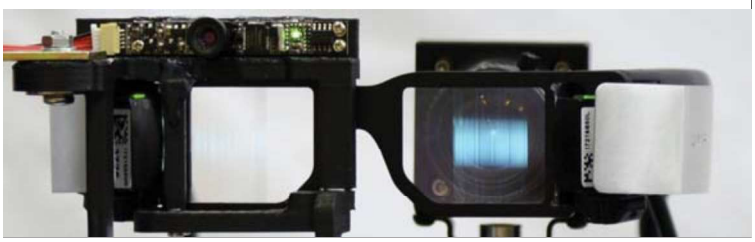
光学シースルーHMDによる映像提示技術の研究動向

2018/1/24, 3Dフォーラム@機械振興会館

伊藤勇太
東京工業大学 情報理工学院



自己紹介

伊藤勇太

光学シースルーHMD, Augmented Human

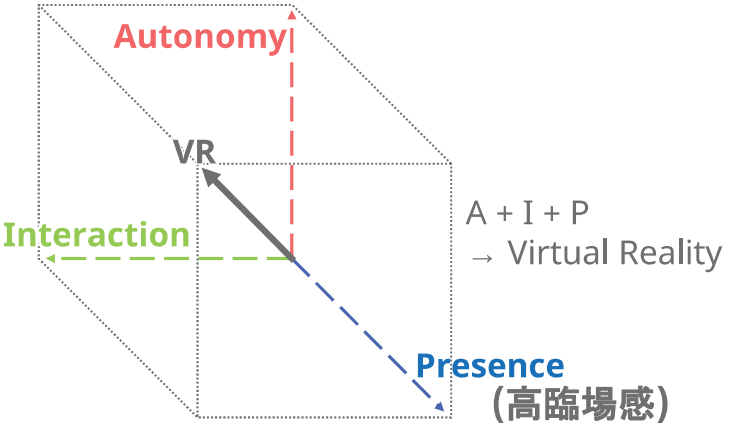
立体映像？

Star Wars

立体映像＋高臨場感？

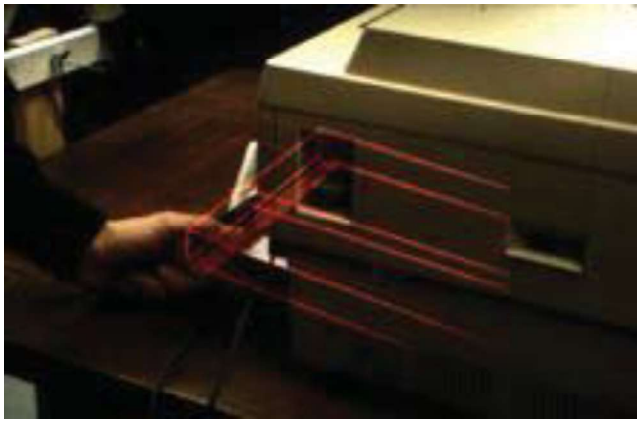
Star Trek

David Zeltzer's AIP Cube



Zeltzer, D. (1992). Autonomy, interaction, and presence. *Presence: Teleoperators & Virtual Environments*, *1*(1), 127-132.

Augmented Reality (AR)

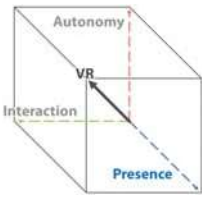


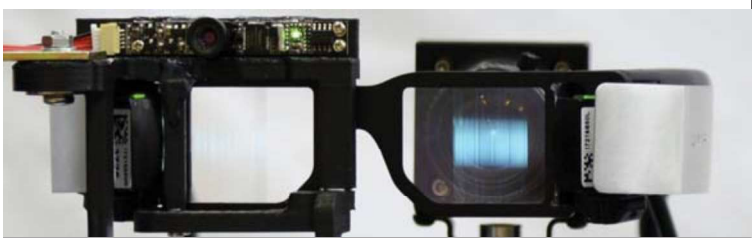
Feiner, Steven, Blair Macintyre, and Dorée Seligmann. "Knowledge-based augmented reality." *Communications of the ACM* 36.7 (1993): 53-62.

