calibration routine
- first approach to compensate varifocal change in FOV
- novel focal stack decomposition approach





related work

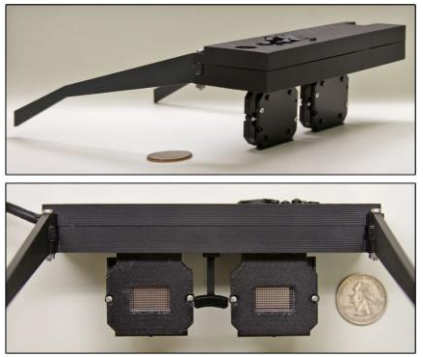
varifocal

Padmanaban et al. 2017

multifocal

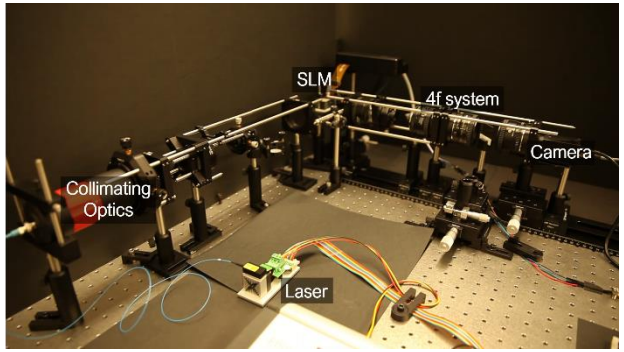
Akeley et al. 2004

light field

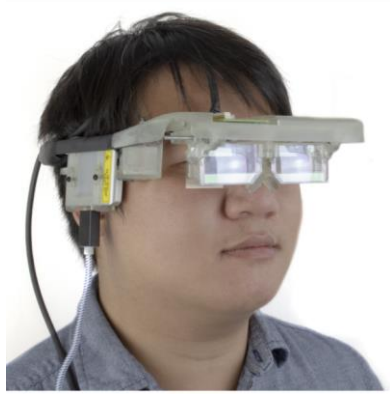


