Dynparity

Dynamic Disparity Adjustment to Avoid Stereo Window Violations on Stationary Stereoscopic Displays
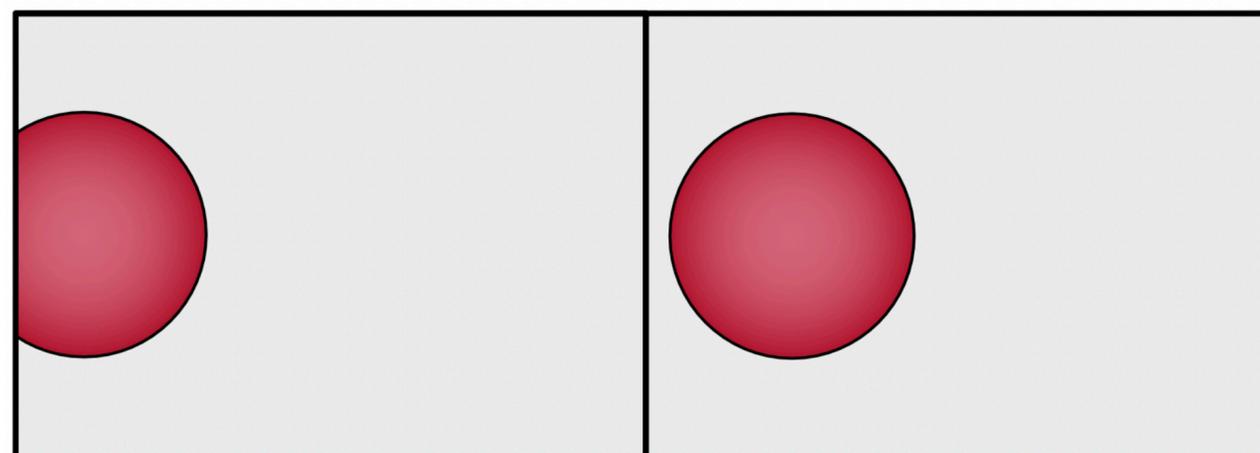
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Motivation

Negative Disparity/Parallax

Screen border

Left eye ⬤

IPD

Right eye ⬤

Screen

Stereo Violations

Stereo Window Violations

Previous Work
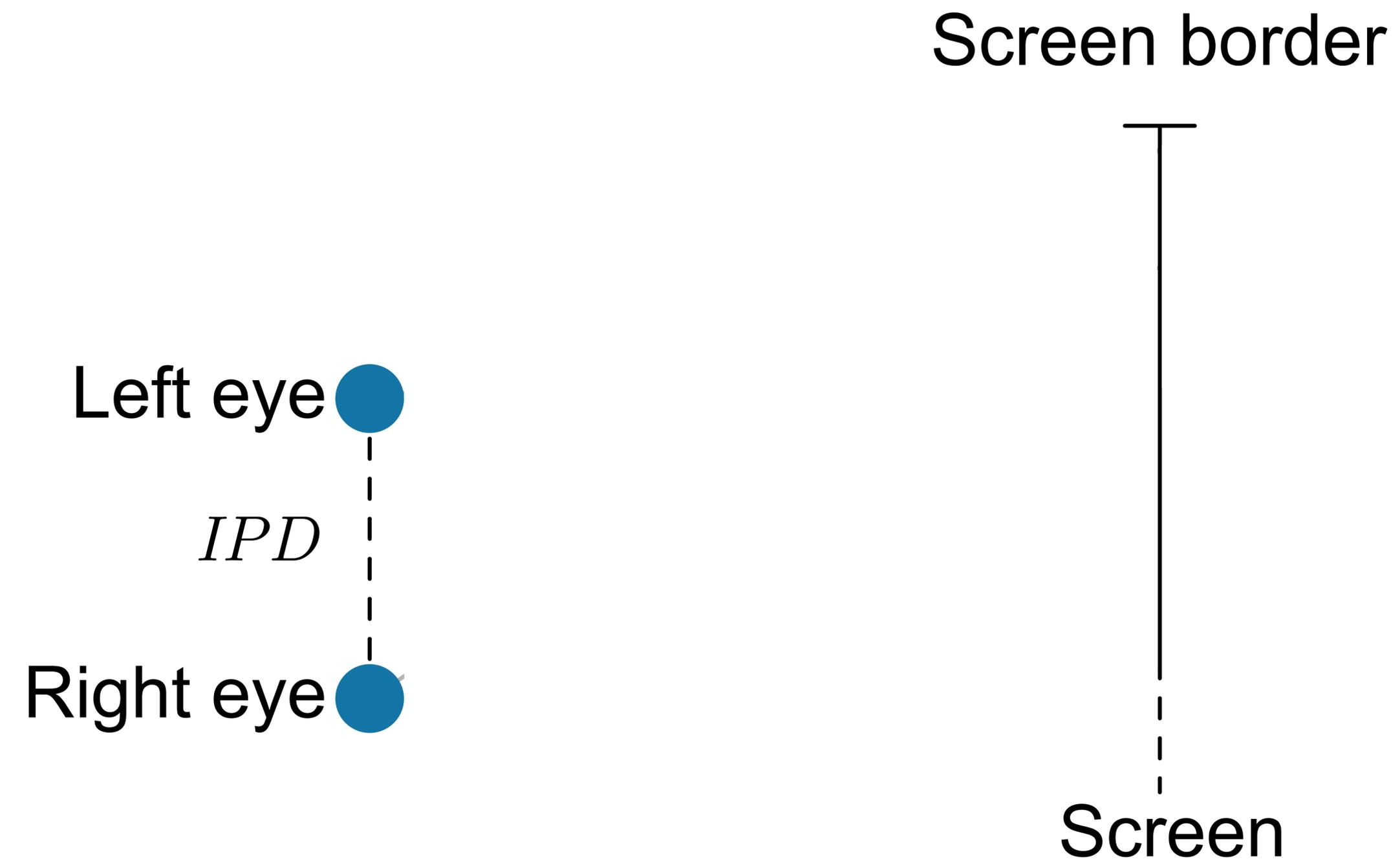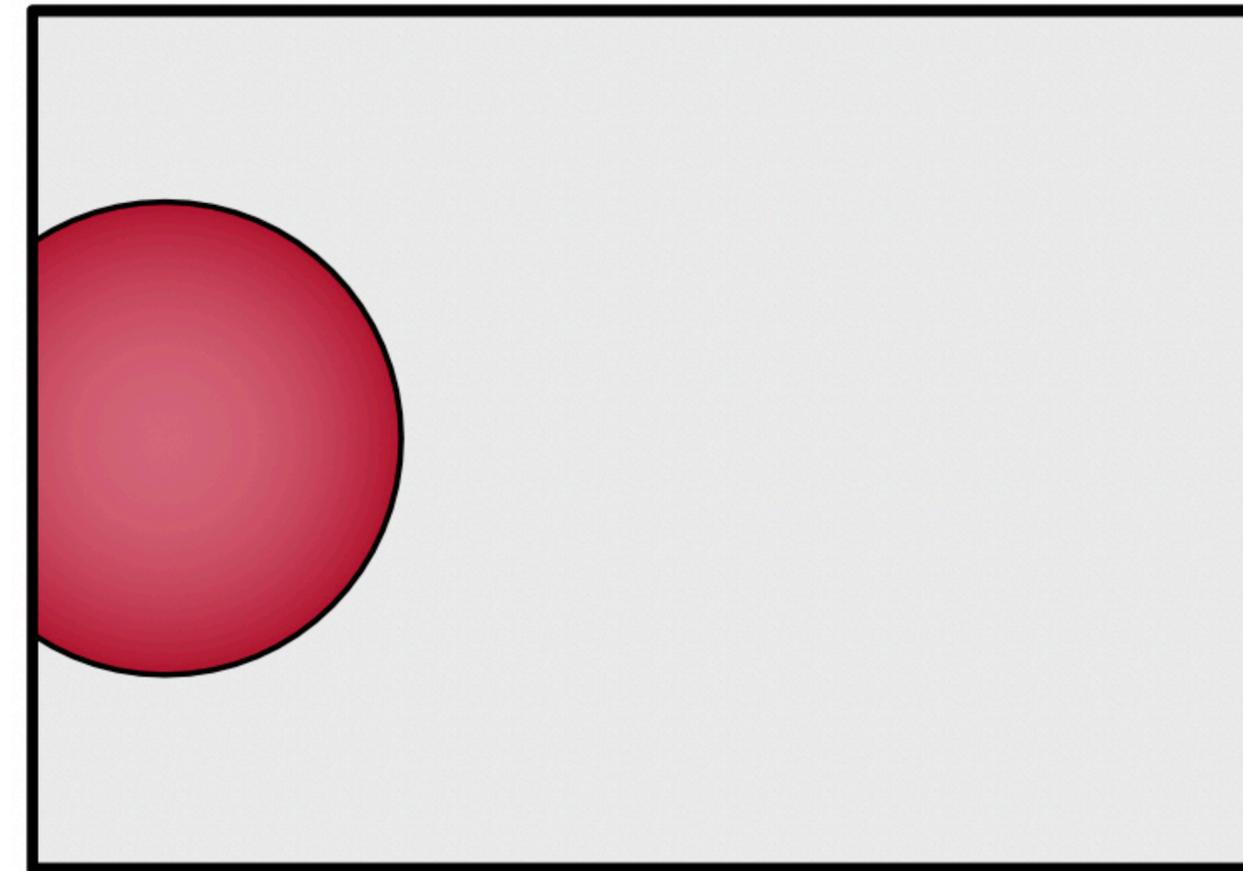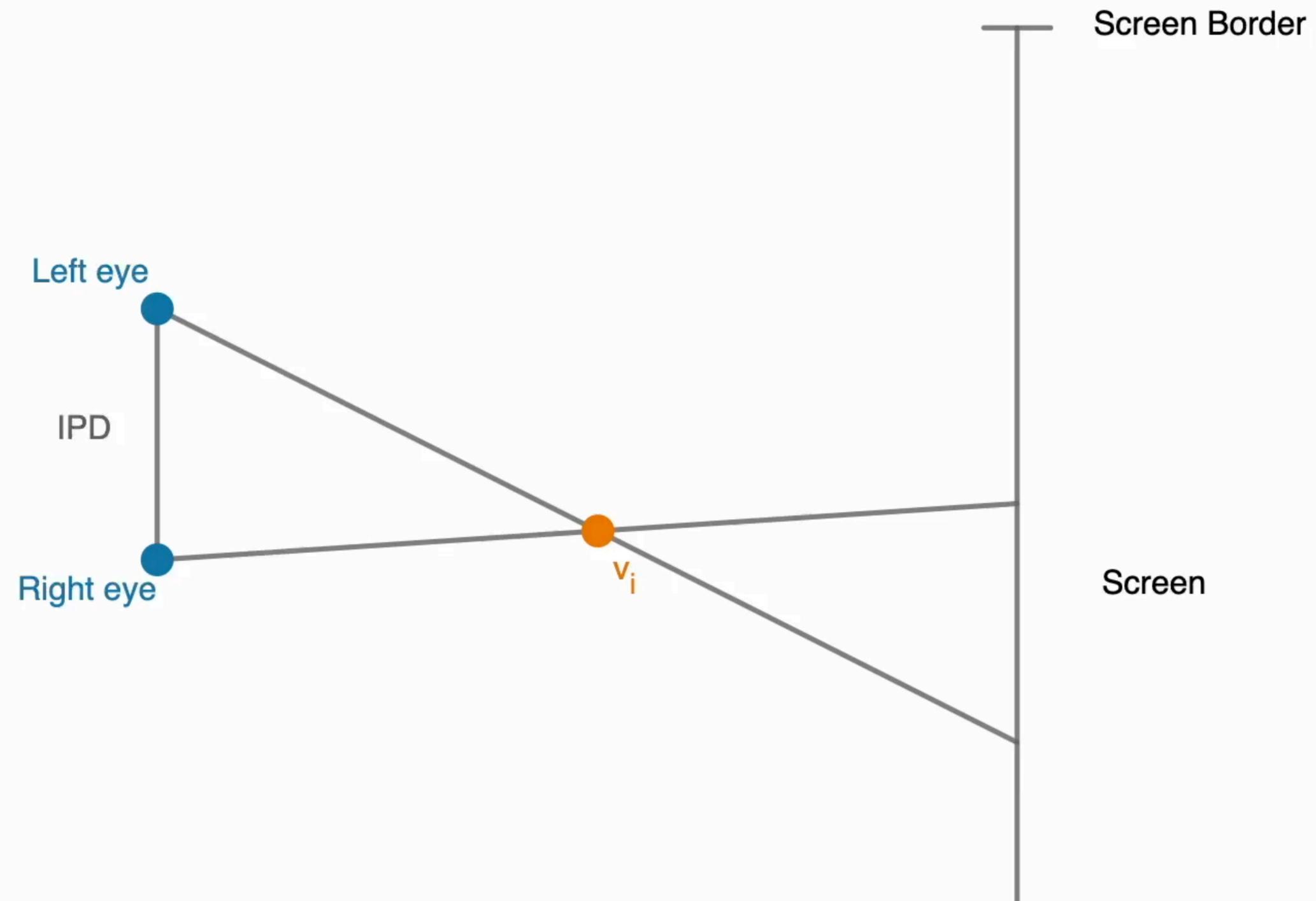
- Framing – What movie directors do