立体映像・高臨場感の達成に向けて

光学シースルーHMD

- 現実世界との整合性
- 視覚拡張





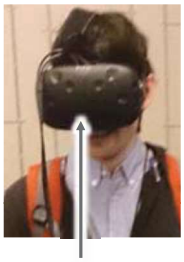
Head-Mounted Displays (HMD)

Non-Optical (Video) See-Through

Optical See-Through (OST-HMD)

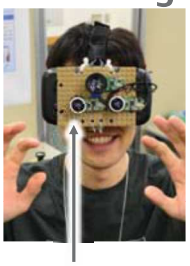
Head-Mounted Displays (HMD)

VR HMDs



Opaque display

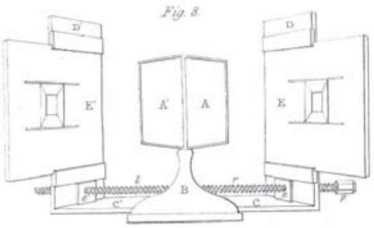
Video See-Through

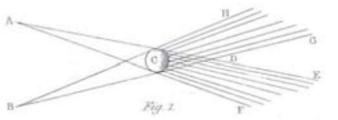


Scene camera

Optical See-Through

StereoScope (1838)

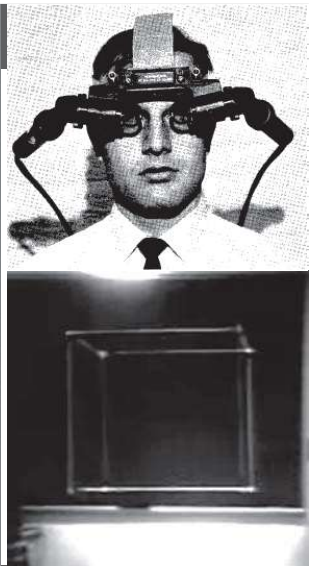




Wheatstone, Charles. "Contributions to the physiology of vision.--Part the first. On some remarkable, and hitherto unobserved, phenomena of binocular vision." *Philosophical transactions of the Royal Society of London* (1838): 371-394.

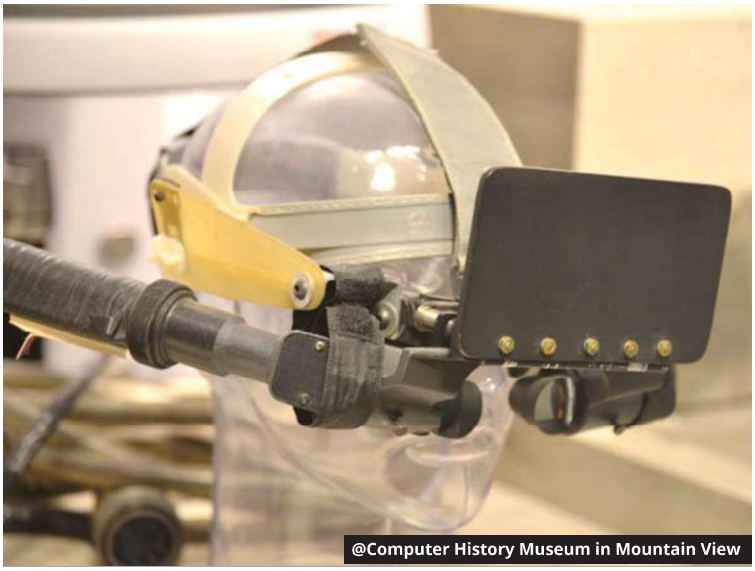
Ivan Sutherland, The Sword of Damocles

1968



Ivan Sutherland, The Sword of Damocles

1968



2016～

Microsoft HoloLens, 2016

EPSON BT-300, 2016

ODG R-9, 2016

Meta Meta2, 2016

2016～

Kotaku, Minecraft Hololens demo at E3 2015
https://www.youtube.com/watch?v=xgakdcEzVwg

2016～

Microsoft, Hololens

https://twitter.com/ksasao/status/7155695116849111(

How to make AR **REAL**?

