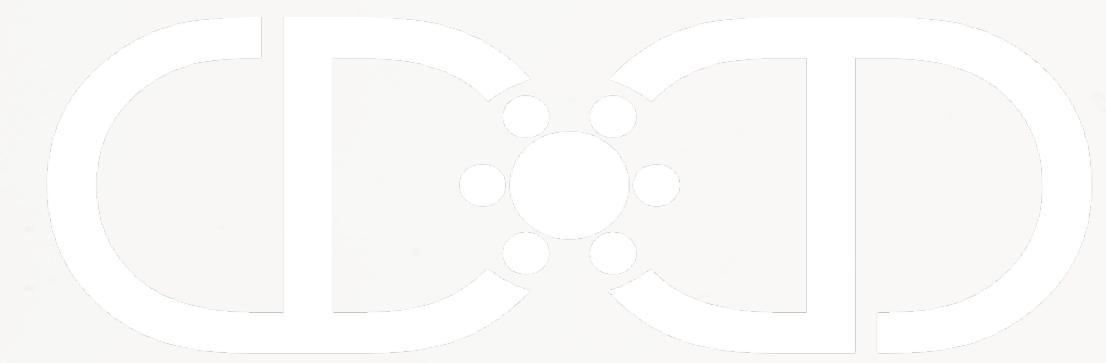


SANTIAGO LOMBEYDA



METHODS OF COMPUTATIONAL SCIENCE
INTRO TO VISUALIZATION

2020 ADDENDUM

OVERVIEW

SECTION 1

WHAT IS VISUALIZATION?