- Global disparity remapping

  - Move scene behind the screeen [Xu 2012]

  - Center scene around zero disparity [Chen 2012]

  - Smaller baseline for close scenes [Pritch 2000]

- Non-Linear remapping

  - "Contrast stretching" for disparity [Xu 2014]

  - Cropping + Warping [Lin 2011]

[1] Xu, D., Coria, L.E., Nasiopoulos, P.: Quality of experience for the horizontal pixel parallax adjustment of stereoscopic 3D videos. In: 2012 IEEE International Conference on Consumer Electronics (ICCE)
[2] Chen,M.J.,Kwon,D.K.,Cormack,L.K.,Bovik,A.C.: Optimizing 3D image display using the stereoacuity function. In: 2012 19th IEEE International Conference on Image Processing
[3] Pritch,Y.,Ben-Ezra,M.,Peleg,S.: Automaticdisparitycontrolin stereo panoramas (OmniStereo). In: Proceedings IEEE Workshop on Omnidirectional Vision
[4] Xu, J., Yan, F., Cao, X.: Stereoacuity-guided depth image based rendering. In: 2014 IEEE International Conference on Multimedia and Expo Workshops (ICMEW)
[5] Lin, H.S., Guan, S.H., Lee, C.T., Ouhyoung, M.: Stereoscopic 3D Experience Optimization Using Cropping and Warping. In: SIGGRAPH Asia 2011 Sketches