* C. Sandor, M. Fuchs, A. Cassinelli, H. Li, R. Newcombe, G. Yamamoto, and S. Feiner, "Breaking the Barriers to True Augmented Reality", 2015

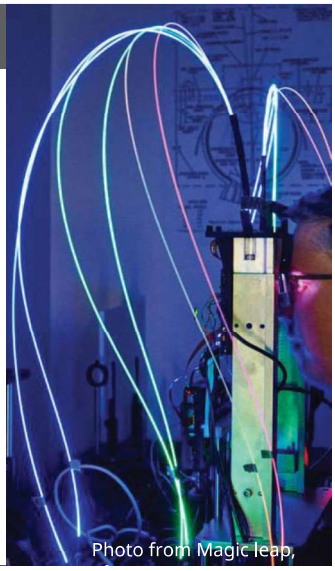


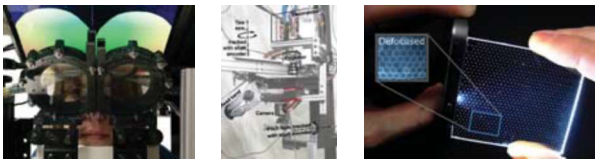
Photo from Magic leap,

How to make AR real?

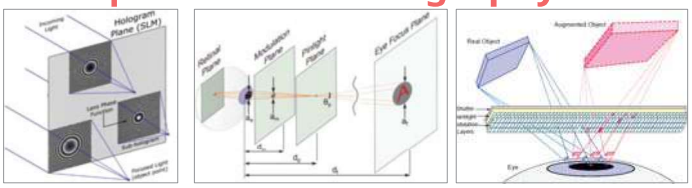
Magic Leap, 2016

OST-HMD　最近の研究動向

- ガチガチの**自作ハード**

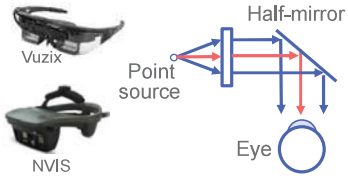


- **Computational Photography**

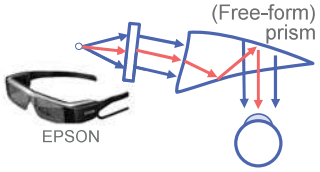


OST-HMD: Optics Designs (Commercial)

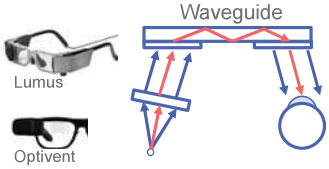
Half-mirror (or cubic prism)



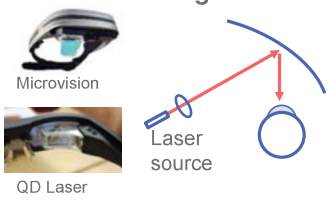
Prism-based



Waveguide-based



Retinal Scanning

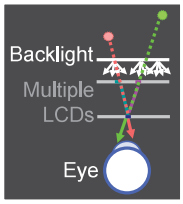


Classification from: Hainich and Bimber, Displays Fundamentals and Applications, 2011

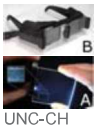
OST-HMD: Optics Designs (Research)

Light field
(Stucked-LCD)

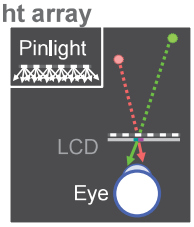
UNC-CH & NVIDIA 2013



Pinhole light array
(Pin-light)



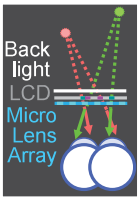
UNC-CH & NVIDIA 2014



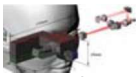
Pinhole effect→ "focus free"

Light field
(Microlens array)

Takaki & Yamaguchi 2015

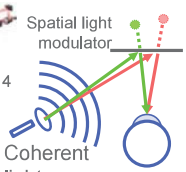


Holography



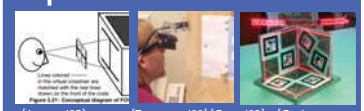
Moon et al. 2014

Maimone et al. 2017



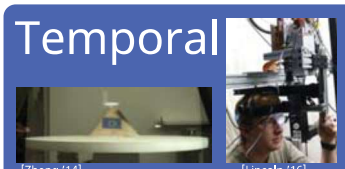
Realism in AR (with OST HMDs)

Spatial



[Azuma '95] [Tuceryan '00] [Genc '02] [Grubert '08]

Temporal



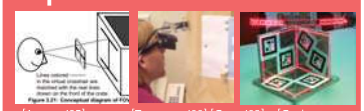
[Zheng '14] [Lincoln '16]

Perceptual

[Fukiage '14] [Kalkofen '13] [Kiyokawa '01] [Liu '08] [Yamaguchi '16] [Maimone '14]

Realism in AR (with OST HMDs)

