

## **Title:** 3D-Color Perception in Virtual Reality Display: Simplifying Color Representation

Color perception is a fascinating interdisciplinary subject with important implications in virtual reality. Specifically, as a dimension of visual realism, color has the utmost importance for 3D immersion. Surprisingly, findings in earlier research suggests that in stereoscopic displays, one eye can be presented with a monochrome image (Figure 1), yet humans still perceive 3D color images with no degradation in color sensation, visual comfort, and depth perception [1, 2, 3]. In this project, we would like to revisit these findings with modern VR headsets, and examine the consequences with rigor in controlled lab experiment(s) with users. The envisioned user experiment(s) will follow the scientific method for hypothesis testing, e.g., controlling for confounding variables, conducting inferential statistical tests etc. We plan on using a navigation scenario in the experiment, however, we are open to your ideas as well. You will be guided by a local advisor as well as an international expert in Switzerland. A visit to Switzerland is possible during the project.



Figure 1: A simulation of monochrome-color stereo display in VR

### **Research Questions:**

1. How do a monochromatic-color stereo (MCS) pairing vs. color-color stereo (CCS) pairing affect participant performance with spatial tasks and subjective 3D color perception in VR [3]?
2. Will participants' self-reported visual comfort be reduced by MCS, compared to CCS [1]?

3. Does MCS impair participants' depth perception [2]?
4. Given that monochrome images are smaller in size, what is the trade-off between perceptual loss (if any) vs. computational gain?

### Requirements

- Unreal Engine, C++, DirectX 11/12, interest in conducting user experiments

### Contact

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### References

- [1] Kai Chen, Zaiqing Chen, Dongming Zhou, Yonghang Tai, and Junsheng Shi. Visual comfort evaluated by hue asymmetries in stereoscopic images. *Journal of the Society for Information Display*, 28(11):843–853, 2020.
- [2] Zaiqing Chen, Junsheng Shi, Yonghang Tai, and Lijun Yun. Stereoscopic depth perception varies with hues. *Optical Engineering*, 51(9):097401, 2012.
- [3] Yael Termin, Gal A Kaminka, Sarit Semo, and Ari Z Zivotofsky. Color stereoscopic images requiring only one color image. *Optical Engineering*, 46(8):087003, 2007.