Motivation

Dynparity – Key Ideas

- Adjust only **what** would clip

- Adjust only **where** it would clip

- Adjust as **little** as possible

Dynparity

Implementation in Godot

Cyclops-eye projection

Left eye

IPD Cyclop's
eye

Right eye

$\vec{v_i}$

Border
distance

Screen

Transfer Function
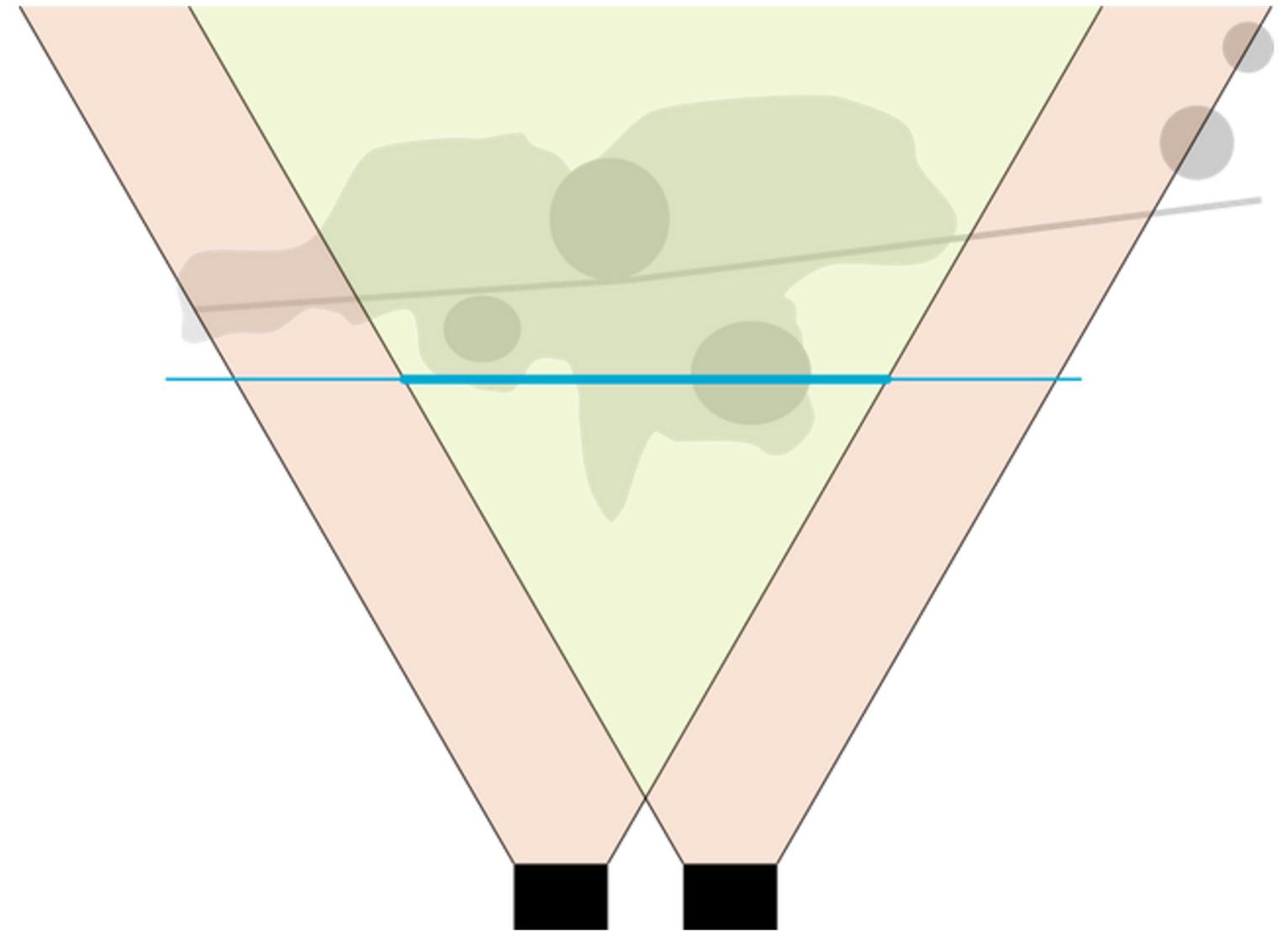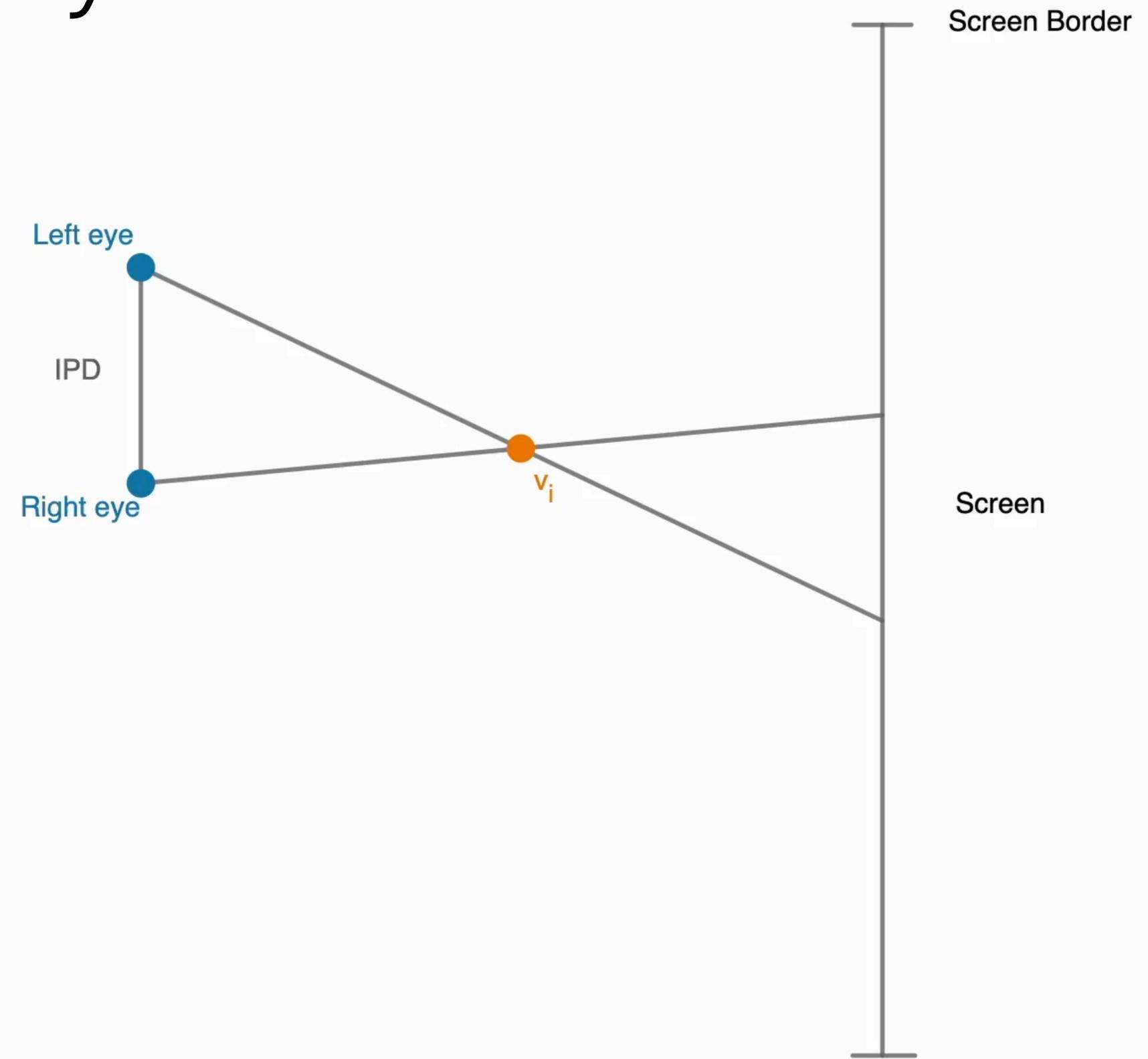