Spatial



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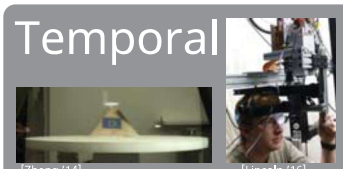
Temporal



[Zheng '14] [Lincoln '16]

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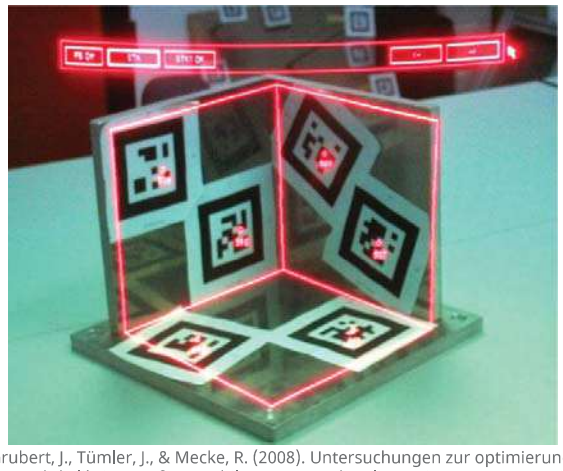
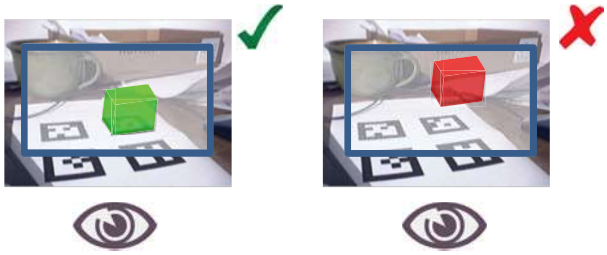
Spatial Realism in OST-HMDs

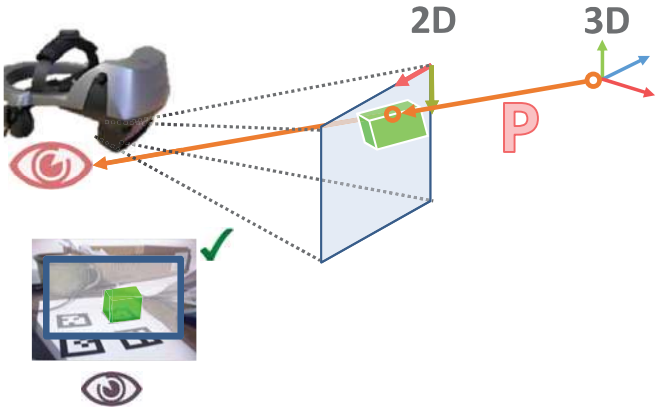


Grubert, J., Tümler, J., & Mecke, R. (2008). Untersuchungen zur optimierung der see-through-kalibrierung fuer mobile augmented reality assistenzsysteme. Michael Schenk

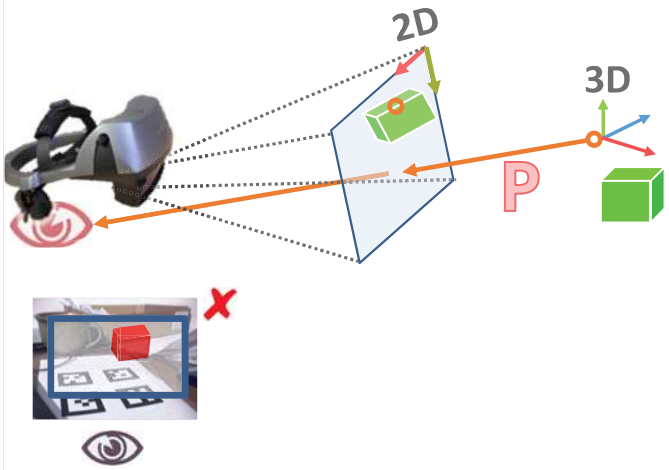
Spatial Realism in OST-HMDs



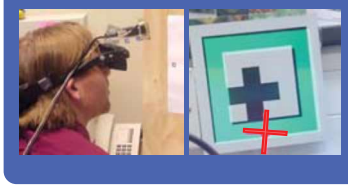
Eye-HMD Calibration



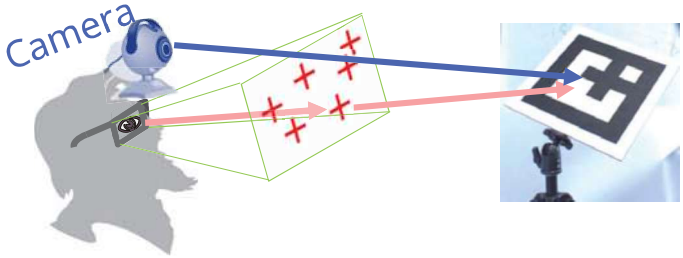
Eye-HMD Calibration



Manual method (De facto standard)