SECTION 2

UNDERSTANDING THE LANDSCAPE

SECTION 3

A TOOL TAXONOMY

SECTION 4

PRINCIPLES OF DATA REPRESENTATION

NOTES

..ON COLOR

NOTES

..ON MAPPING MULTIPLE DIMENSIONS

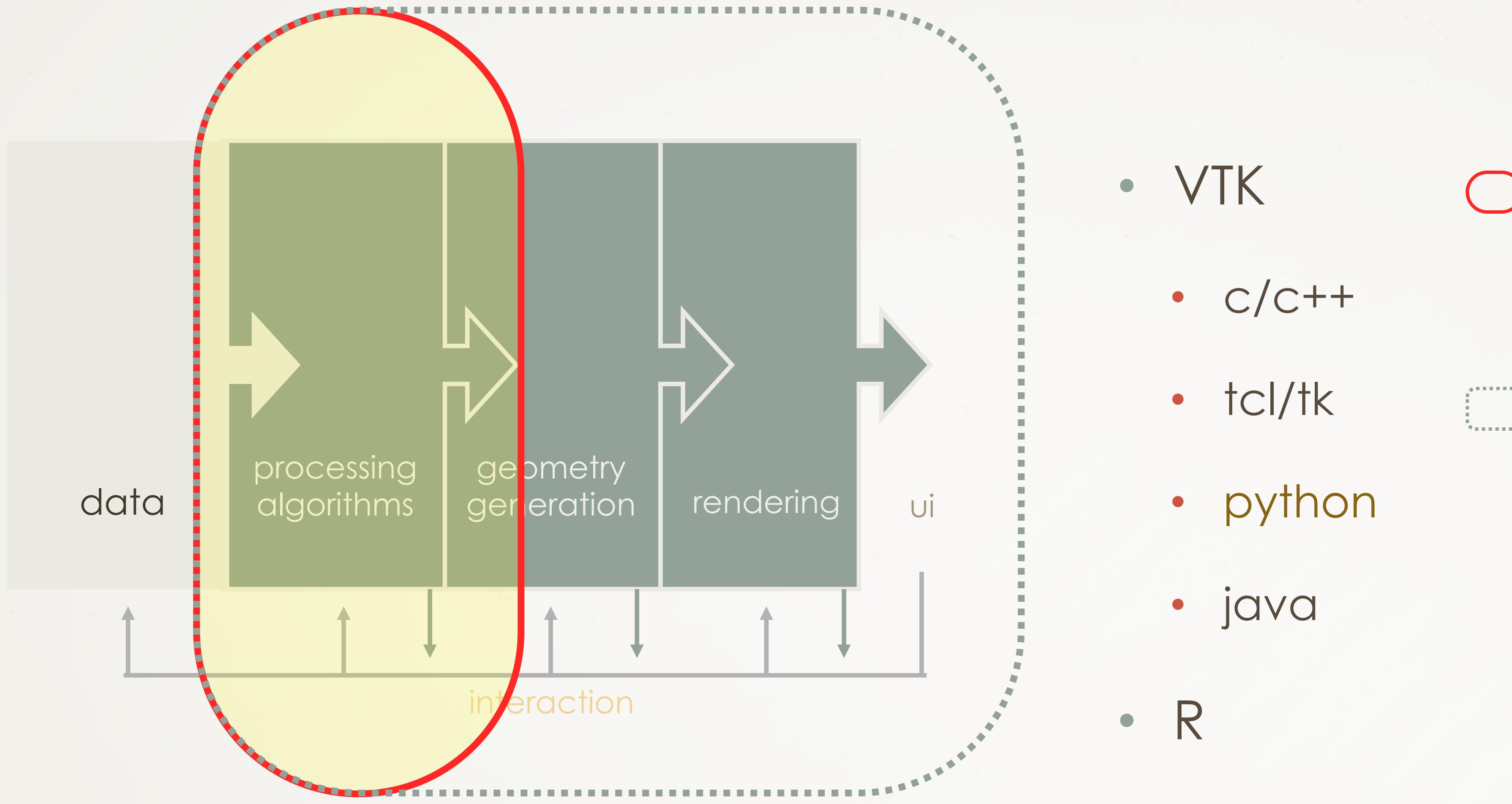
SECTION 5

ADDRESSING BOTTLENECKS

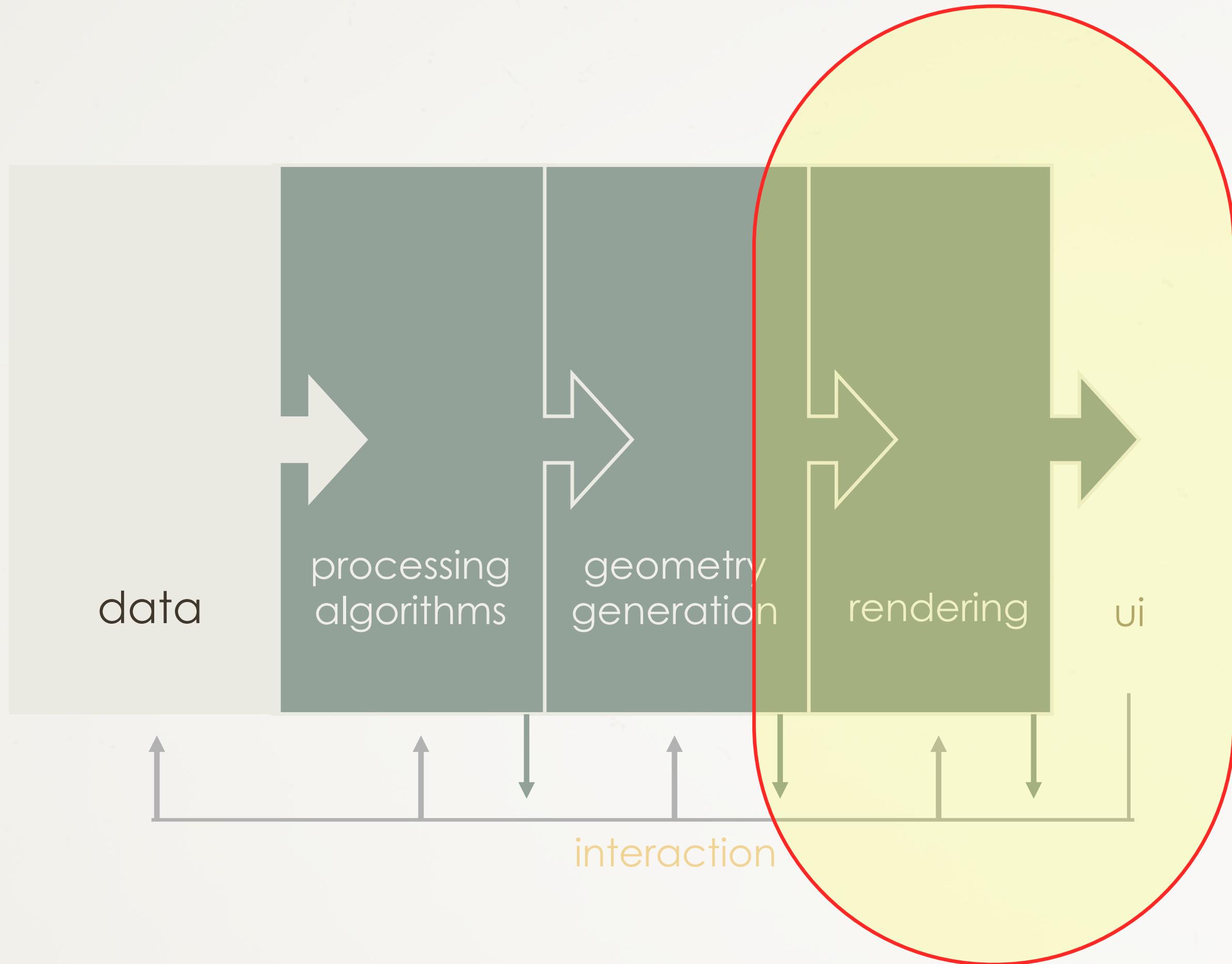
SECTION 6

PUTTING IT ALL TOGETHER

“THE” VISUALIZATION TOOLKIT

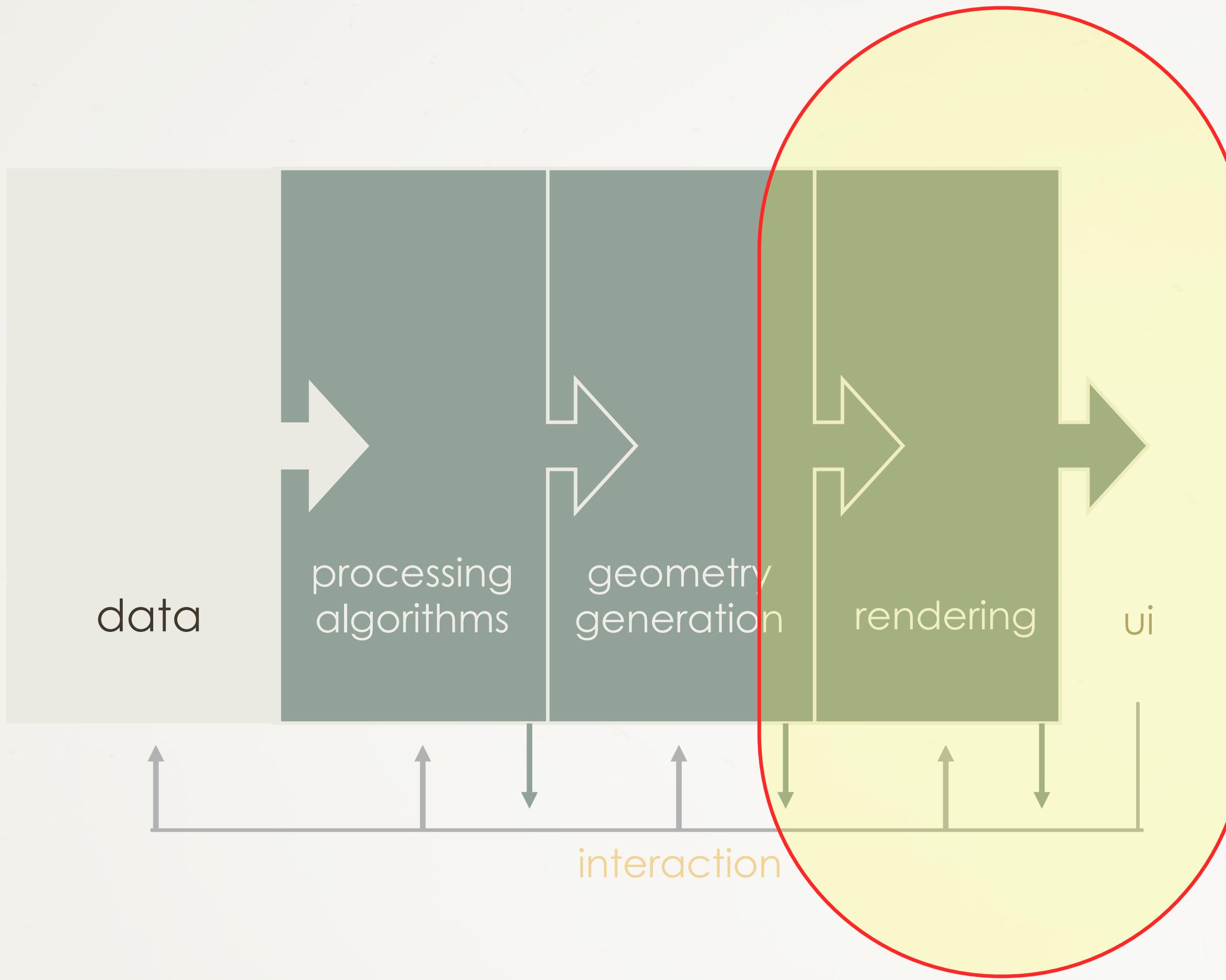


INTERACTIVE RENDERERS



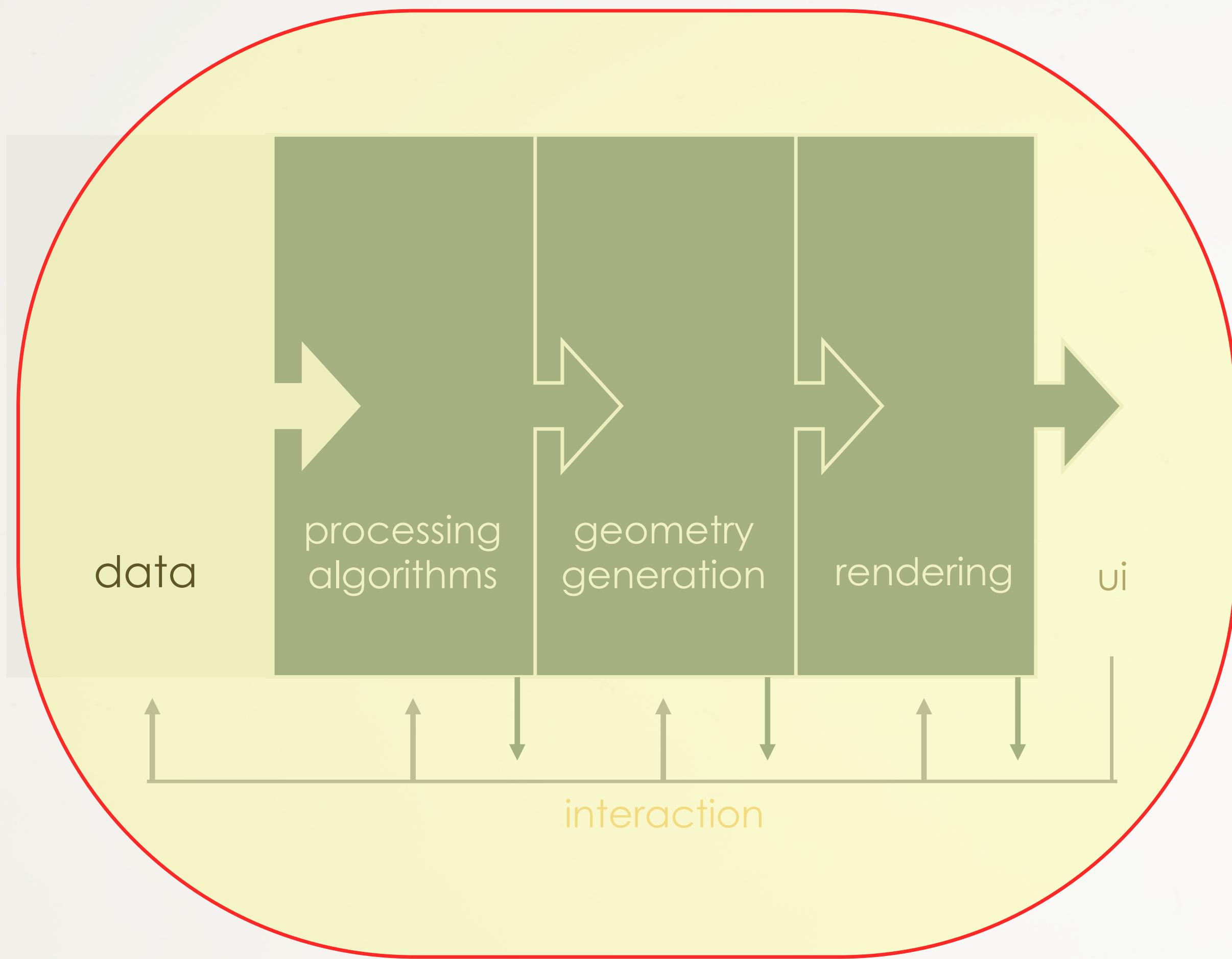
- **OpenGL**
 - mesaGL
 - direct3D
 - openGL ES
- HIGHER LEVEL:
 - **OpenInventor**
 - C++/GL
 - COIN
 - **Java3D**
 - Java/GL
 - **WebGL**
 - ➔ **three.js**

INTERACTIVE RENDERERS



- OpenGL
 - mesaGL
 - direct3D
 - openGL ES