Lanman and Luebke 2013

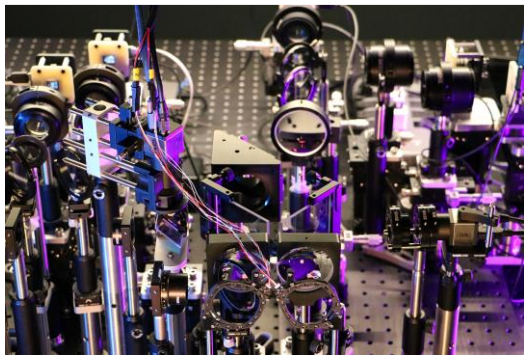
holographic



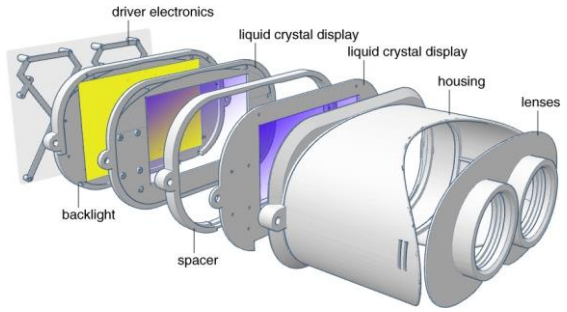
Peng et al. 2020



Kim et al. 2019



Mercier et al. 2017

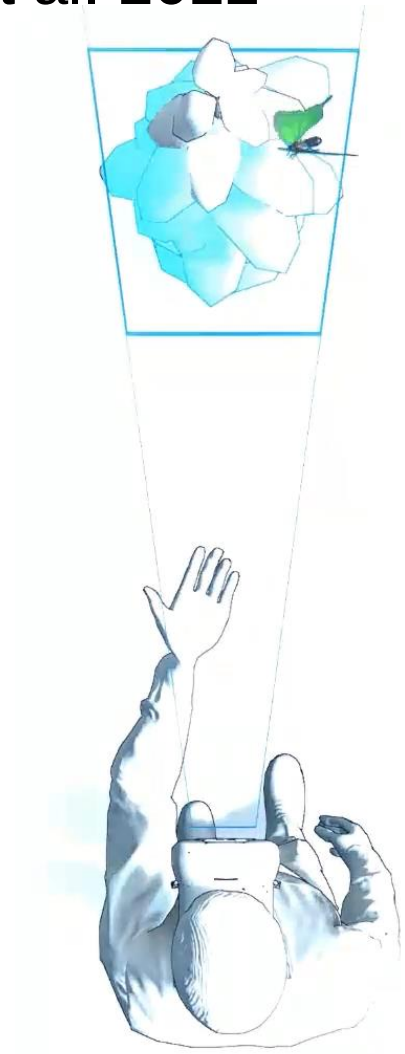


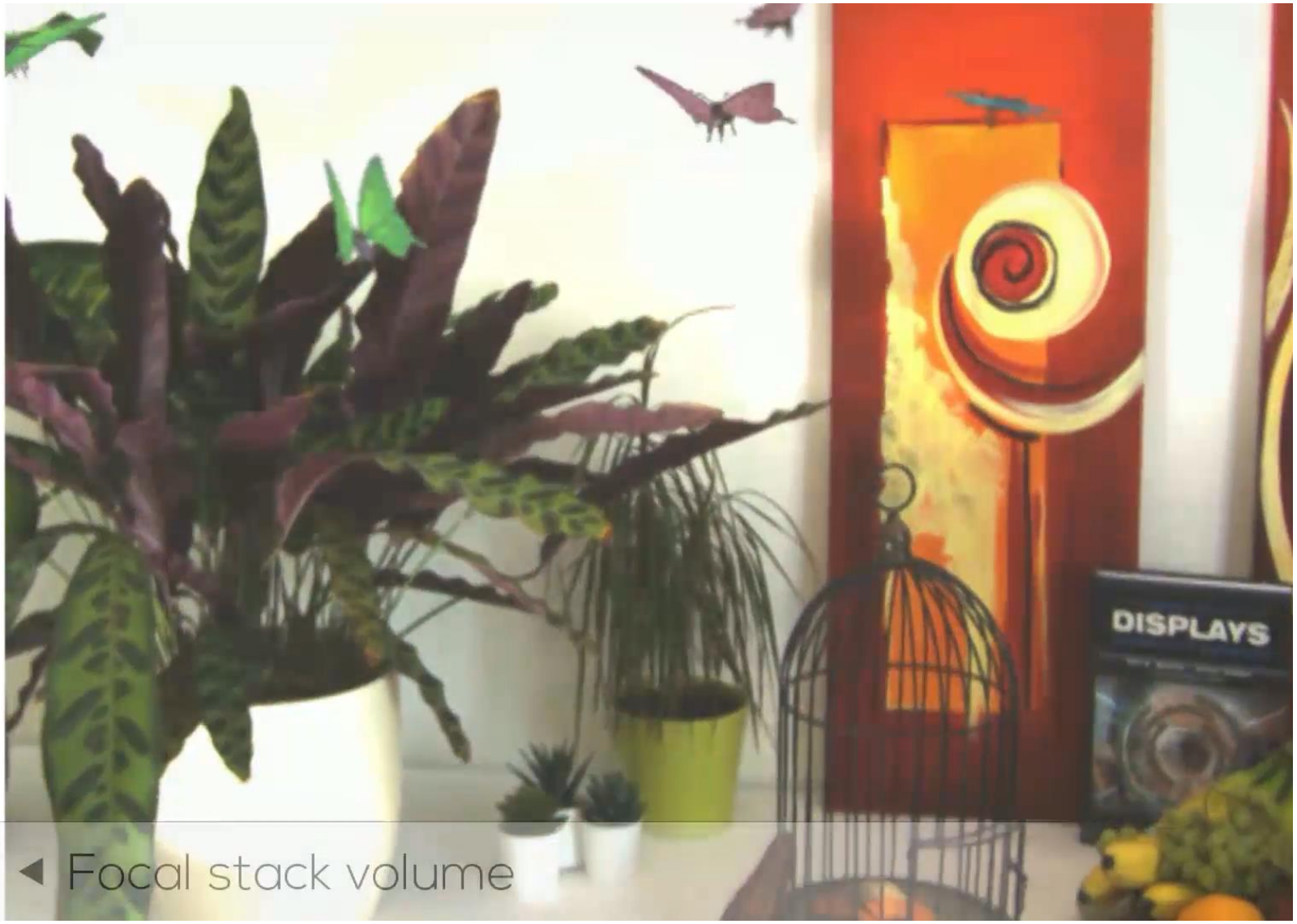
Huang et al. 2015

Kim et al. 2022

previous work