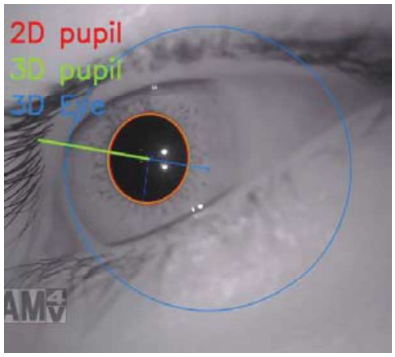


Single Point Active Alignment Method (SPAAM)
[Tuceryan '00] [Genc '02]



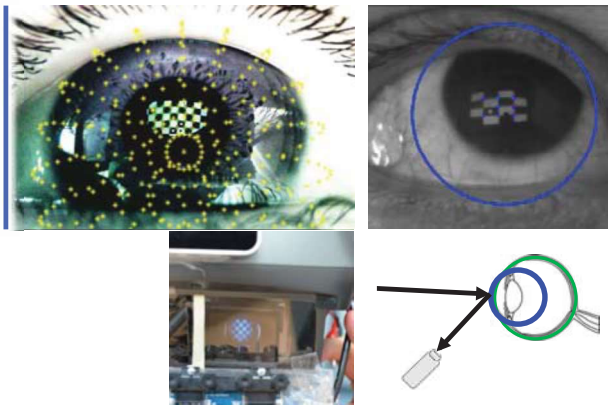
Automated method

Track the  position!



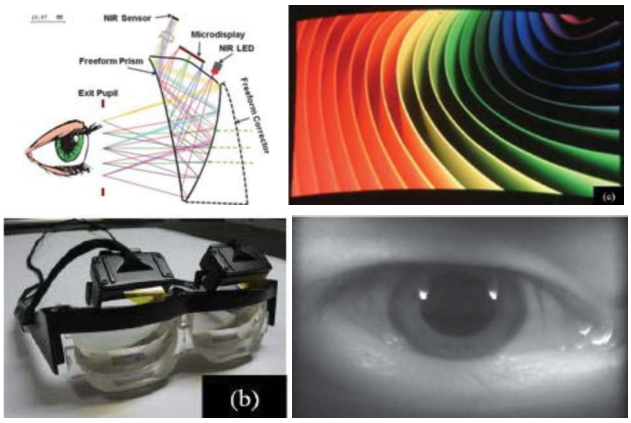
Itoh and Klinker, IEEE 3DUI 2014, IEEE ISMAR 2014