- HIGHER LEVEL | DESKTOP
- cross-platform
 - OPEN FRAMEWORKS
 - CINDER, PROCESSING (P5.js)
- gaming
 - UNITY
 - UNREAL
- web based
 - three.js
 - babylon.js

VISUALIZATION SYSTEMS



- Paraview^{VTK}
- LLNL VisIt^{VTK}
- Ensight\$
- tableau\$
 - D3^{WWW}
- Many Eyes^{WWW}
 - Wiki based
- Modrian^R,
TomCat,
Mollegro

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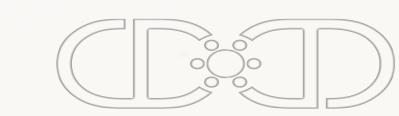
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CENTER FOR DATA-DRIVEN DISCOVERY

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SECTION 7

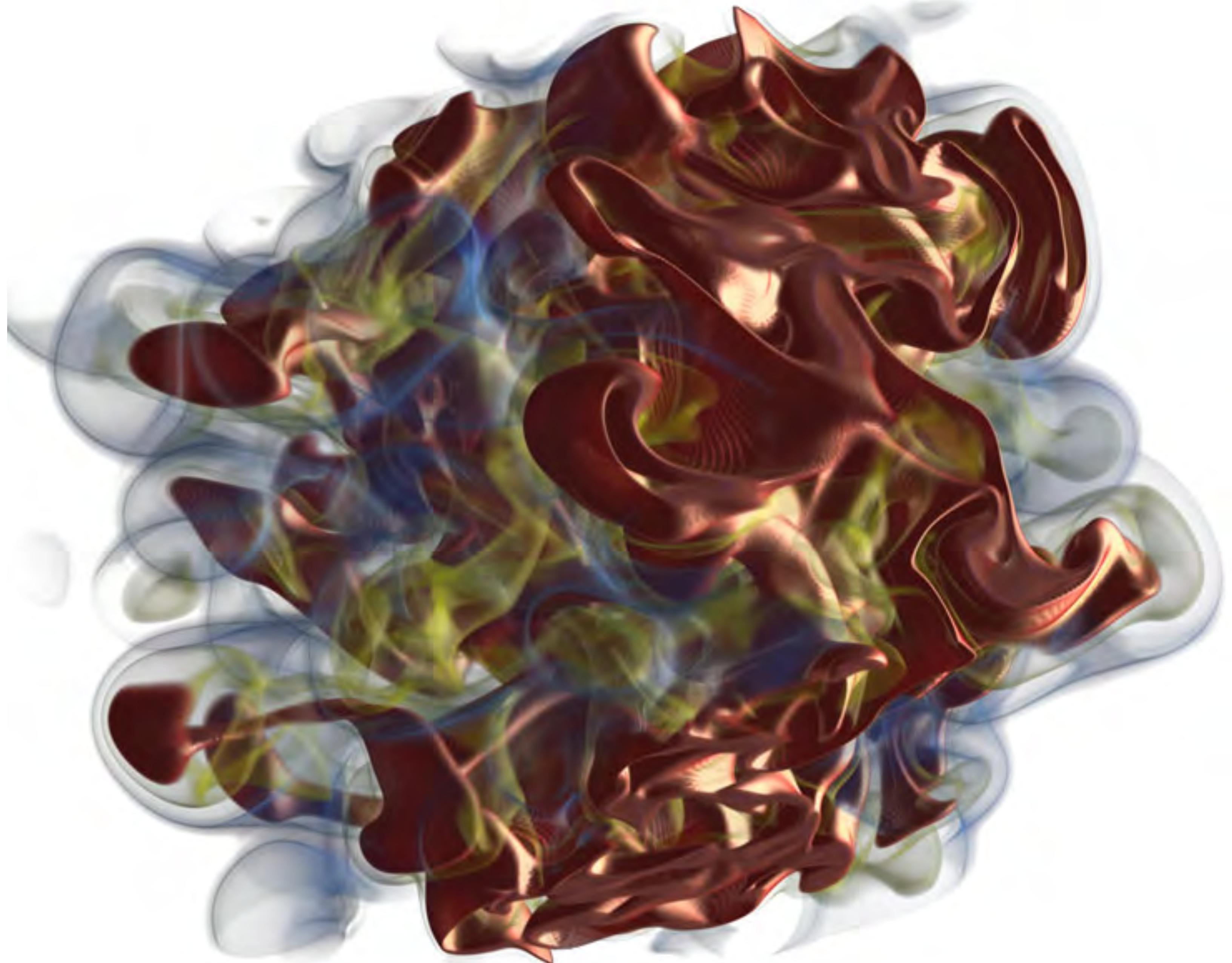
3D VIEWING AND VIRTUAL REALITY

SECTION 7

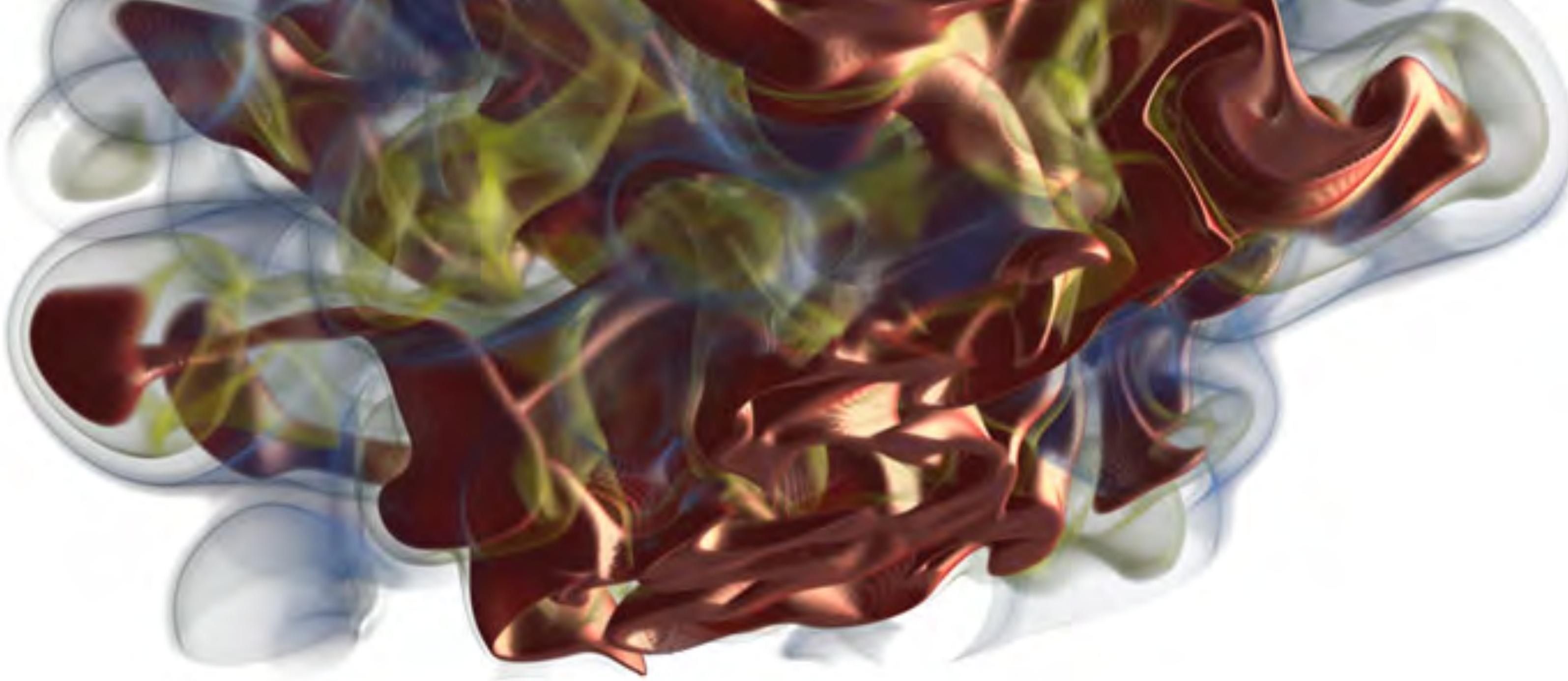
why 3D?