Ebner et al. 2022

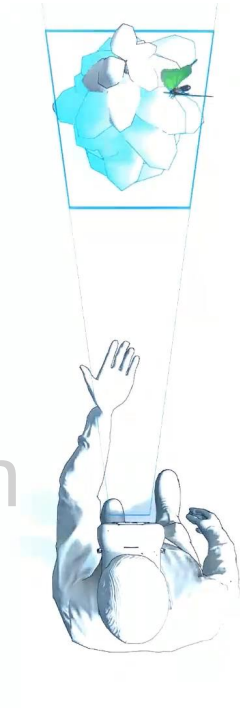


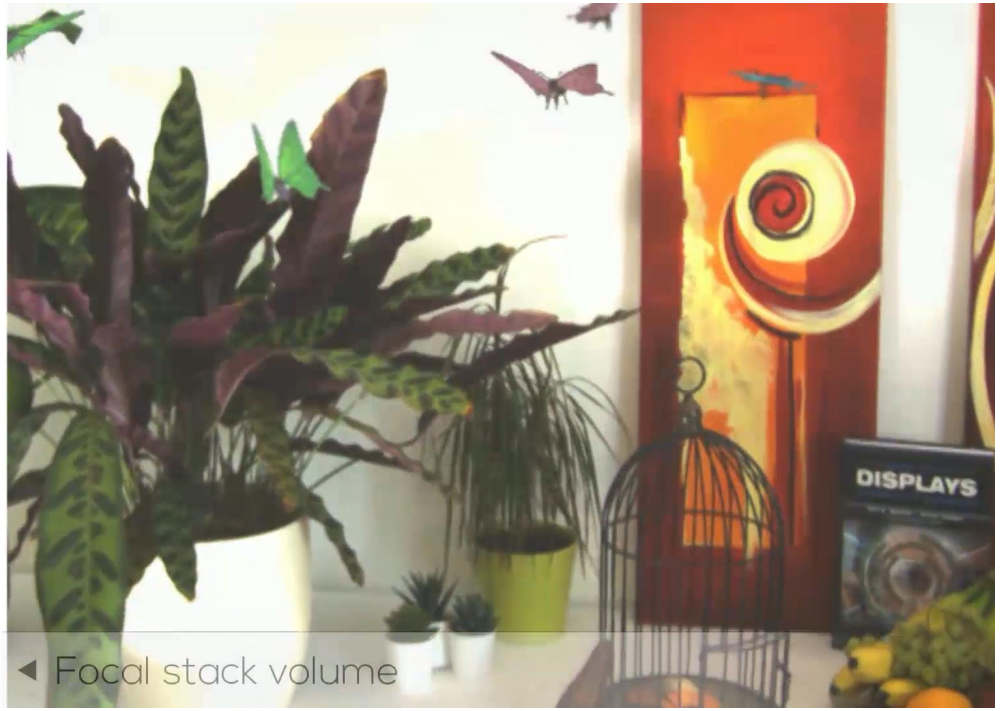


previous work

Ebner et al. 2022

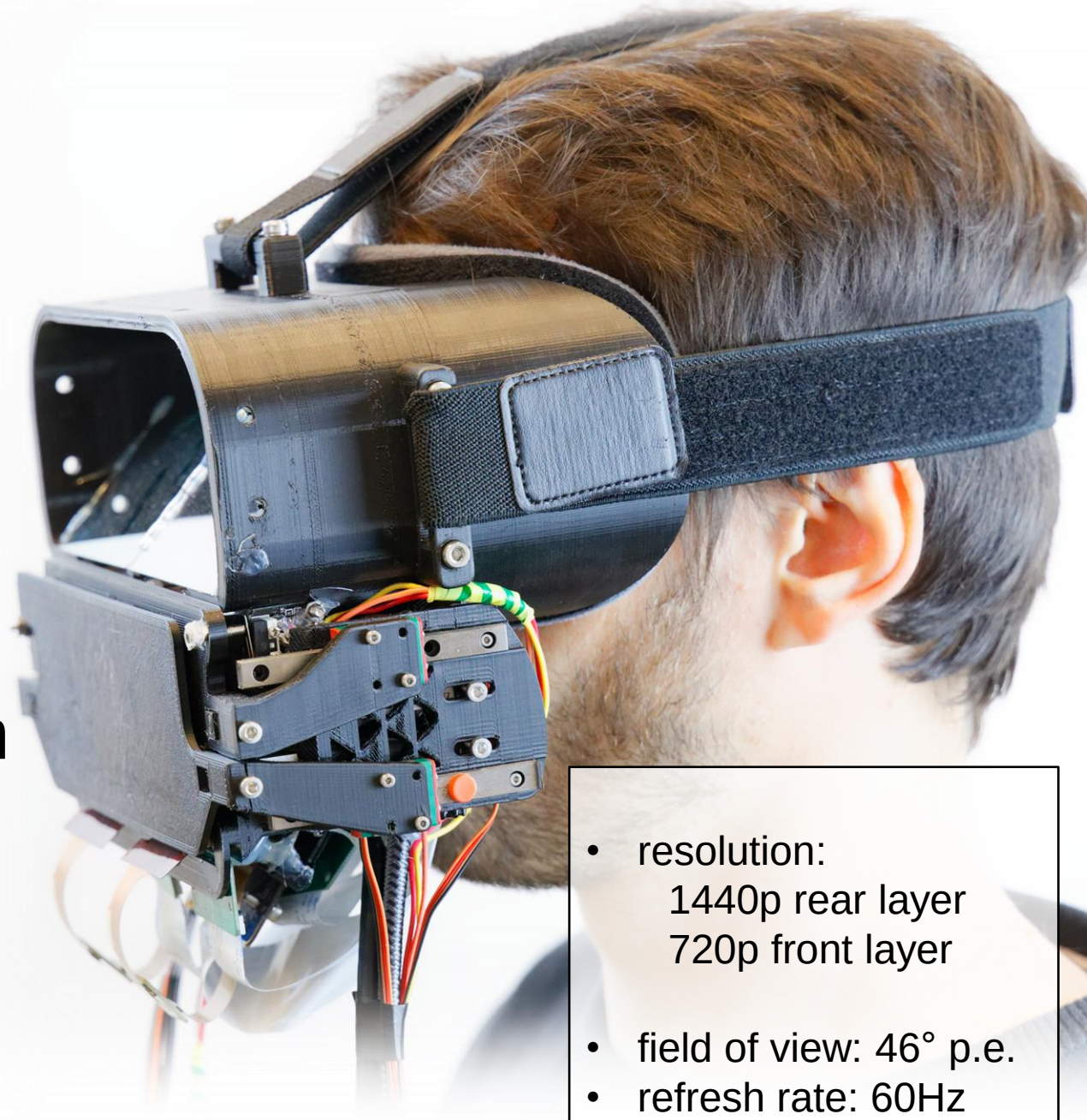
- hybrid of multifocal display and varifocal display
- enhanced contrast due to eye-tracking error compensation
- static display volume size