Automated Spatial Calibration

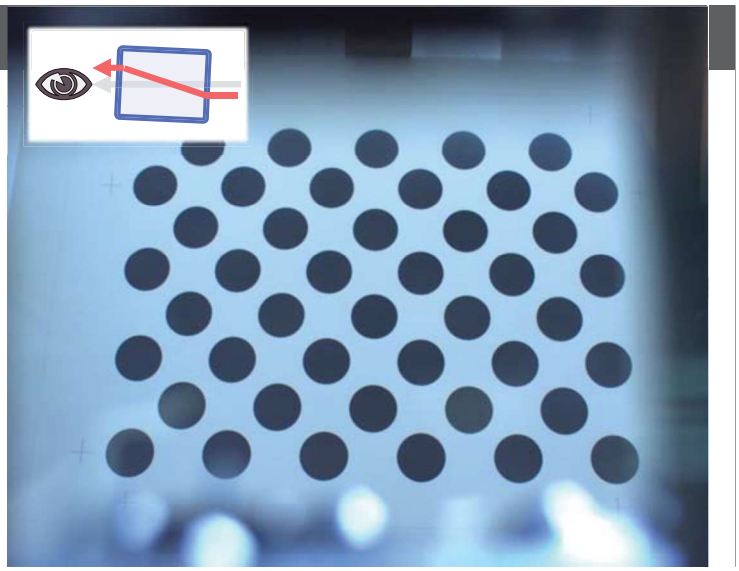


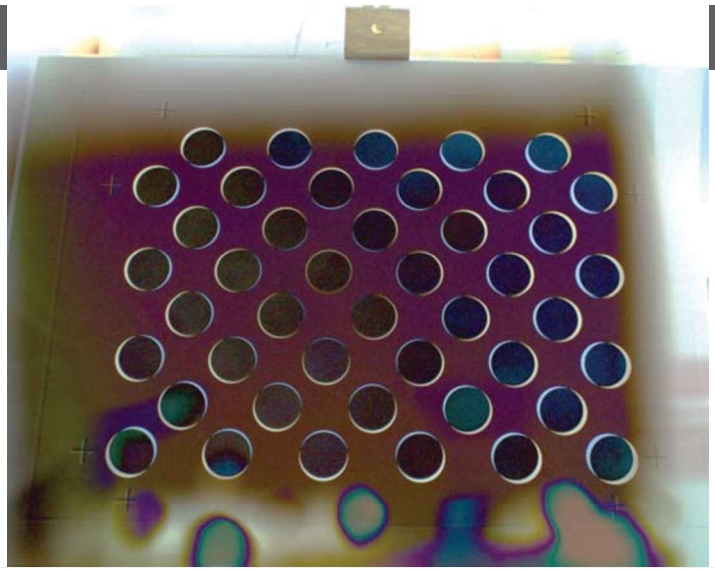
Plopski, A., Itoh, Y., Nitschke, C., Kiyokawa, K., Klinker, G., & Takemura, H. (2015). Corneal-imaging calibration for optical see-through head-mounted displays. *IEEE transactions on visualization and computer graphics*, *21*(4), 481-490.

Eye-tracking OST-HMDs

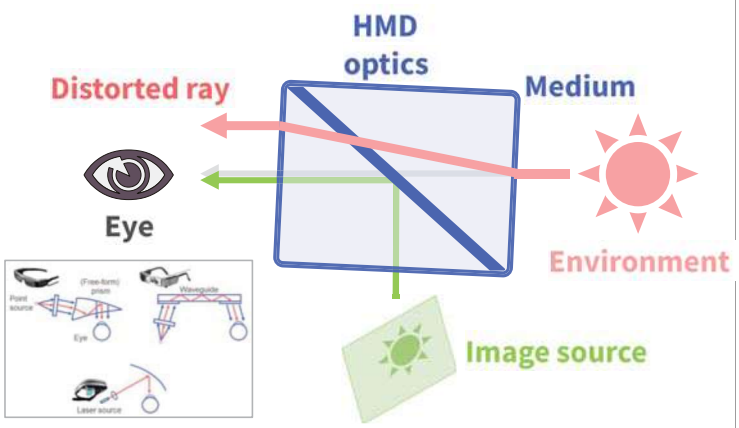


Hua, Hong, and Chunyu Gao. "A compact eyetracked optical see-through head-mounted display." *IS&T/SPIE Electronic Imaging*. International Society for Optics and Photonics, 2012.



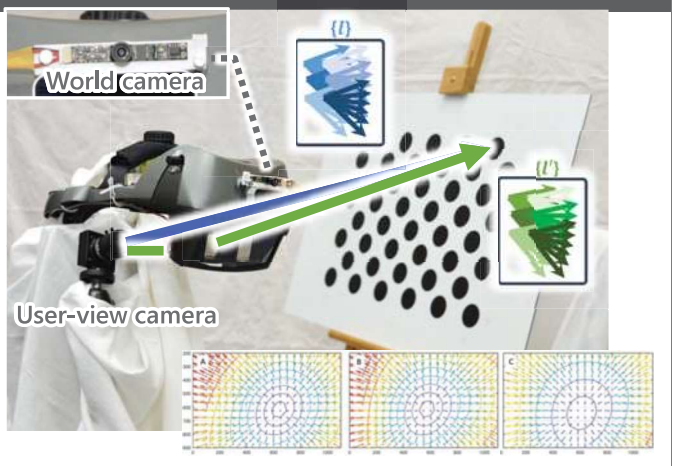


View-Dependent Lens Distortion



Itoh and Klinker IEEE TVCG '15 (VR '15) & IEEE

Light Field Calibration



Itoh and Klinker IEEE TVCG '15 (VR '15) & IEEE