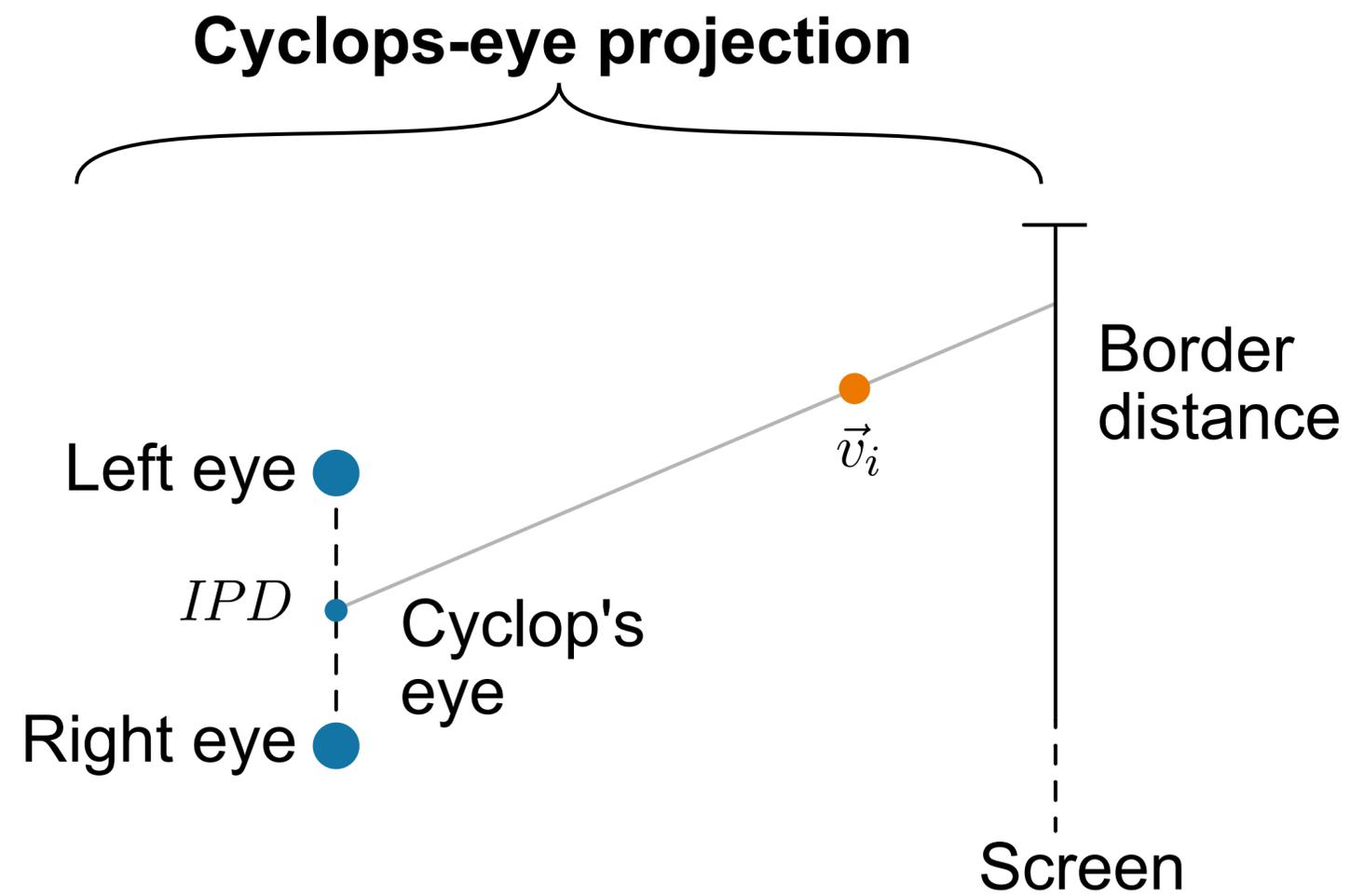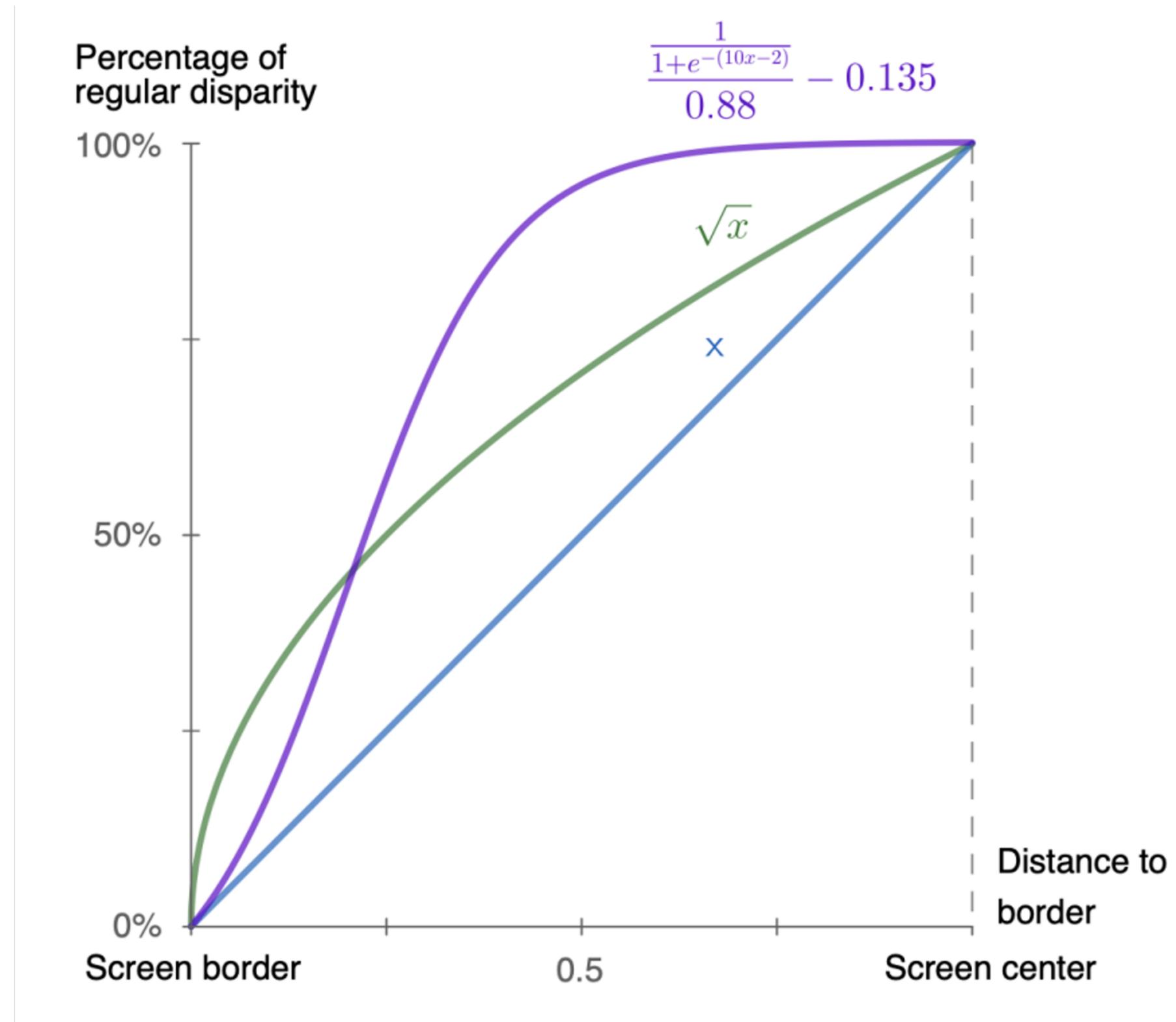
Dynparity – Influence
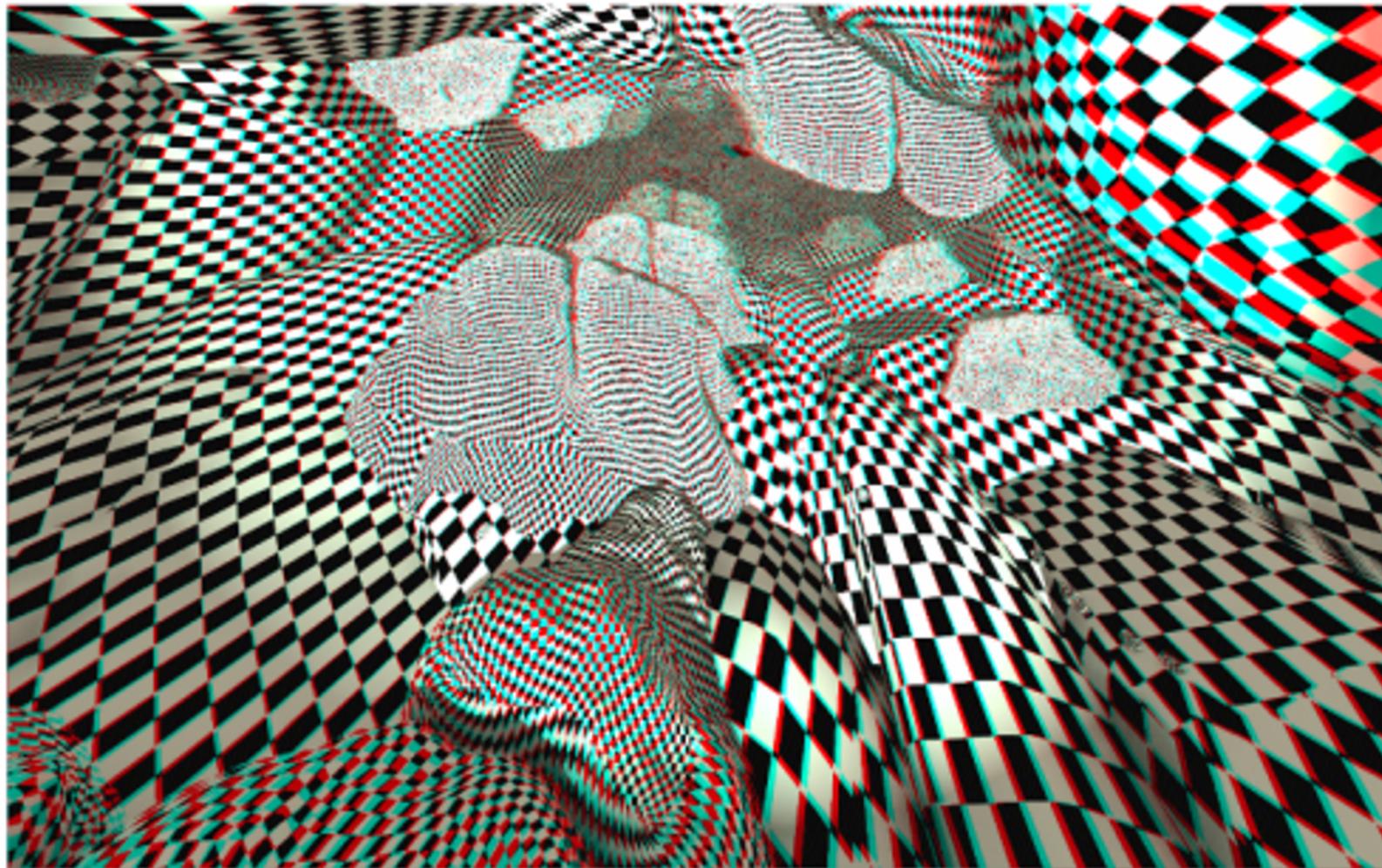
Dynparity - Off
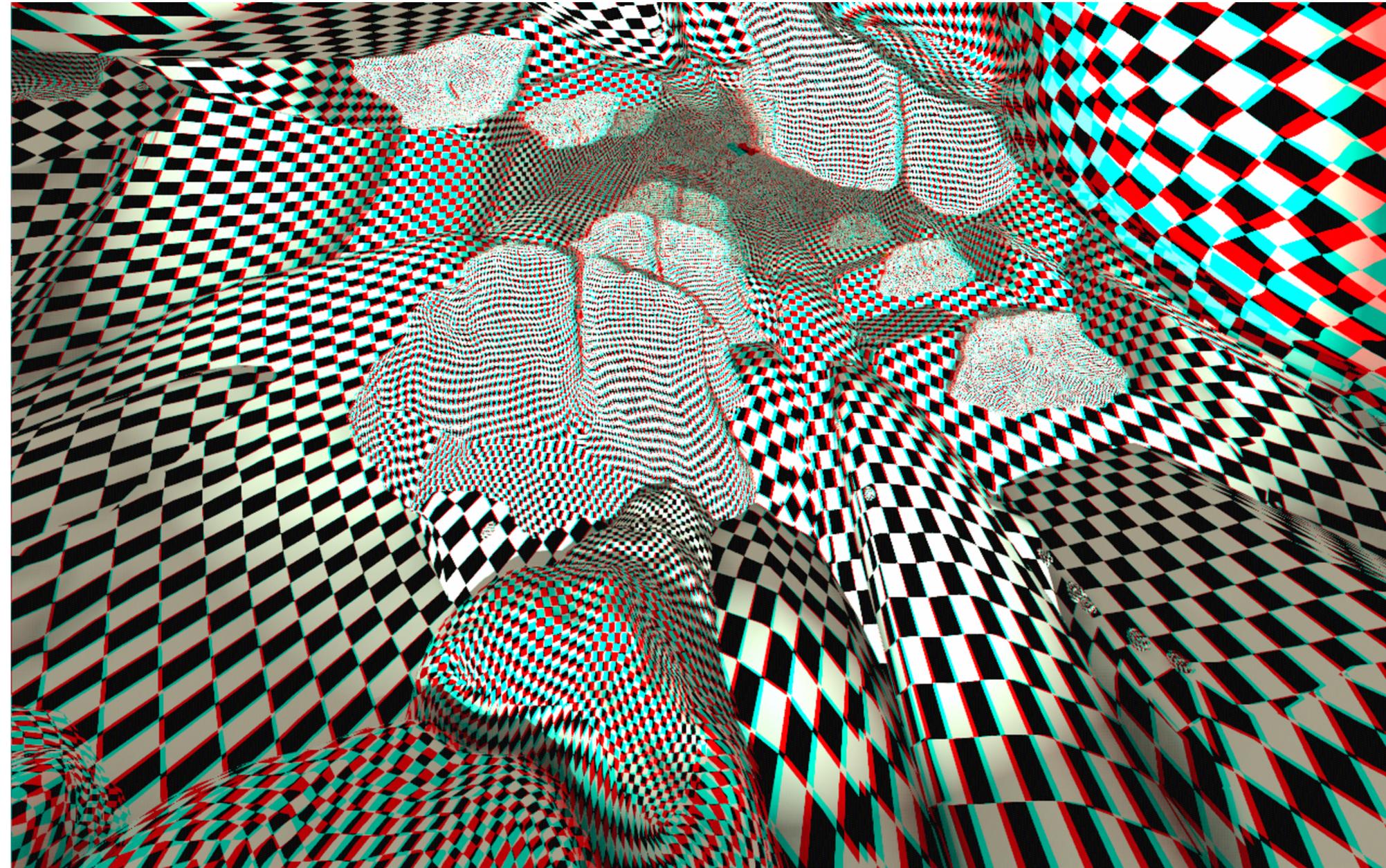
Dynparity - On