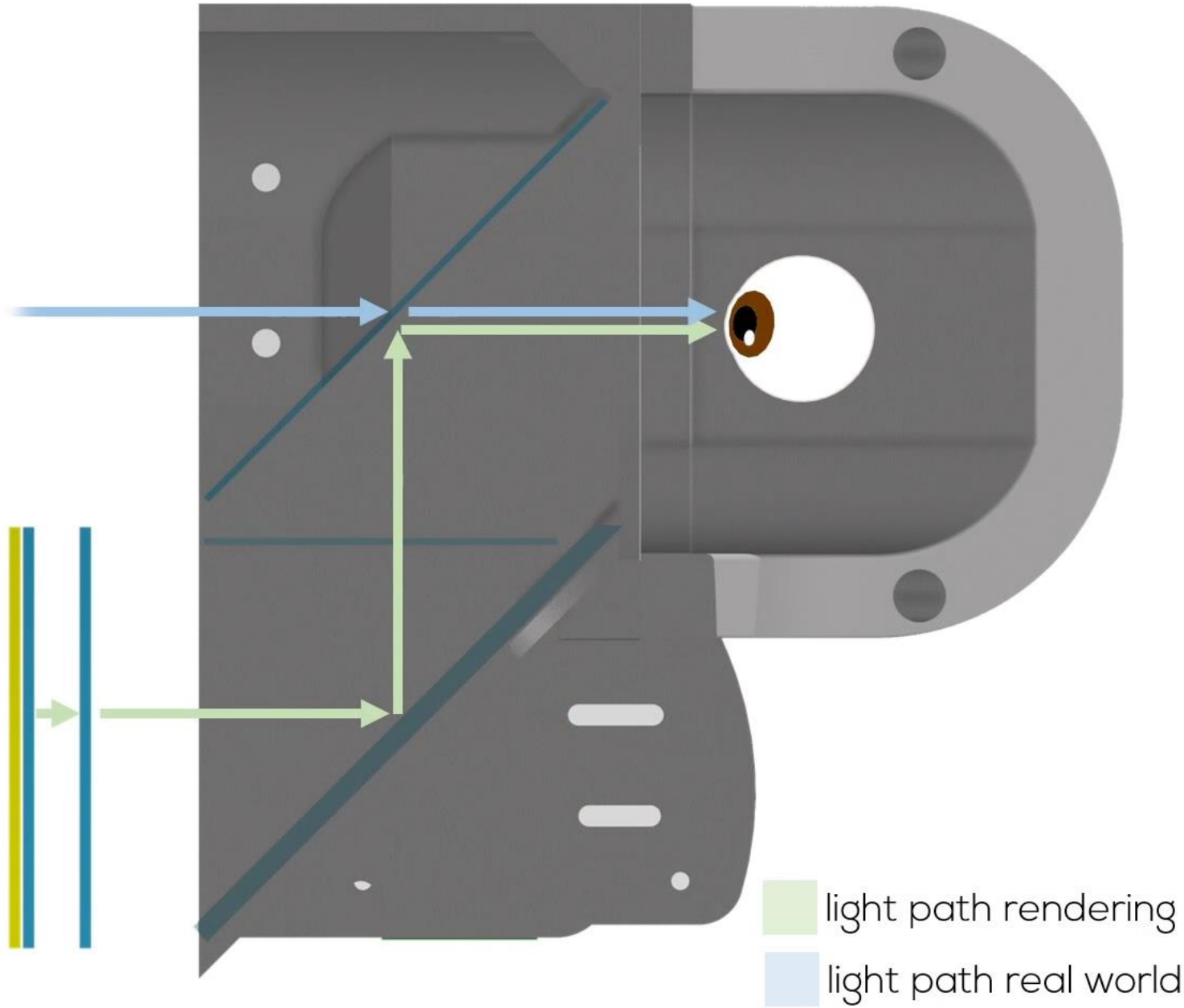


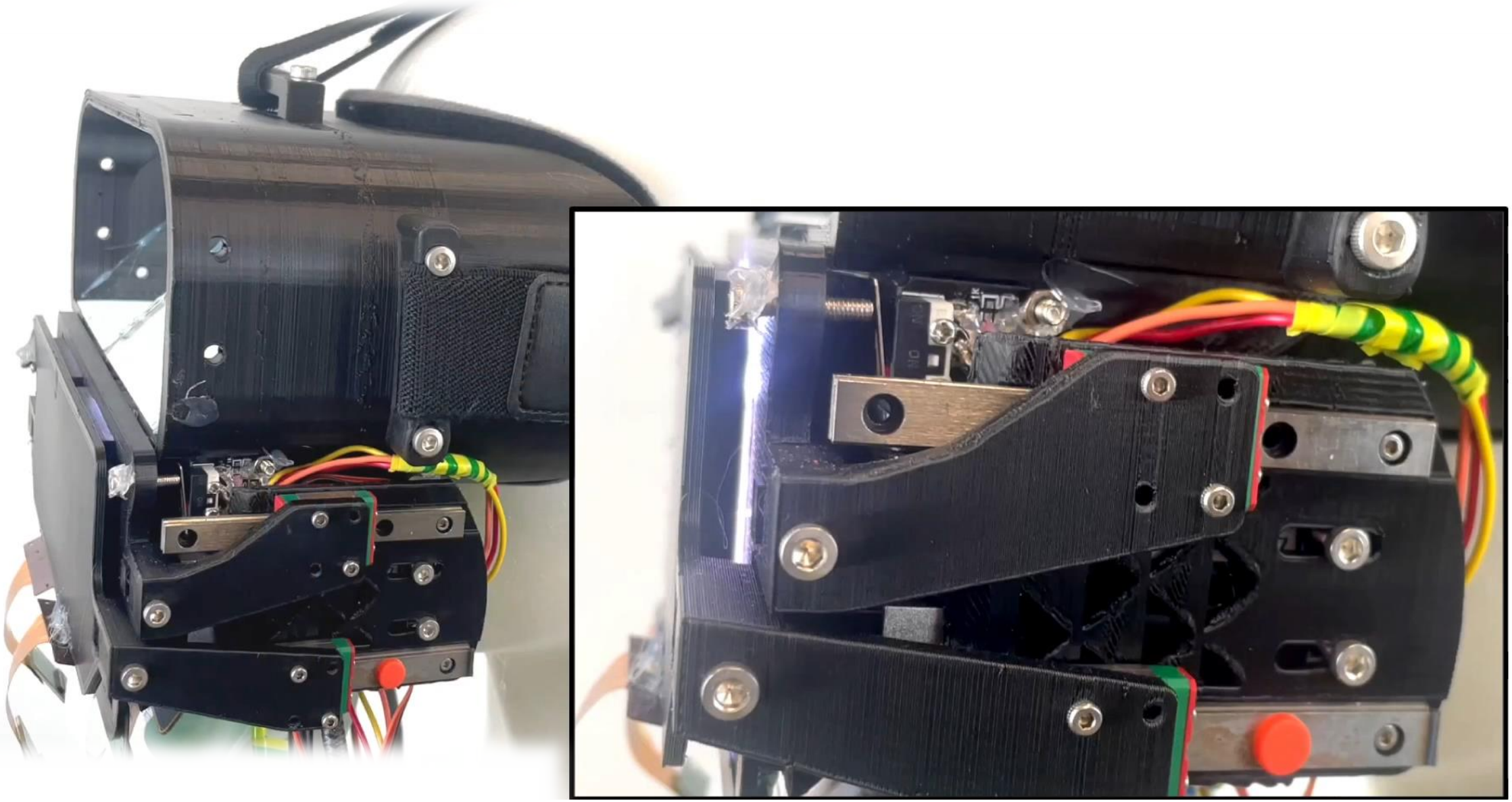
current work

- hybrid of ~~multifocal~~ light field display and varifocal display
- ~~enhanced~~ optimal contrast due to eye-tracking error compensation
- ~~static~~ dynamic display volume size