**"WE KNOW NEXT TO NOTHING ABOUT
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- BACTRA REVIEW BY COSMA SHALIZI OF EDWIN HUTCHINS'S BOOK COGNITION IN THE WILD
quote stolen from Colin Ware's Vis2009 keynote



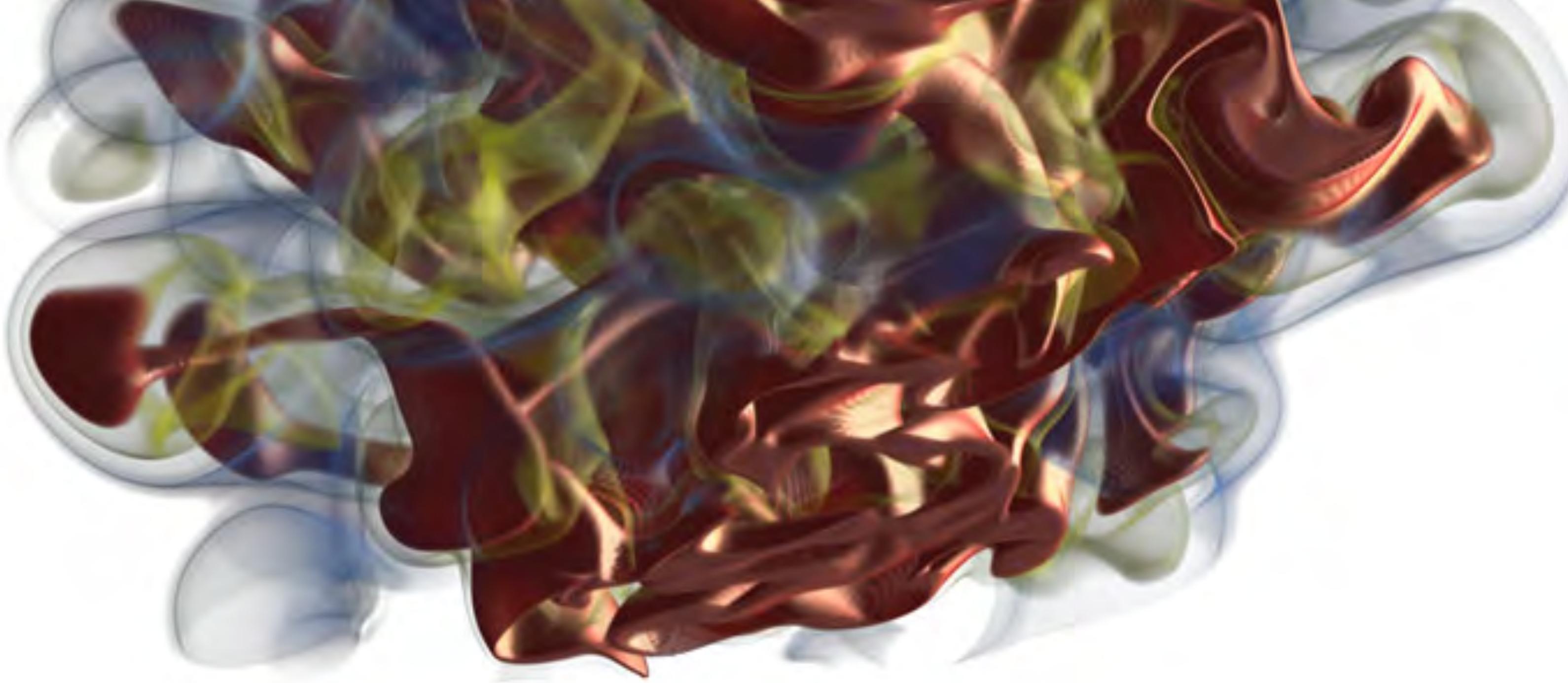
THE VOLUMEPRO VOLUME RENDERING CLUSTER | SANTIAGO LOMBEYDA & JOHN MCCORQUODALE | CALTECH | 2003



THE VOLUMEPRO VOLUME RENDERING CLUSTER | SANTIAGO LOMBEYDA & JOHN MCCORQUODALE | CALTECH | 2003

WHY 3D

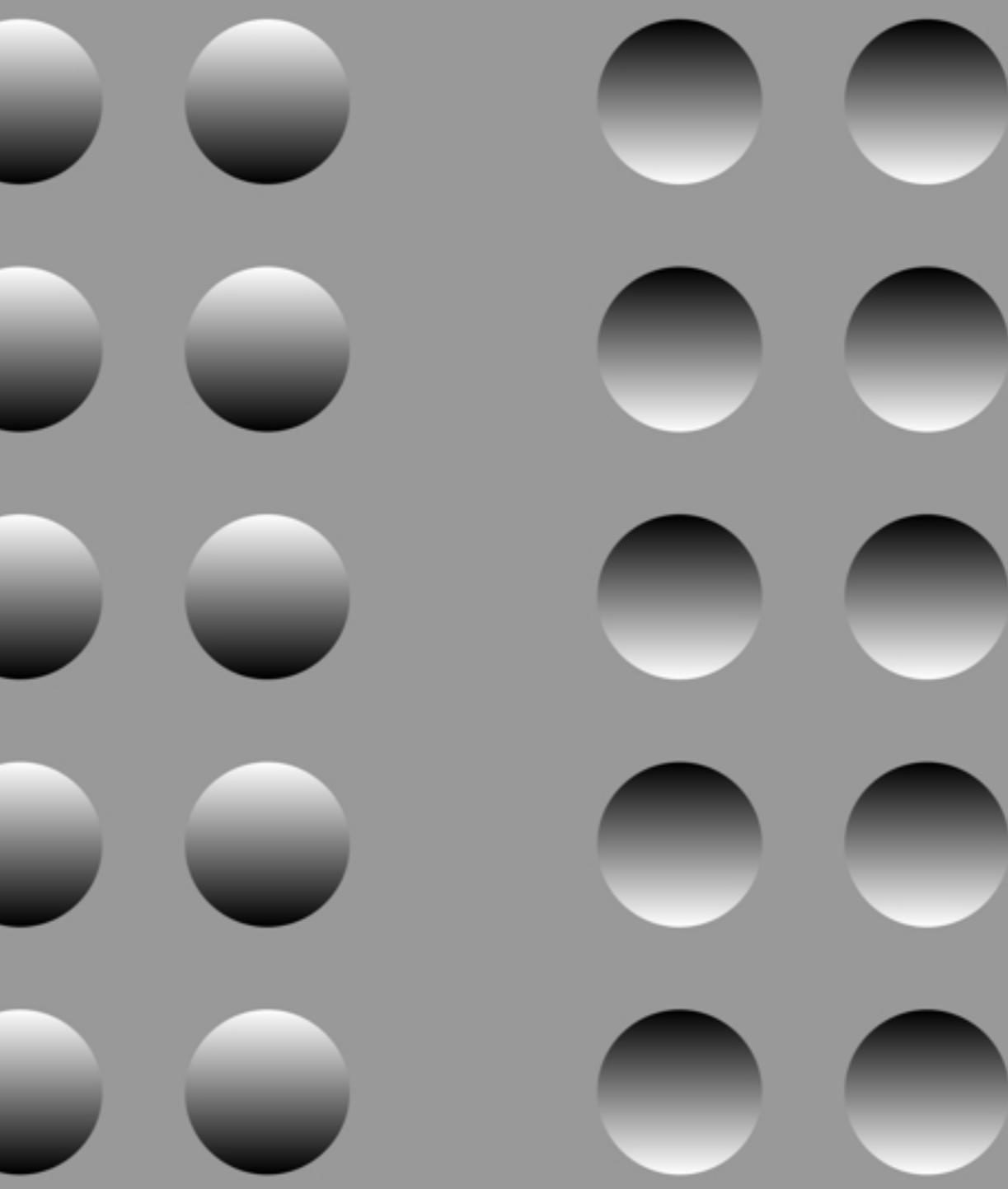
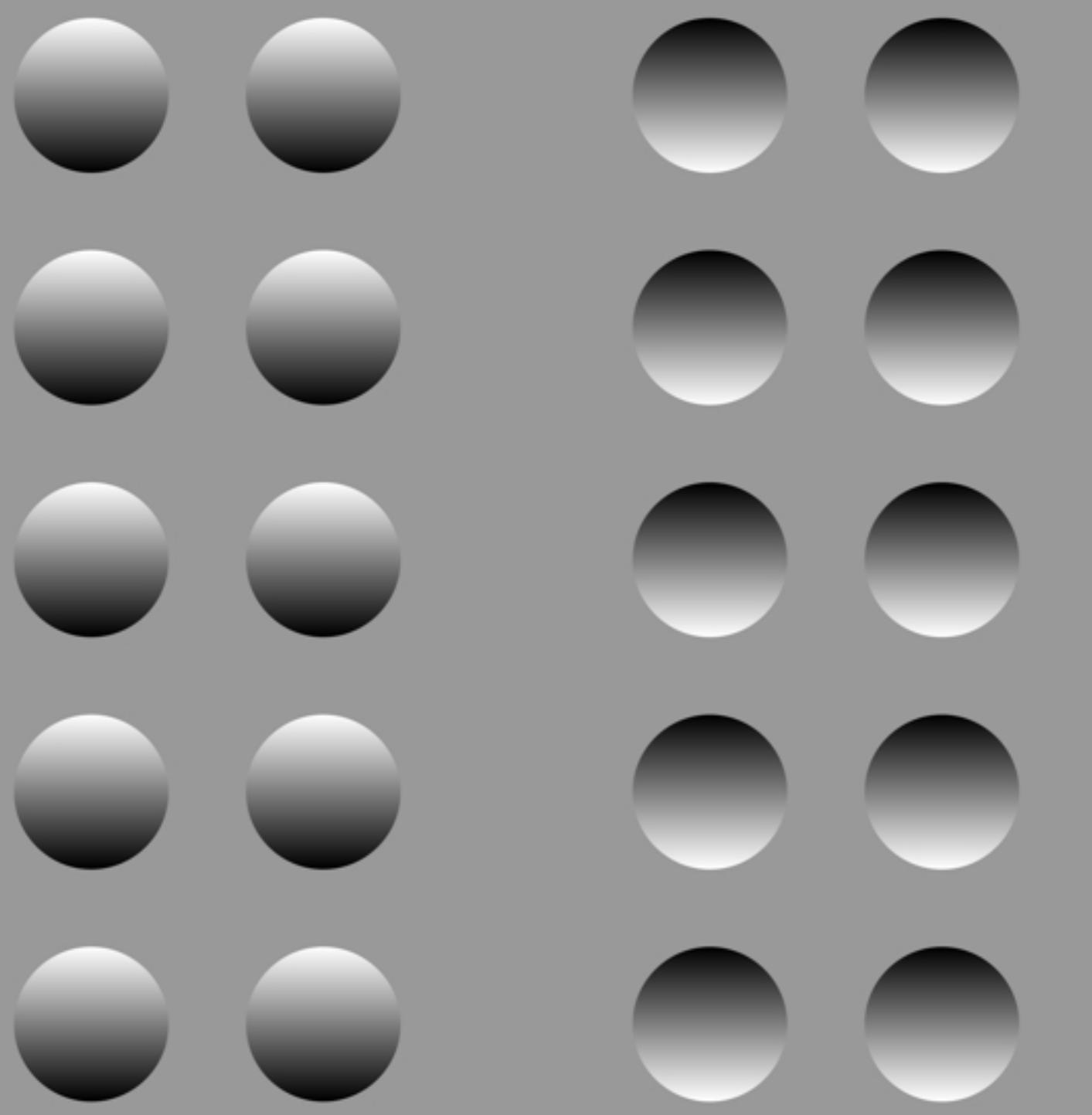
- phenomena is in 3D
- spatial relationships meaningful in 3D
- we understand 3D world



THE VOLUMEPRO VOLUME RENDERING CLUSTER | SANTIAGO LOMBEYDA & JOHN MCCORQUODALE | CALTECH | 2003

WHY NOT 3D

- spatial relationships more difficult to understand
- our displays are 2D
- we abstract in 2D or 1D







- _OCCLUSION
- _PERSPECTIVE
- _MOTION PARALLAX

- _SIZE: RELATIVE | FAMILIAR | ABSOLUTE
- _LIGHTING AND SHADING

- _DEFOCUS BLUR
- _DEPTH FROM MOTION
- _KINETIC DEPTH EFFECT
- _ATMOSPHERIC PERSPECTIVE
- _ACCOMODATION
- _CURVILINEAR PERSPECTIVE
- _TEXTURE GRADIENT
- _ELEVATION



- _BINOCULAR PARALLAX
(STEREOPSIS)