Evaluation
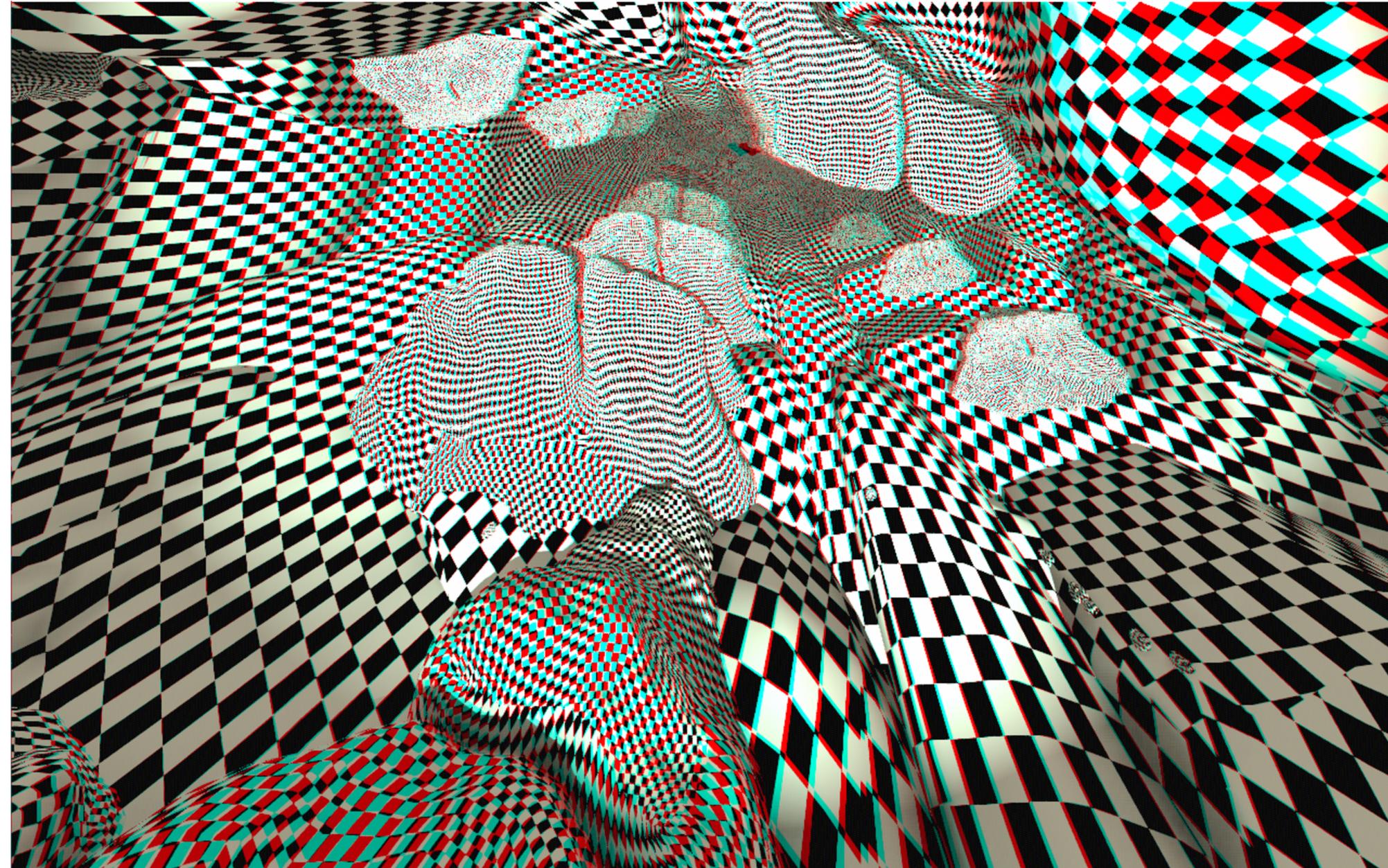
1. Do the participants prefer the Dynparity rendering over the standard stereo rendering with stereo window violations?