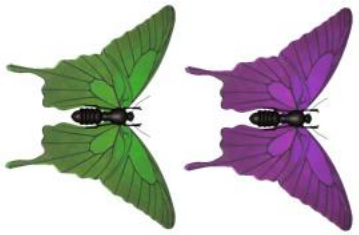


- resolution:
  1440p rear layer
  720p front layer
- field of view: 46° p.e.
- refresh rate: 60Hz

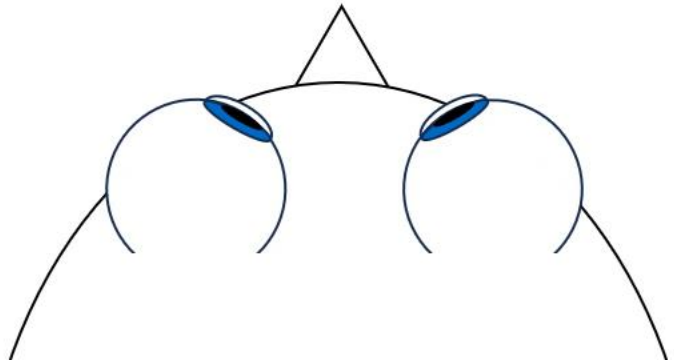

light path rendering
light path real world

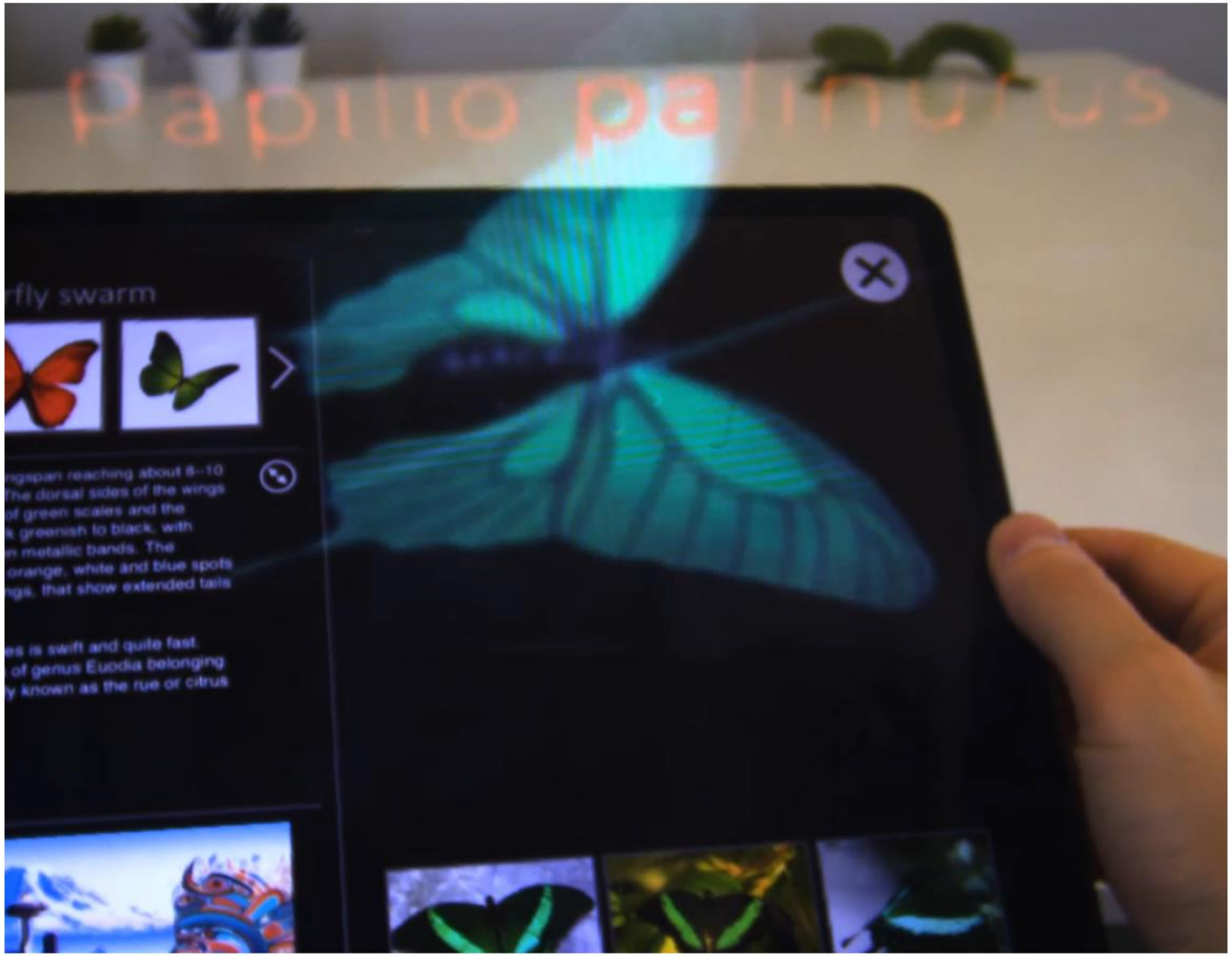


0.3 dpt



3 dpt