- _CONVERGENCE

- _SHADOW STEROPSIS

3D CUES

_OCCLUSION

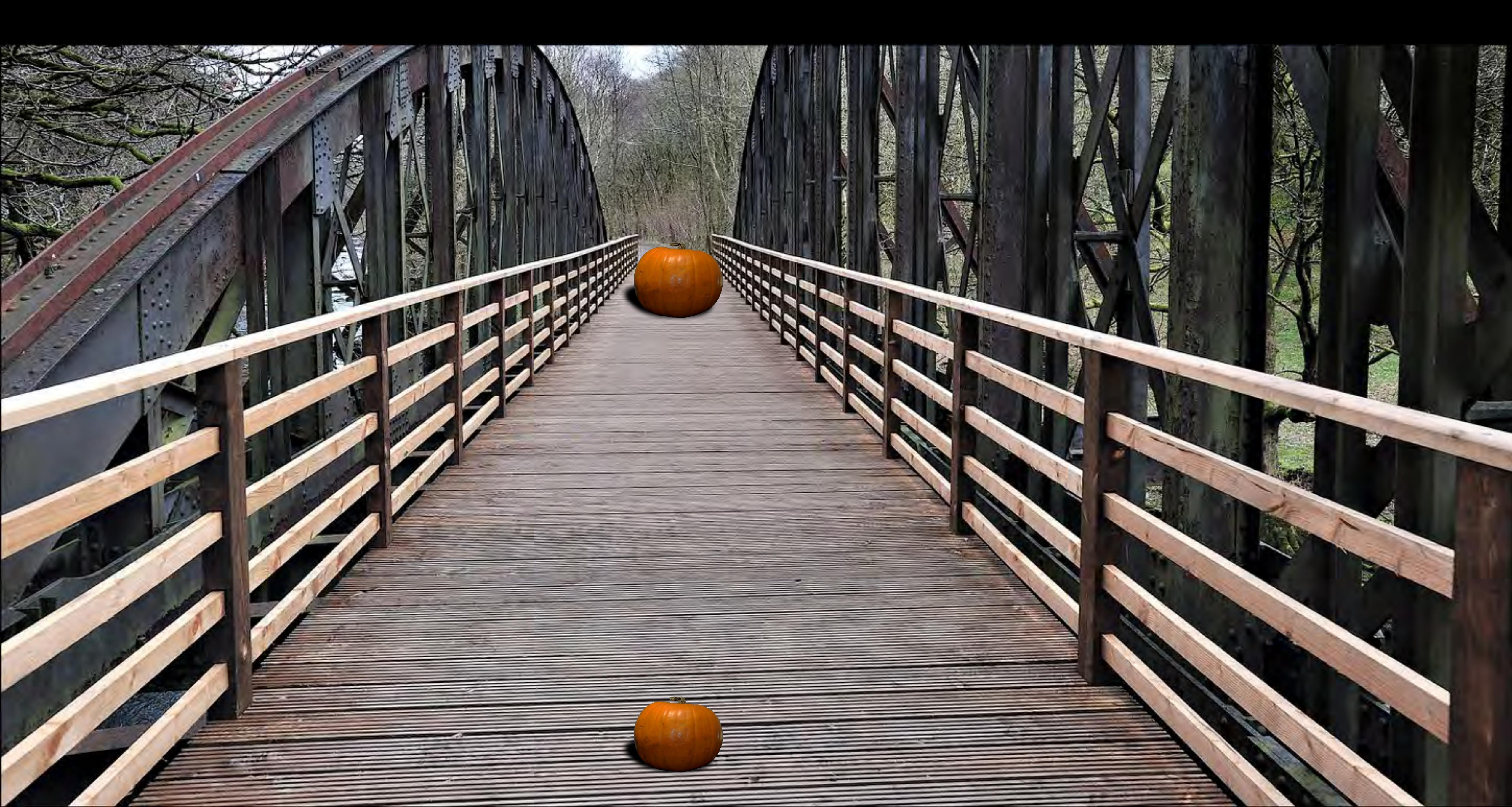


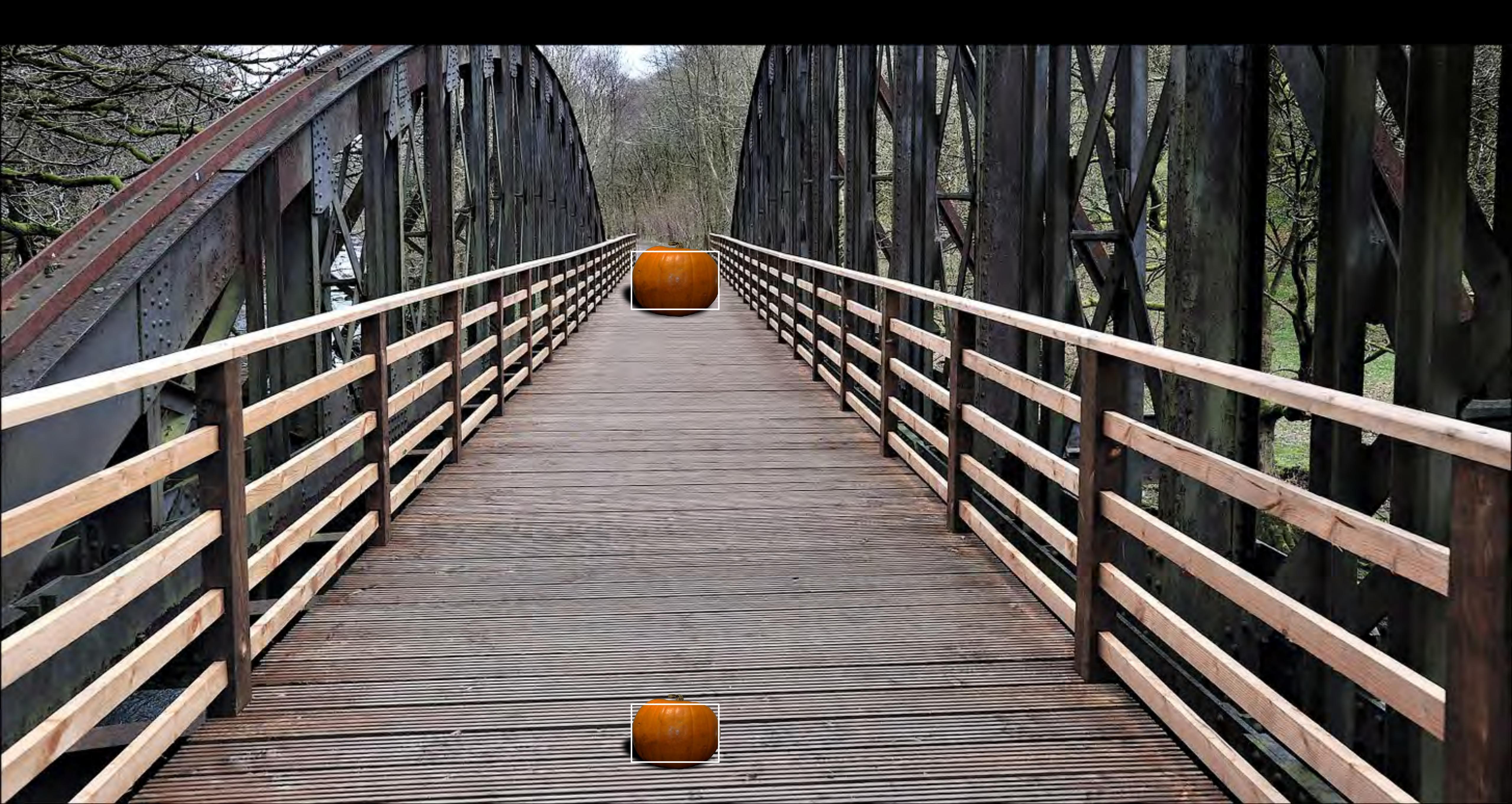




_PERSPECTIVE

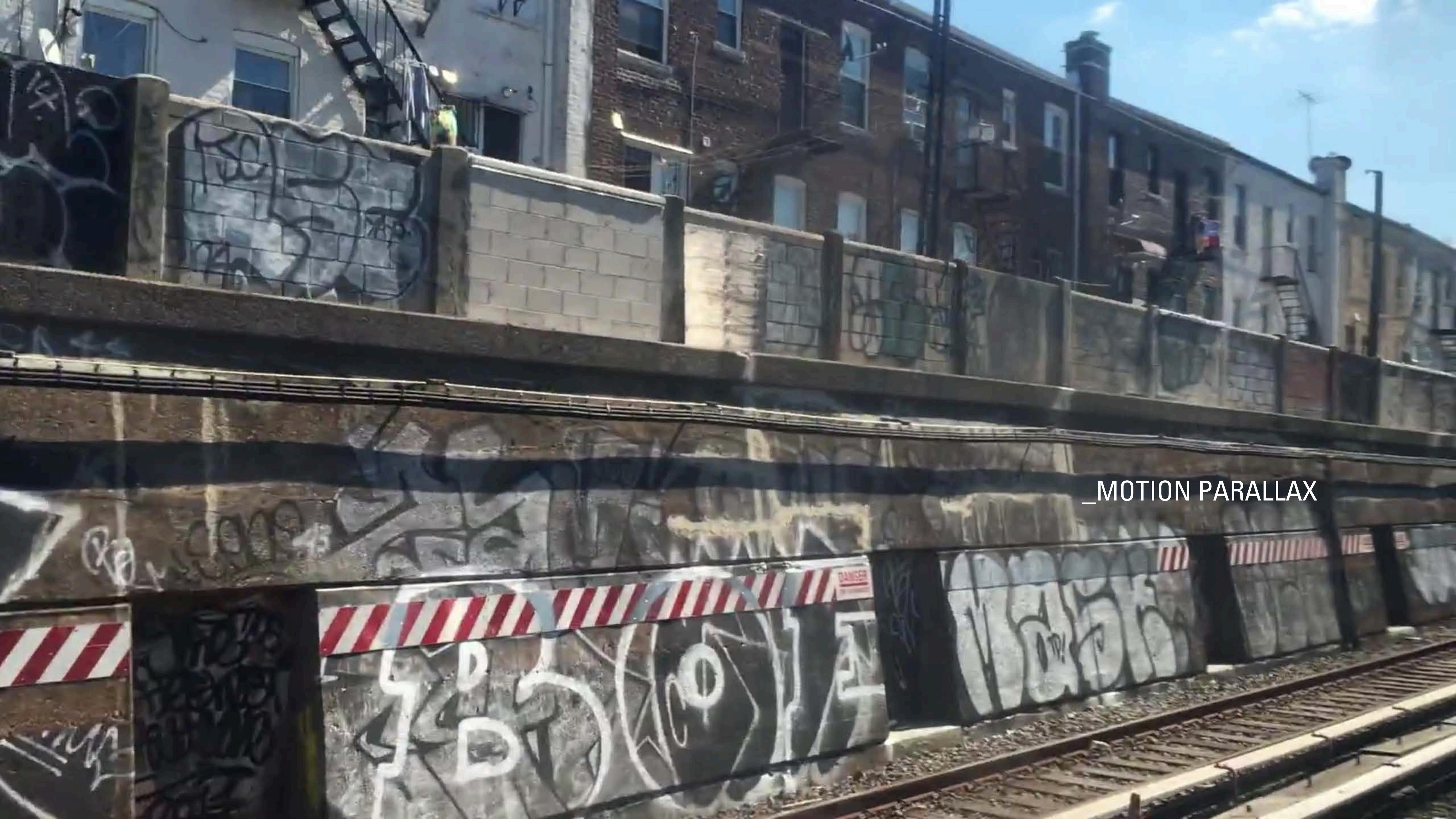






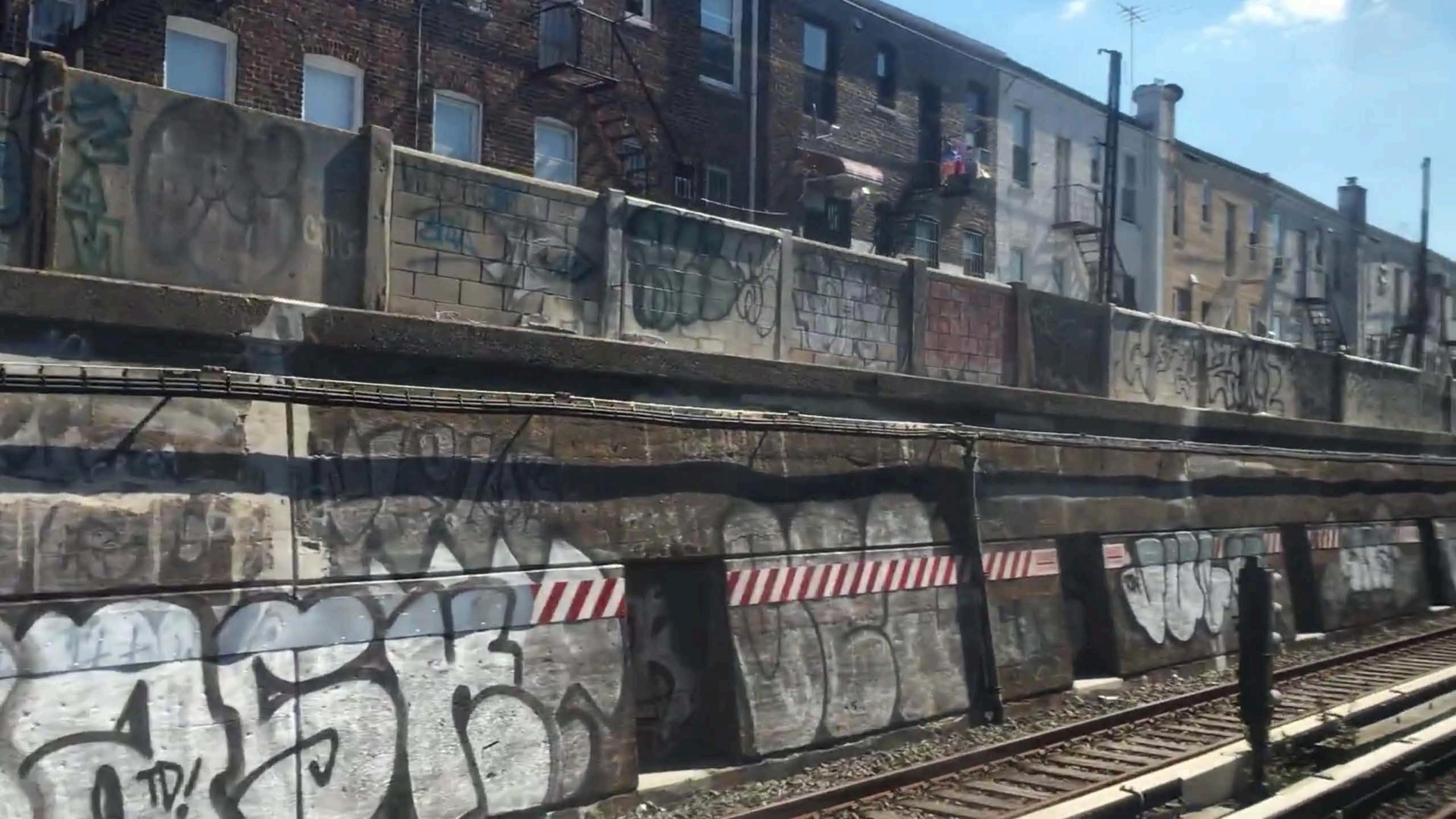




A photograph of a graffiti-covered wall next to a railway track. The wall features large, stylized white and grey spray-painted letters spelling out "ROCKY". Below the letters, there's a red and white striped barrier tape with the word "DANGER" printed on it. The background shows a multi-story brick building with several windows and a chimney. The sky is clear and blue.