2. Does Dynparity rendering reduce simulator sickness compared to standard stereo rendering?

User Study: Stimuli

- 36 volunteer participants

- 31 passed stereo acuity test

- 4m x 2.5 m Powerwall
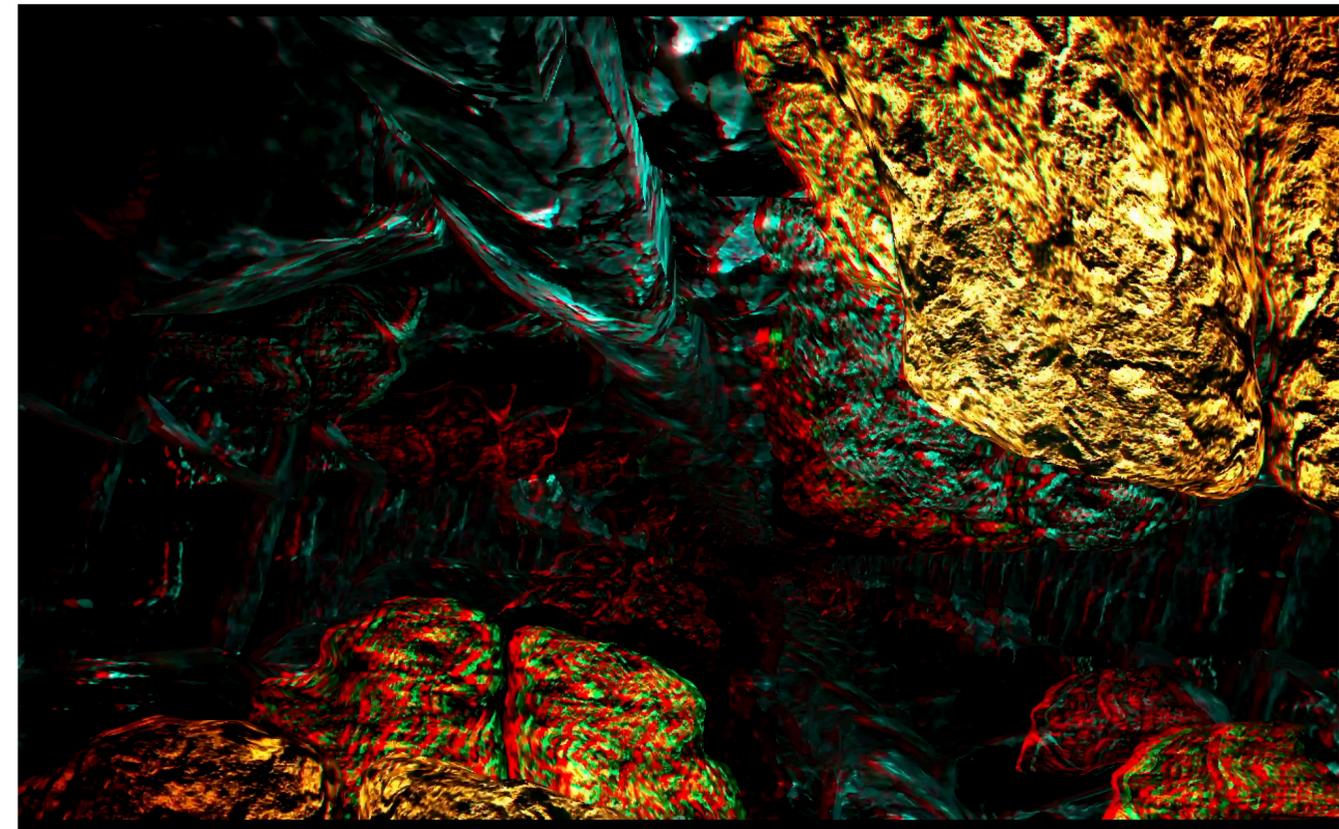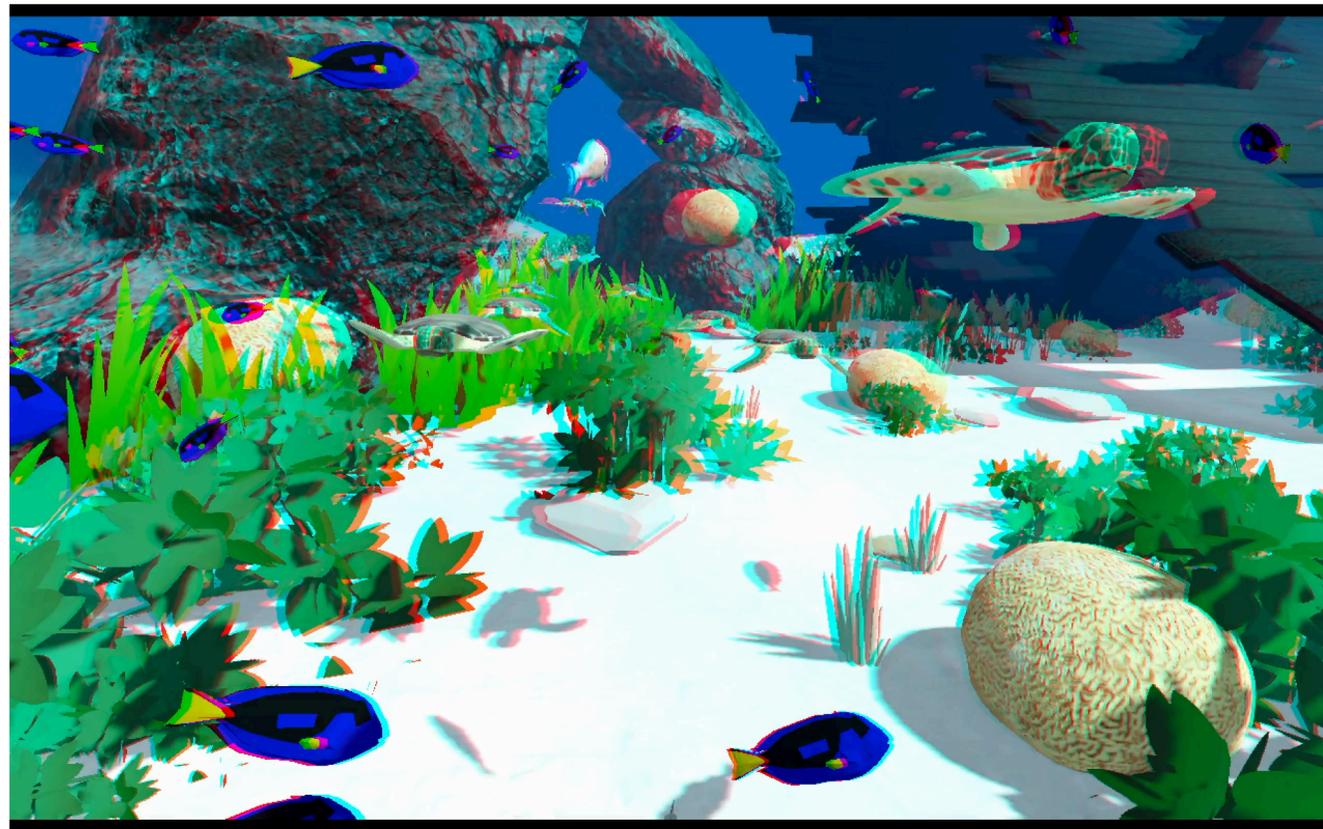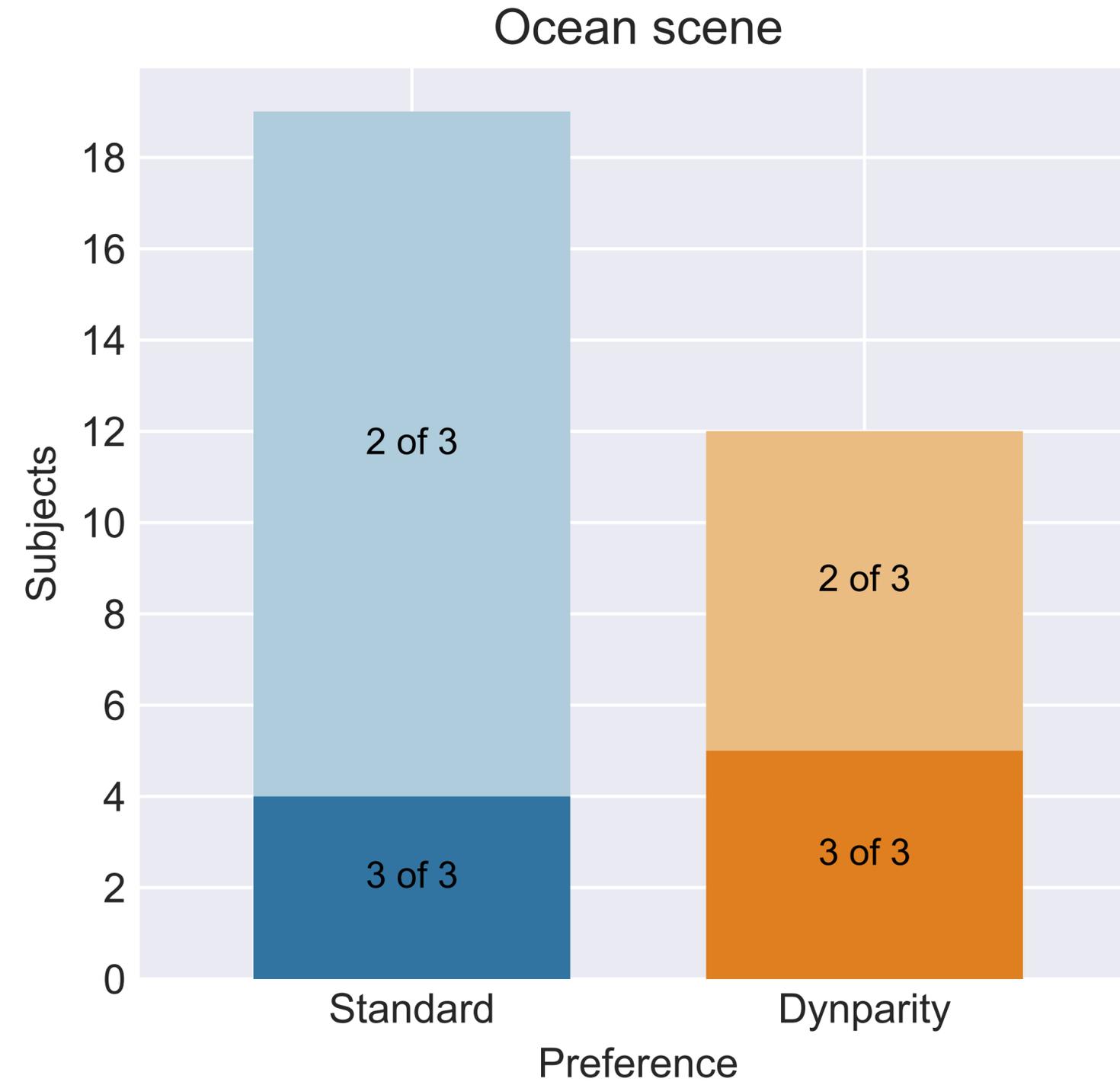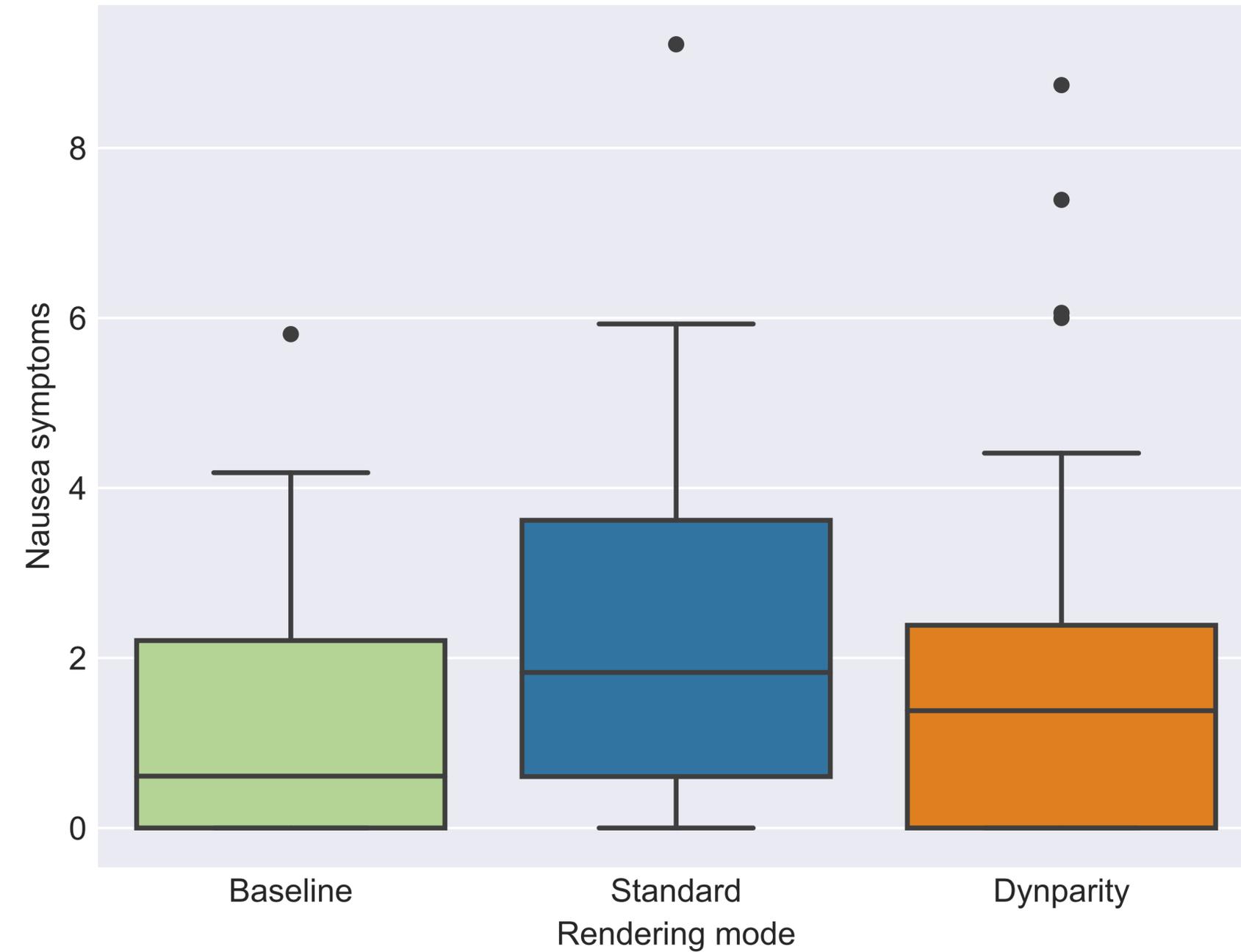
Results – User Preference

Ocean scene

Results – User Preference

Bouchard,S.,Robillard,G.,Renaud,P.: Revisingthefactorstructure of the simulator sickness questionnaire.
Annual Review of CyberTherapy and Telemedicine 5, 128–137 (2007)