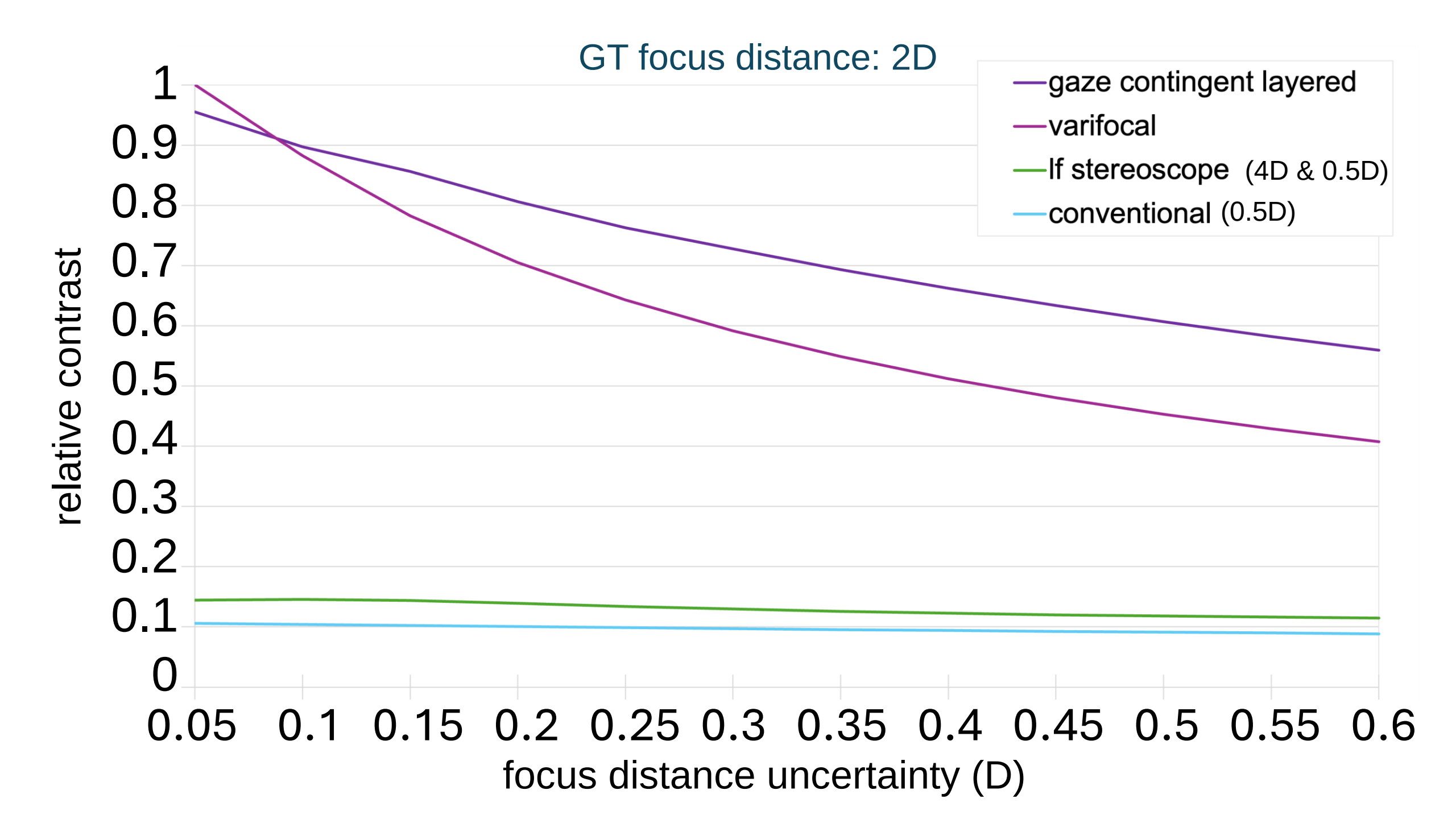


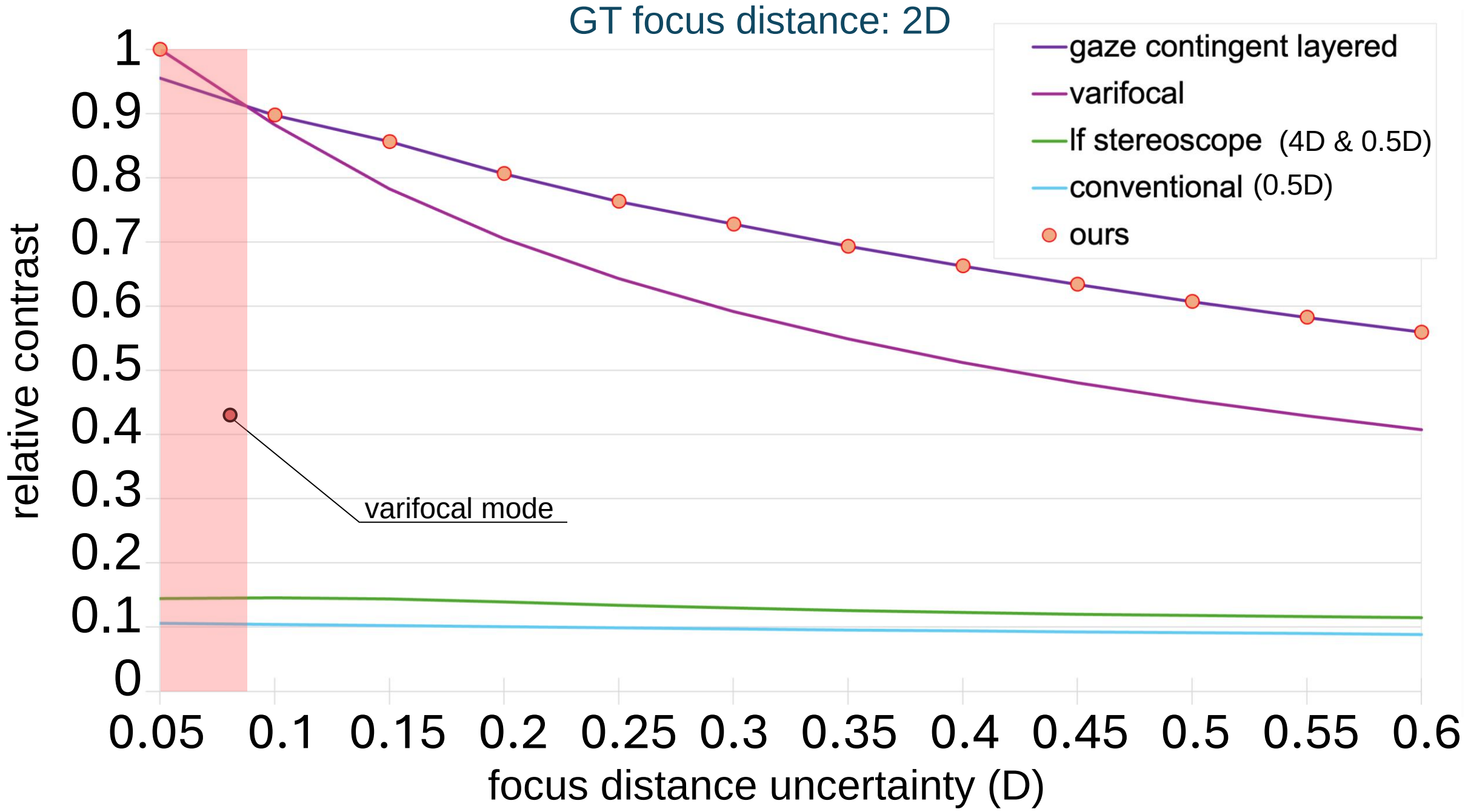


through-the-lens recording

static volume

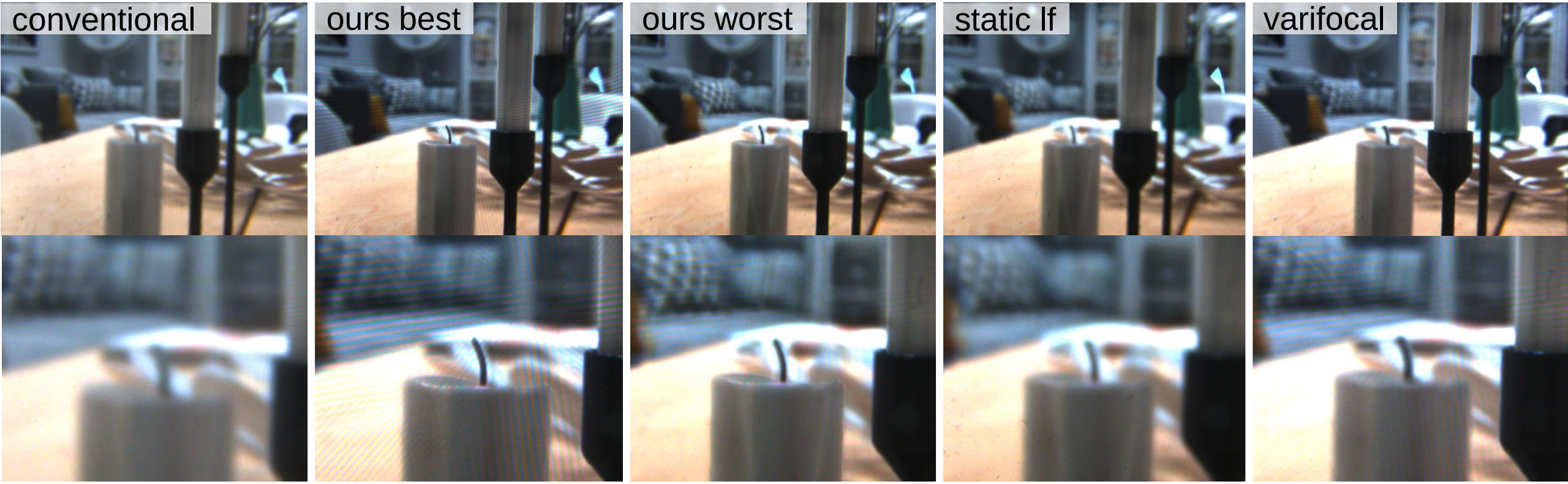
dynamic volume


GT focus distance: 2D
gaze contingent layered
varifocal
lf stereoscope (4D & 0.5D)
conventional (0.5D)
relative contrast
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
focus distance uncertainty (D)


GT focus distance: 2D
gaze contingent layered
varifocal
lf stereoscope (4D & 0.5D)
conventional (0.5D)
ours
varifocal mode
relative contrast
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
focus distance uncertainty (D)