_MOTION PARALLAX



















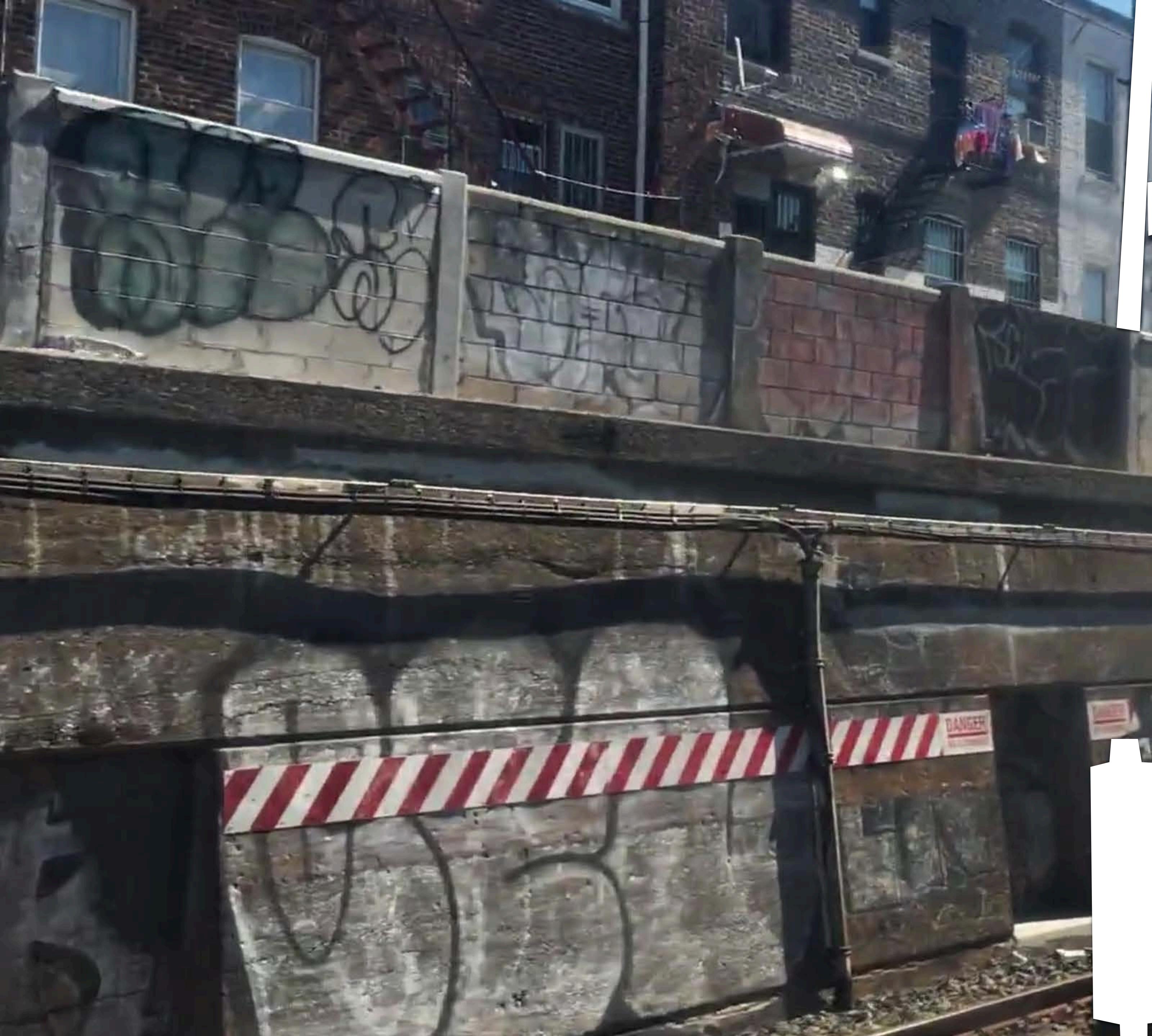










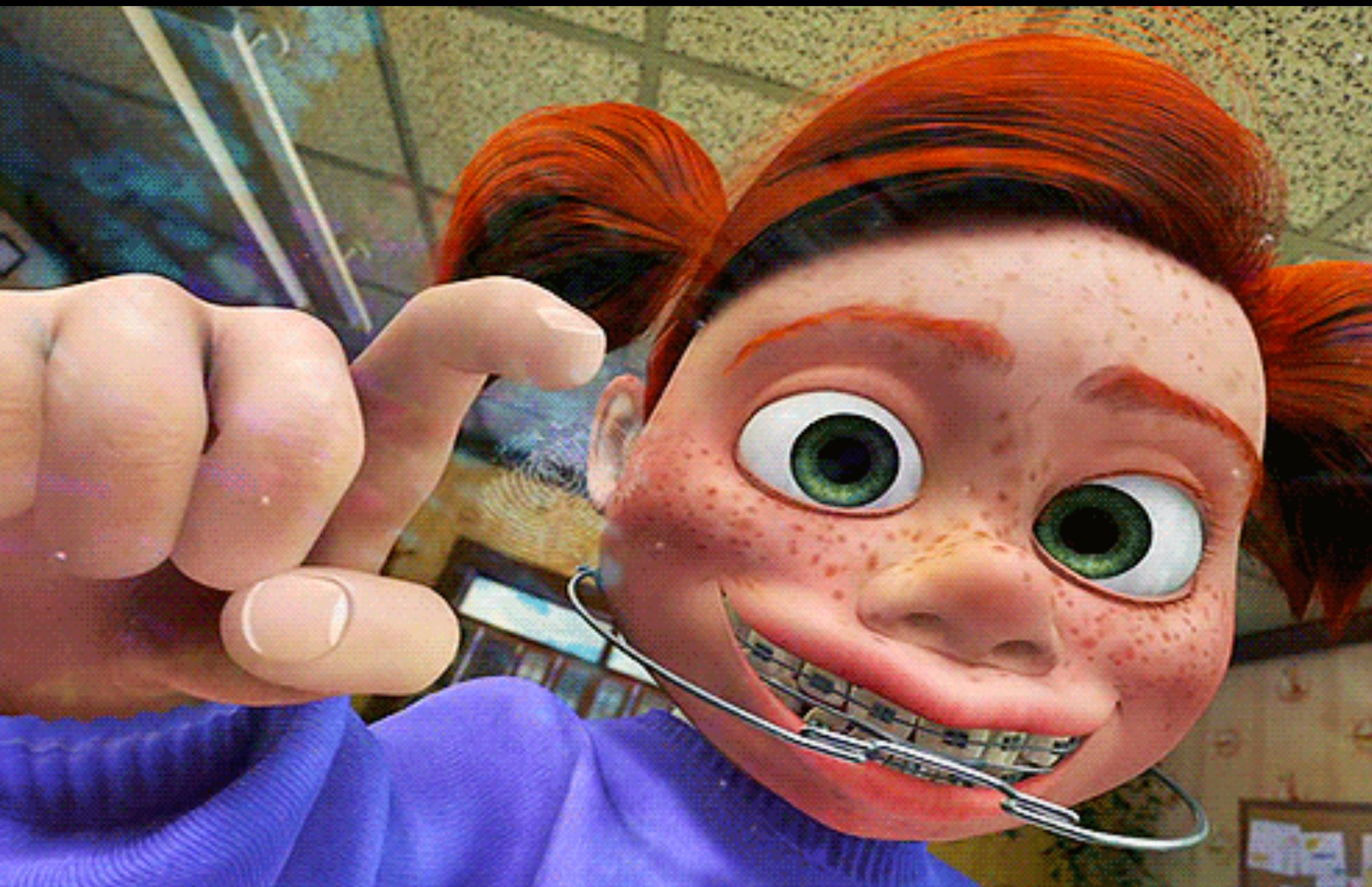


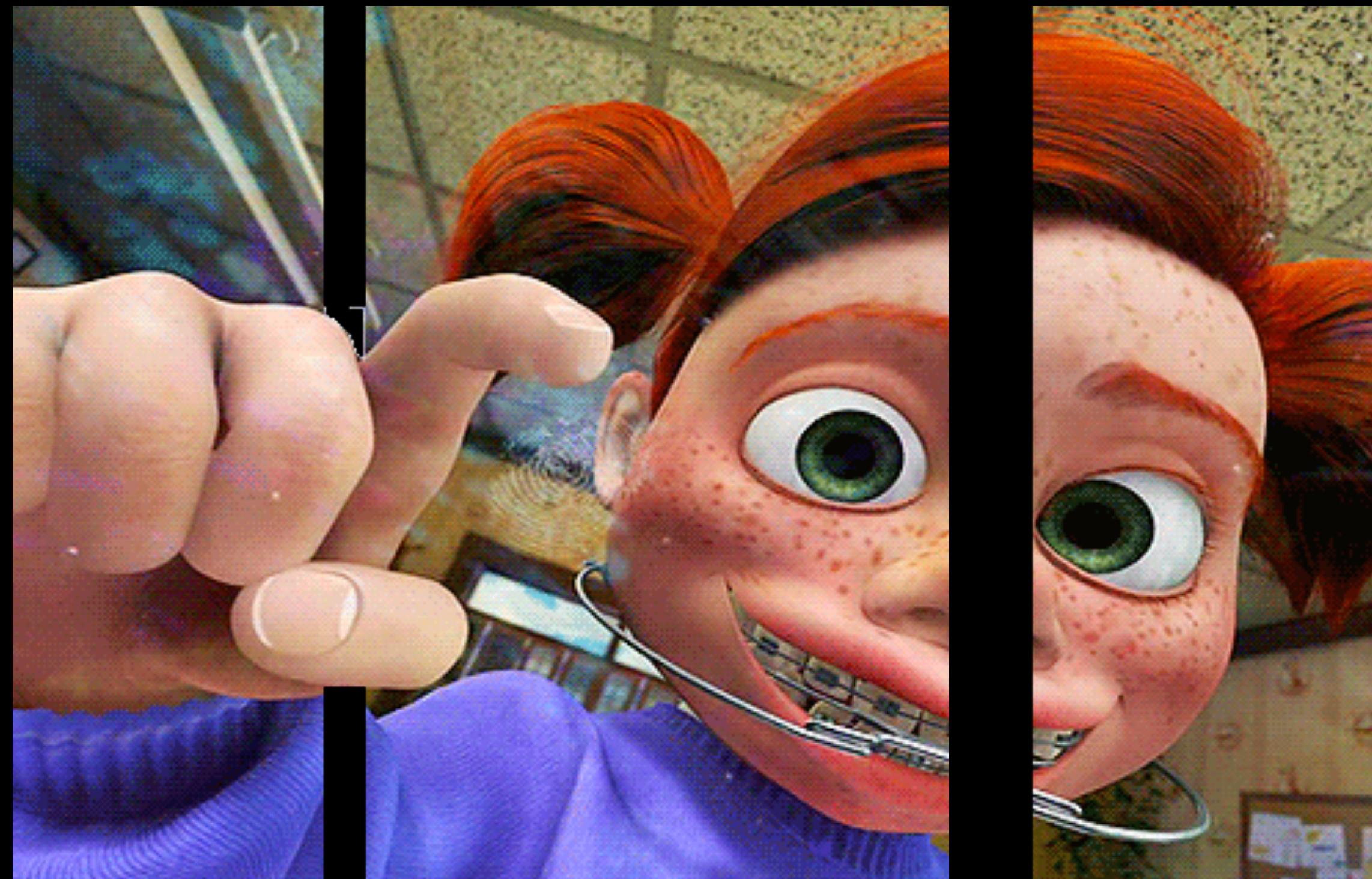




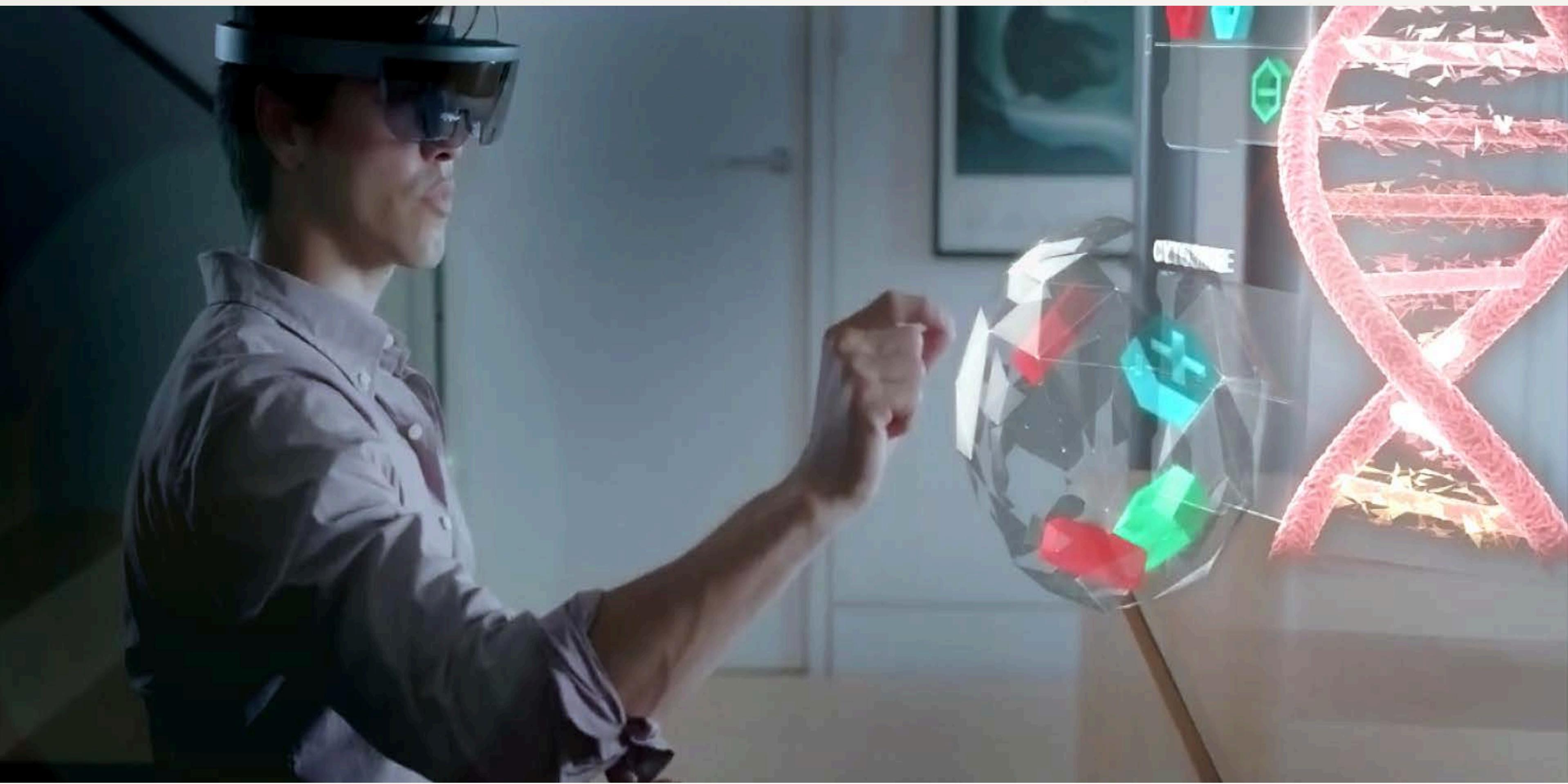


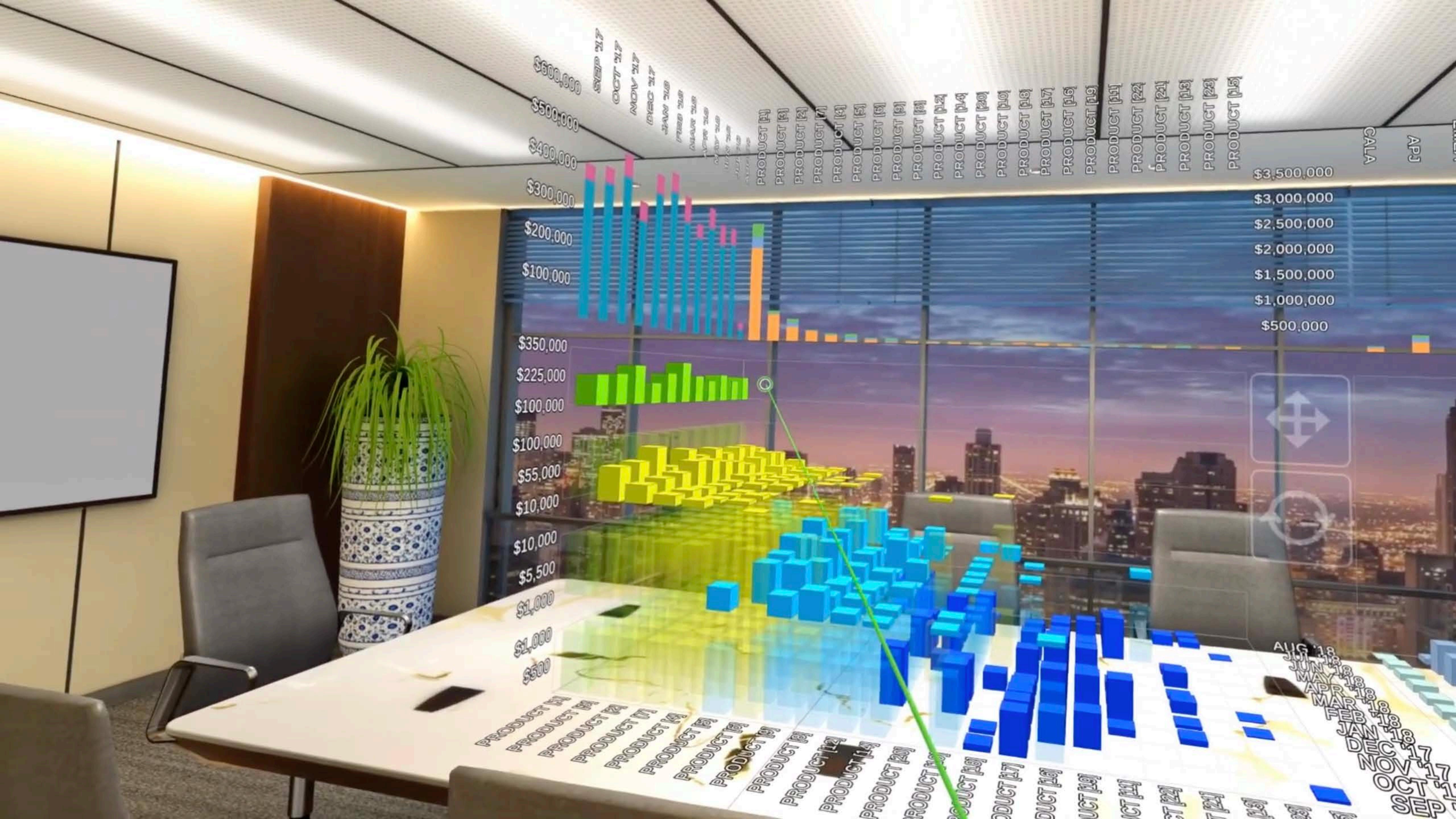


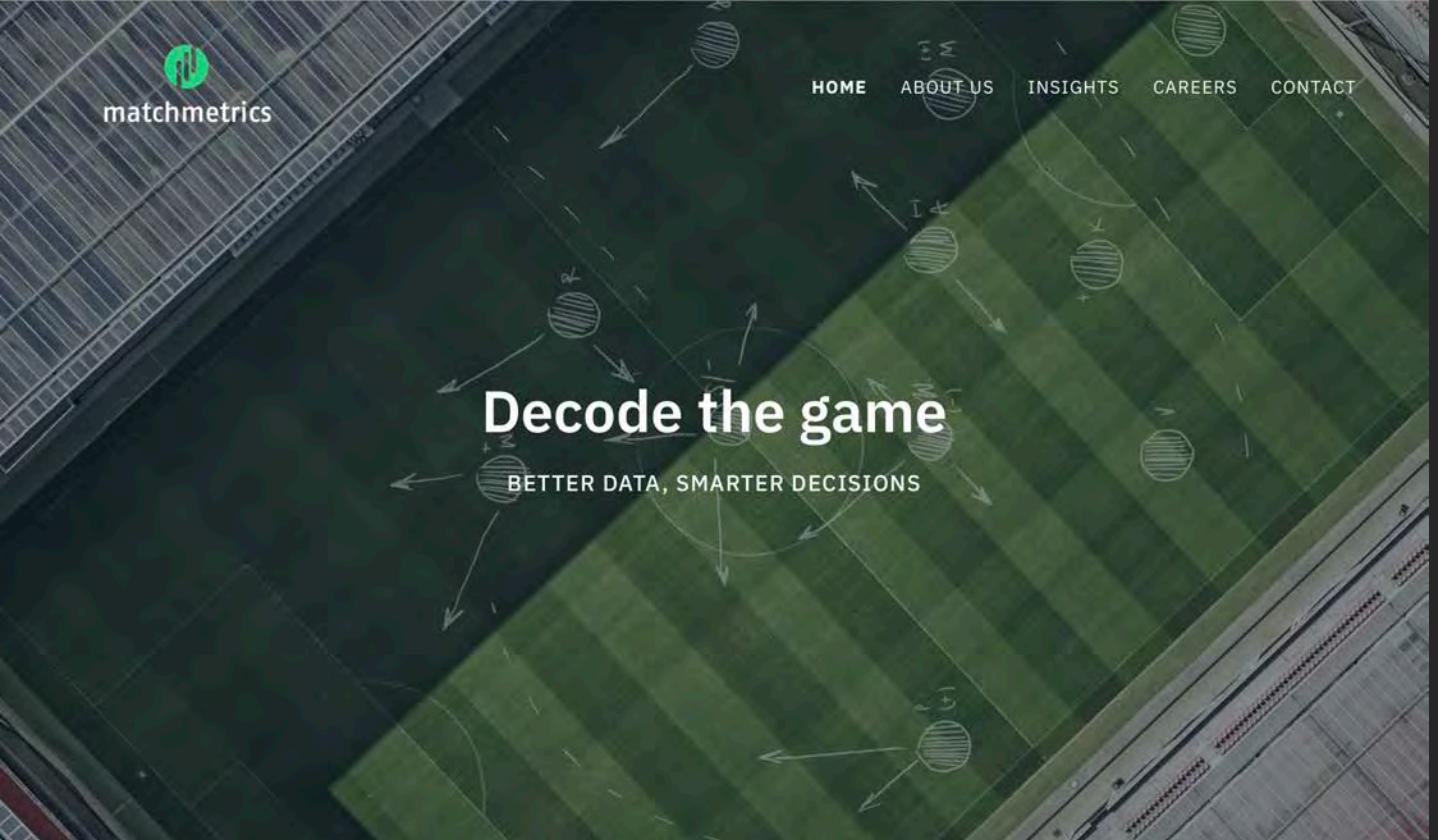