Results – User Preference

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Limitations and Future Work
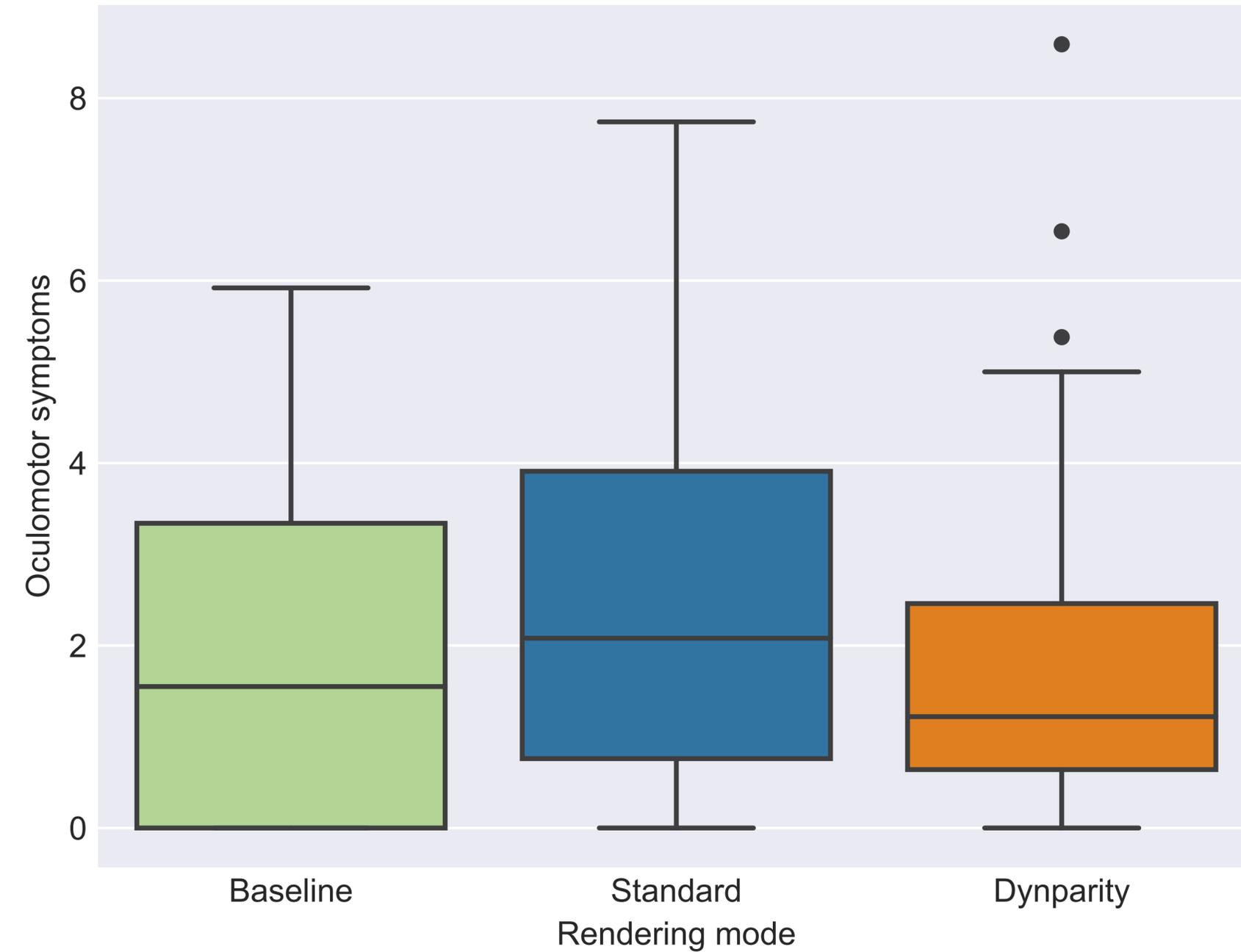
- Optimal mapping function

- Influence on depth perception

- Effect on smaller screens

- Influence on accommodation-vergence conflict

- Dynamic tesselation

Conclusion

- Single pass real-time disparity adjustment

- User-Study evaluation

- Only two noticed a distortion

- Compared to standard stereo rendering

  - No significant difference in preference

  - Significant reduction in oculomotor symptoms

  - -> Can reduce simulator sickness

Thank You!
Any Questions?

https://cgvr.cs.uni-bremen.de/research/dynparity
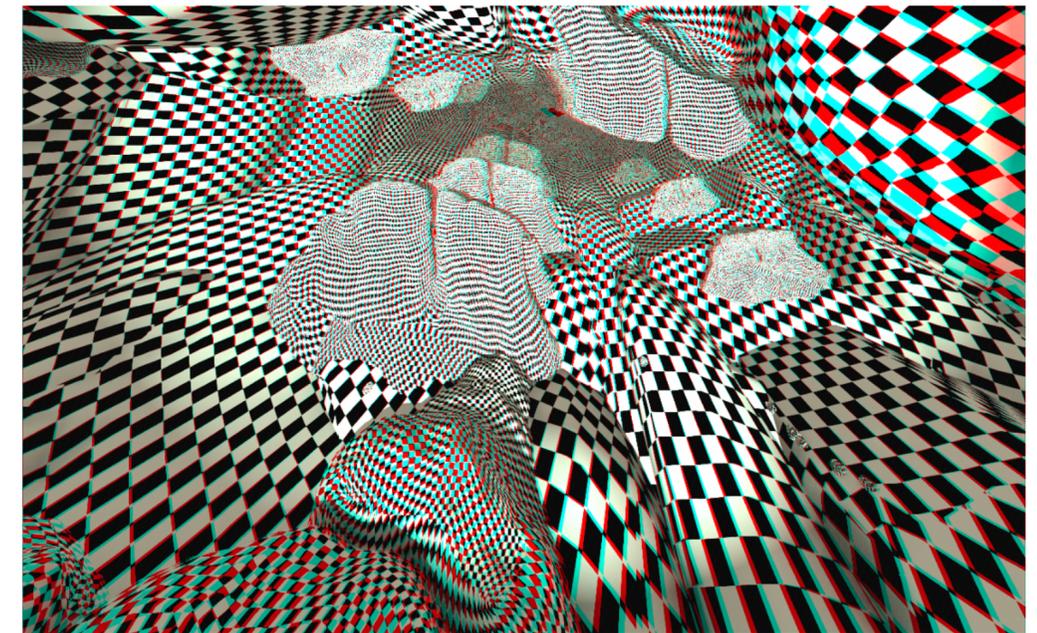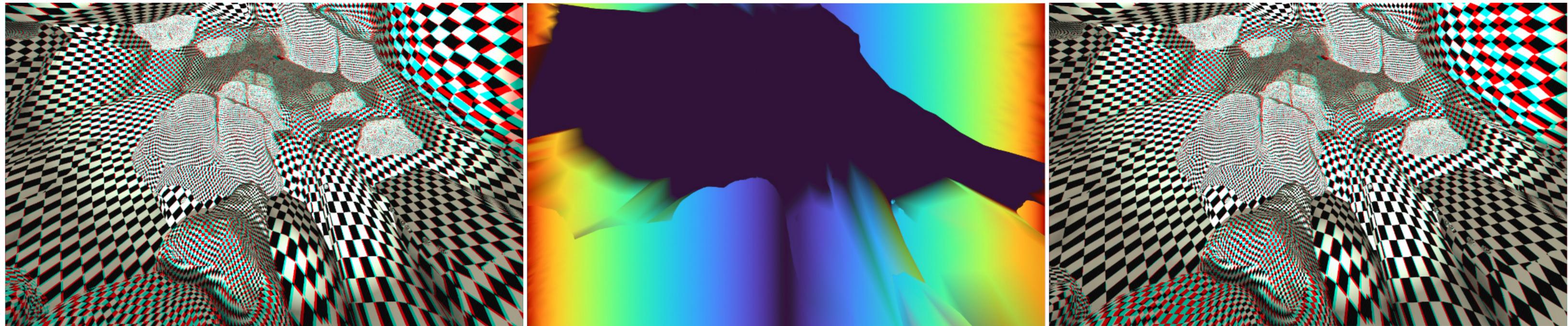
Christoph Schröder-Dering

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