through-the-lens results

GT focus distance: 3D
eye tracking error: 0.6D



display alignment

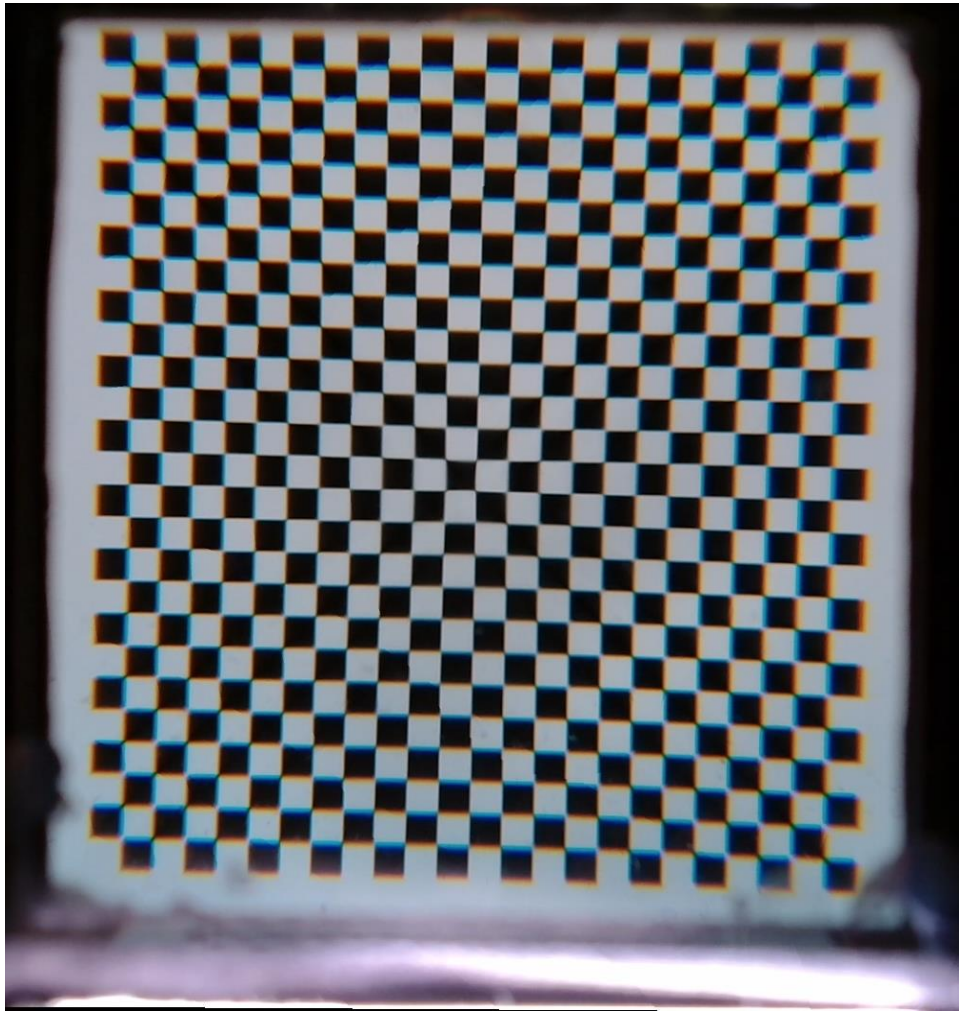
through-the-lens images

naïve rendering

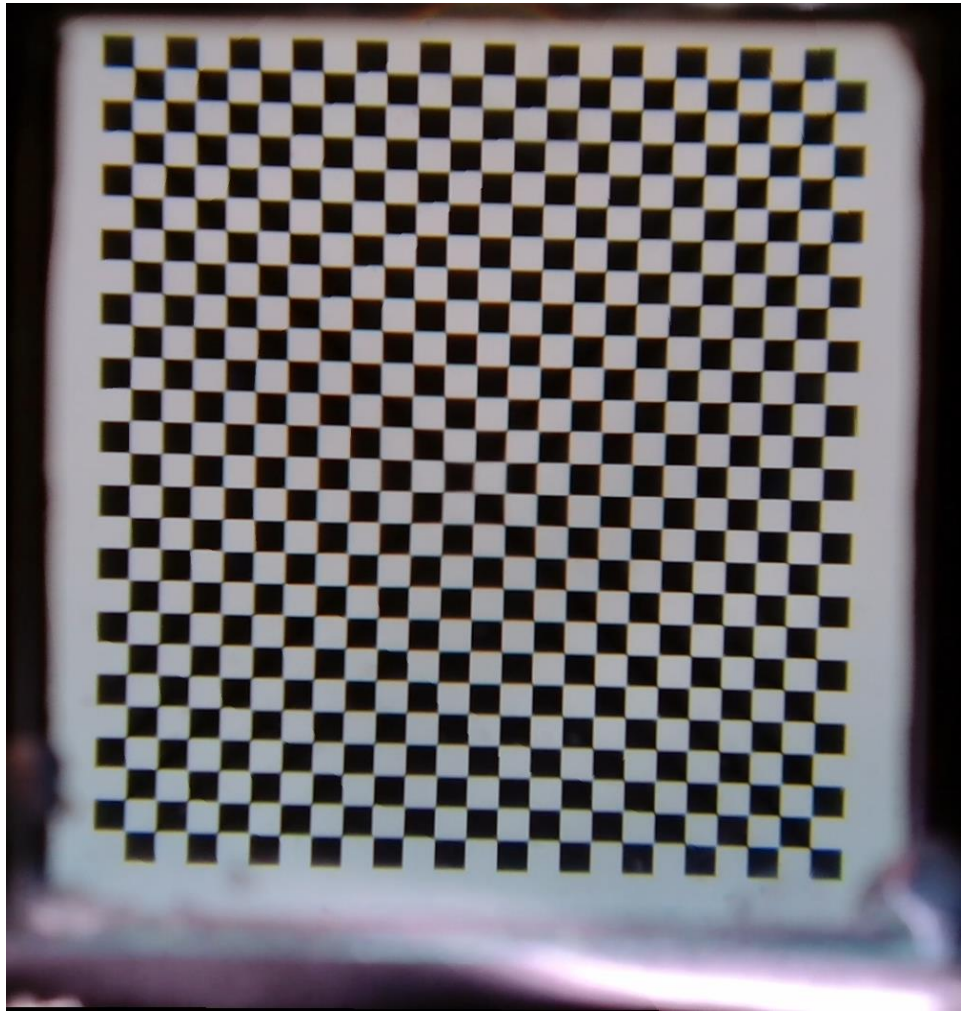
aligned rendering

magnification compensation

through-the-lens recordings of moving LCD layer



no compensation



magnification compensation

IEEE ISMAR 2024
GREATER SEATTLE AREA

Gaze-Contingent Layered Optical See-Through Displays with a Confidence-Driven View Volume

Christoph Ebner
Graz University of Technology

Alexander Plopski
Graz University of Technology

Dieter Schmalstieg
University of Stuttgart,
Graz University of Technology

Denis Kalkofen
Graz University of Technology