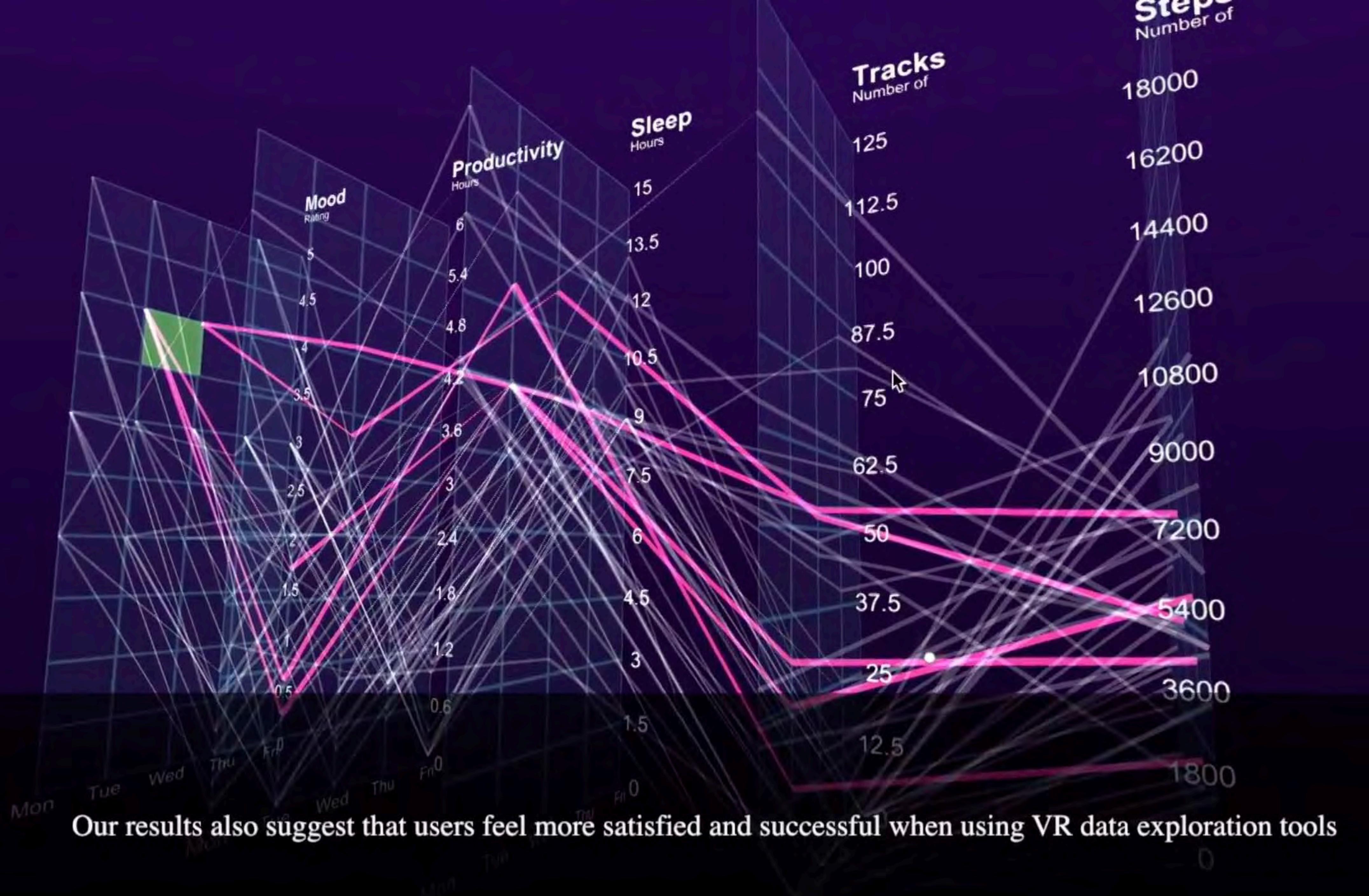


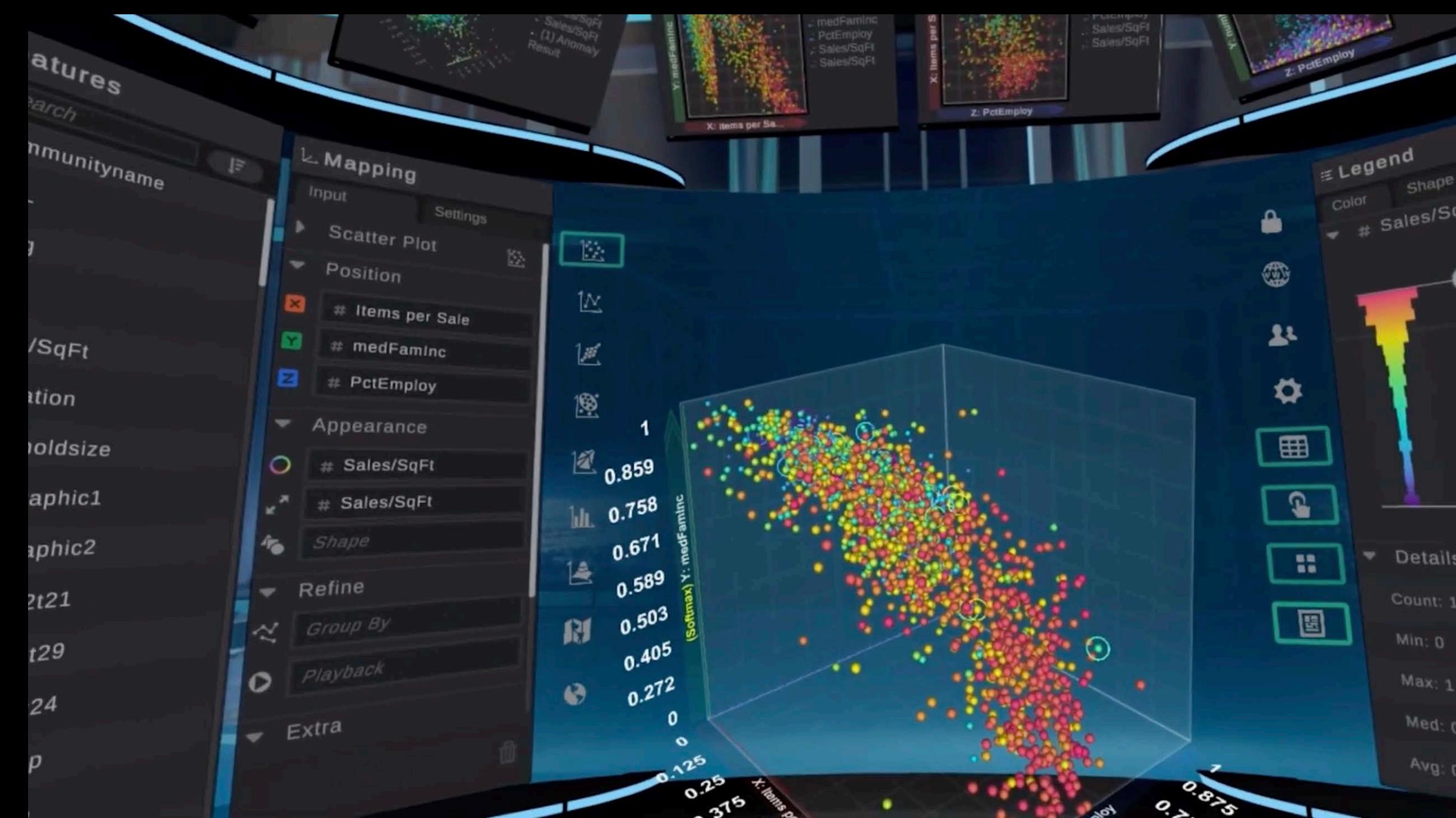
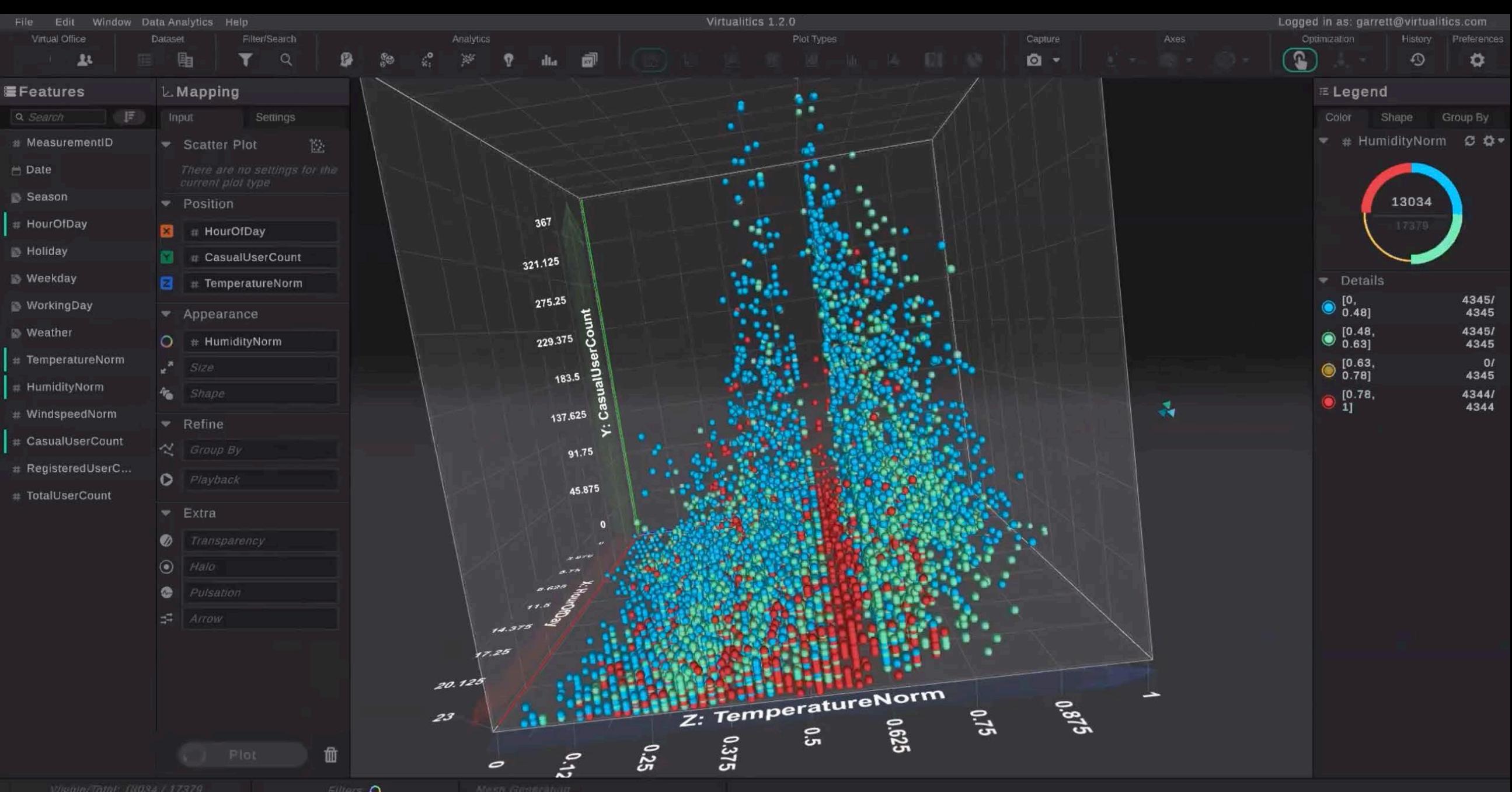












WHY/WHY NOT VR FOR DATA VISUALIZATION?

_ POSITIONAL ACCURACY:

absolute?

no

relative size?

yes

_ DATA RETENTION:

physical models?

no

engagement of senses?

yes

_ ERGONOMICS:

space gesturing?

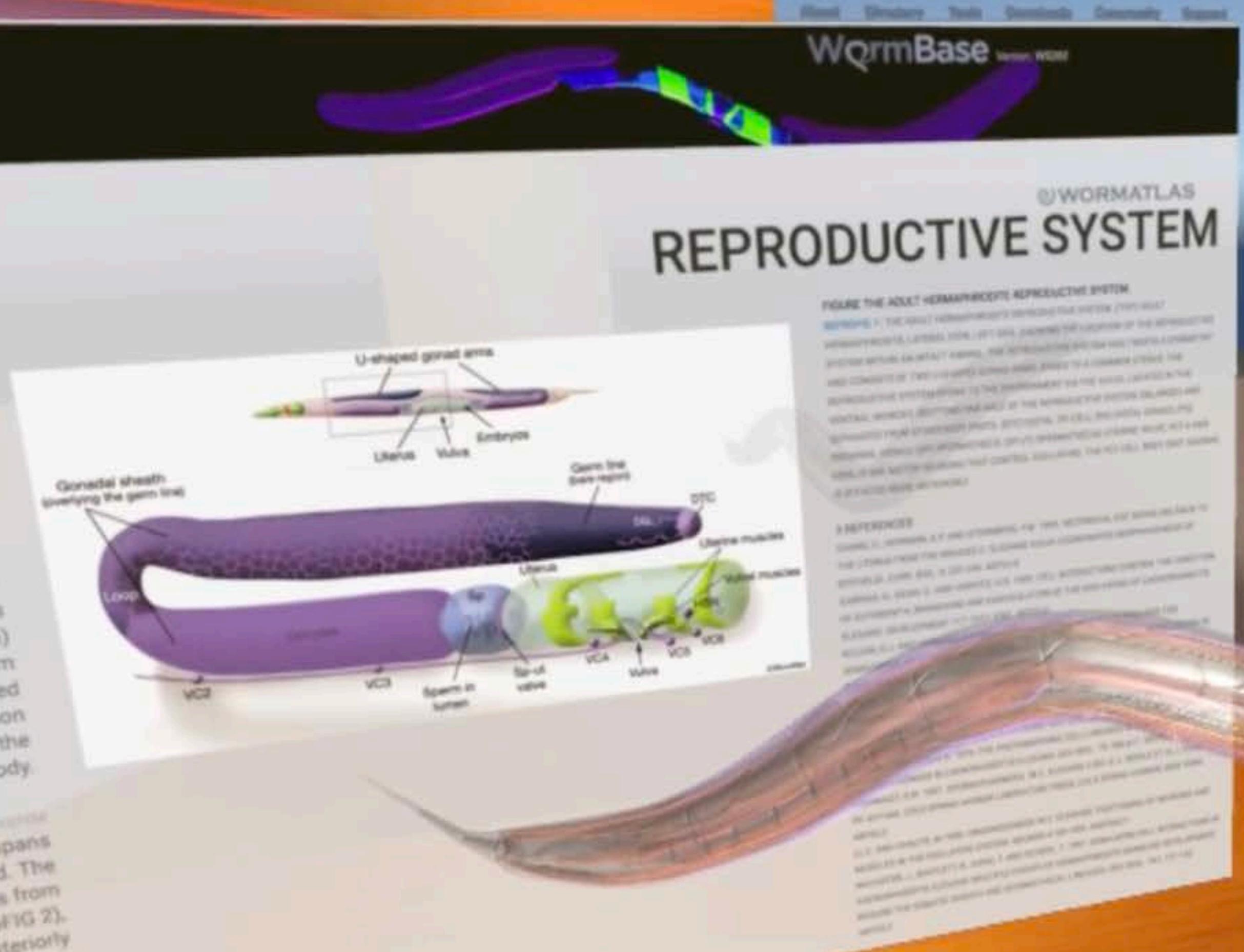
no

direct manipulation?

yes

GENERAL DESCRIPTION
The reproductive system is one of the most complex tissues in the animal, with many components differing between females and males (see Introduction to a review of the male anatomy). The complete reproductive system produces oocytes and provides the structure and environment for fertilization and development (ReproFIG 1). It can be divided into three major parts: the somatic gonad (described in Reproduction System - Somatic Gonad), the germ line (Reproductive System - Germ Line), and the egg-laying apparatus (described in Reproductive System - Egg-laying Apparatus) (TABLE 1). The somatic gonad and germ line together form two symmetrical U-shaped tubes (arms) that are joined to a common uterus and egg-laying apparatus in the midbody.

CLINICAL PERSPECTIVE
Formation of the reproductive system spans the entire post-embryonic period. The reproductive system is formed by cells from several lineages (ReproTABLE 1; ReproFIG 2), including some that originate more posteriorly and must migrate considerable distances to be included in the developing system (e.g., the HSNs and uterine and vulval muscle precursors) (Sulston and Horvitz, 1977; Sulston et al., 1983).



_OVS

OVAS worm
OO ● O

GOAL

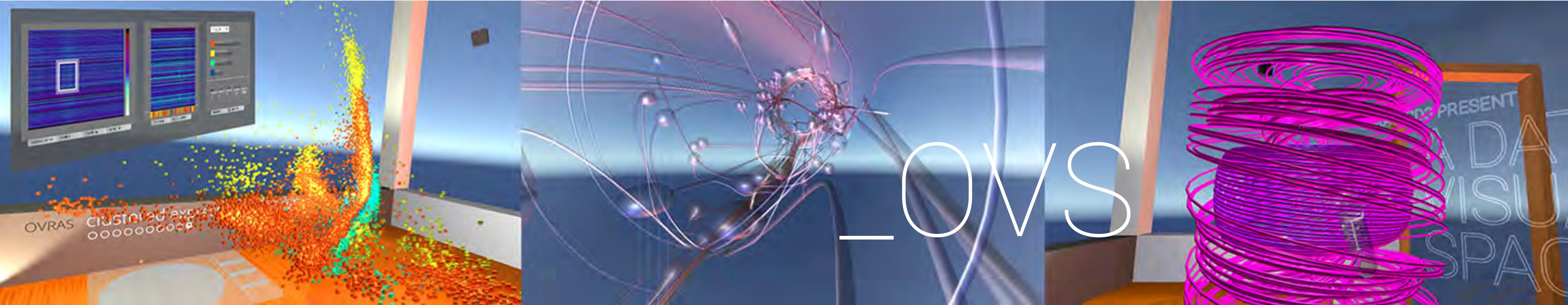
- _ experience 3d information
- _ Intuitive
- _ least intrusive manner

☞ INMERSIVE 3D

- _ better tracking of complex 3d structures
- _ better tracking of small 3d structures

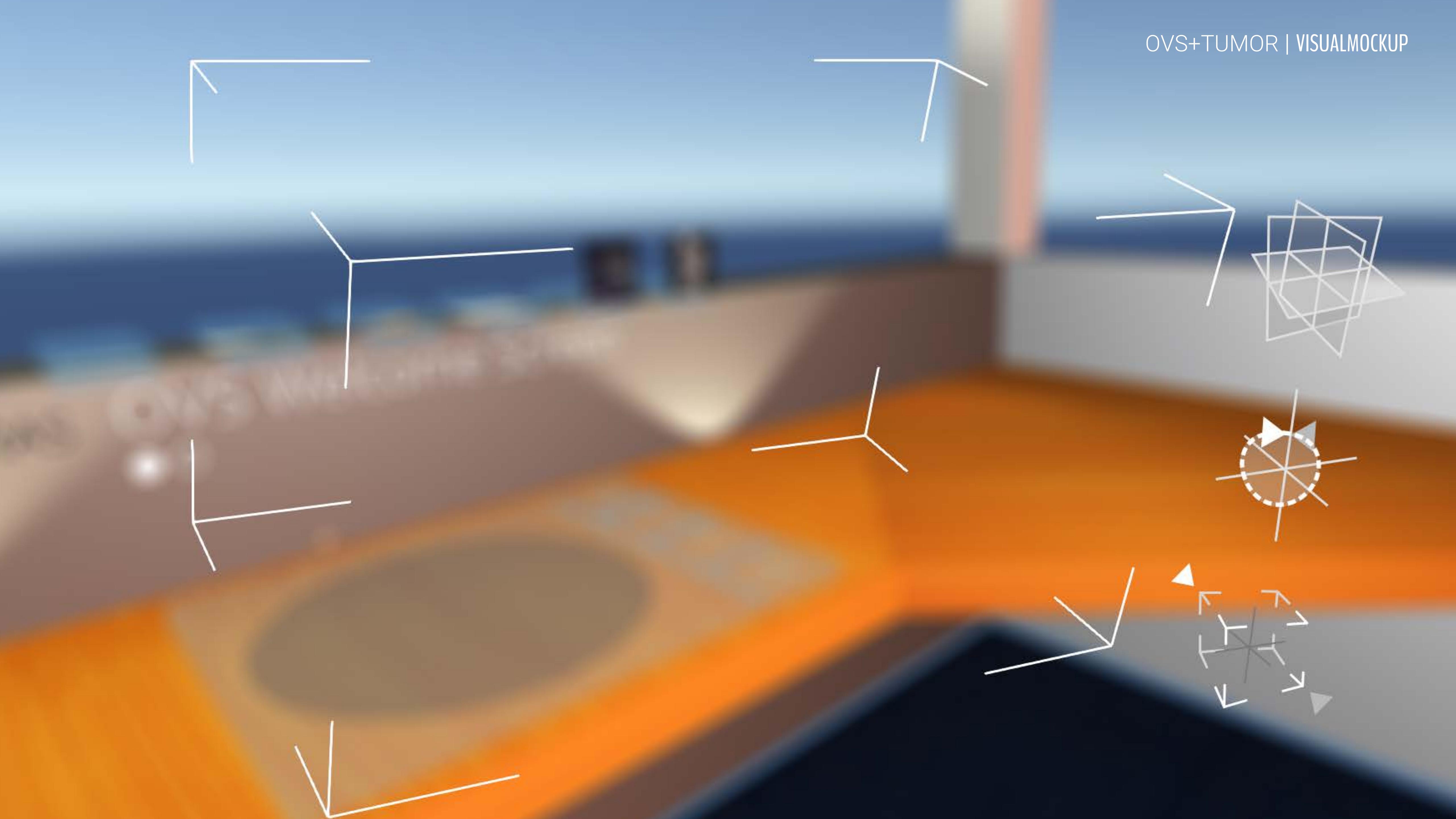
☞ VIRTUAL REALITY

- _ direct interaction
- _ intuitive manipulation
- _ easy selection/annotation

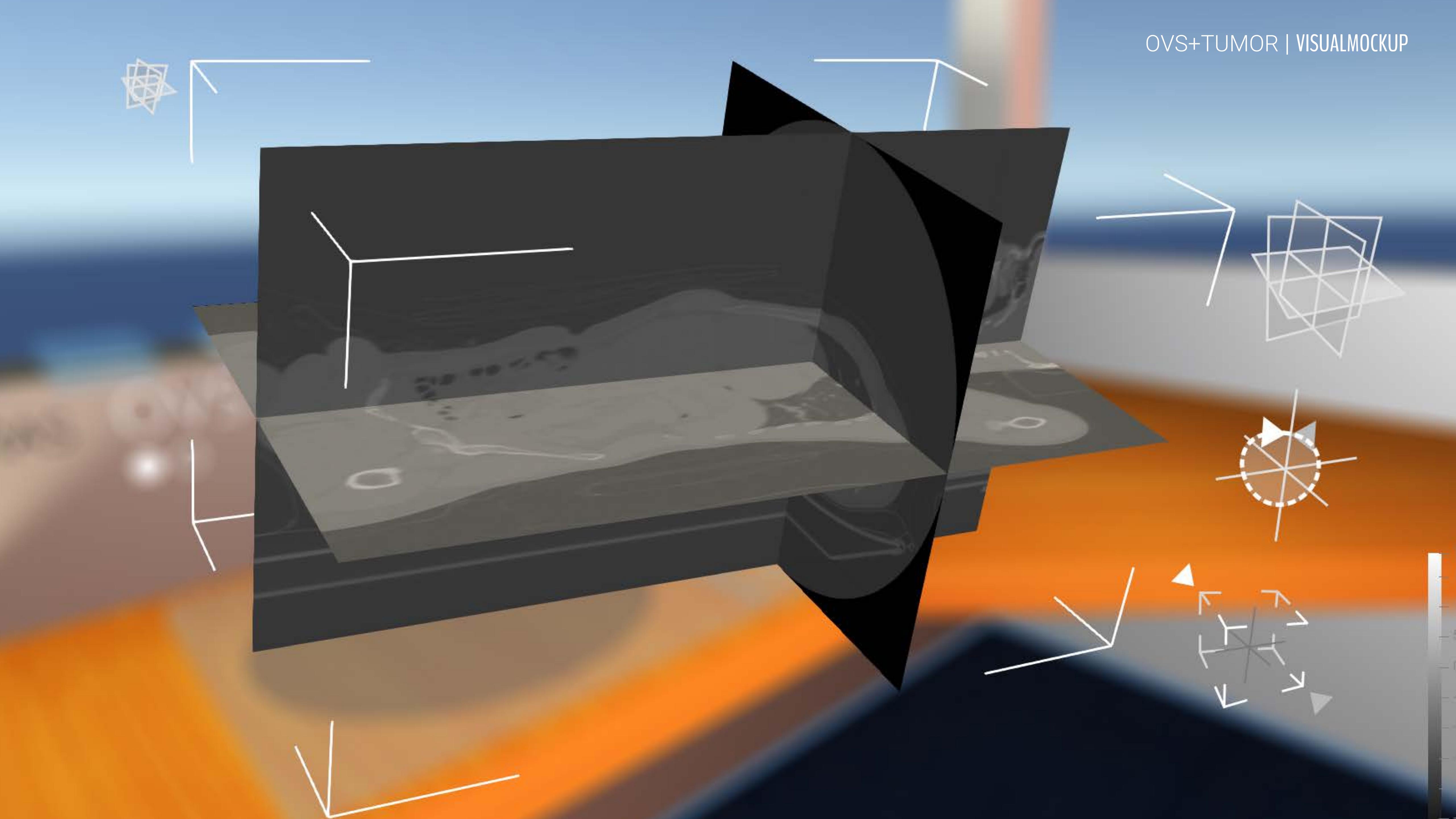


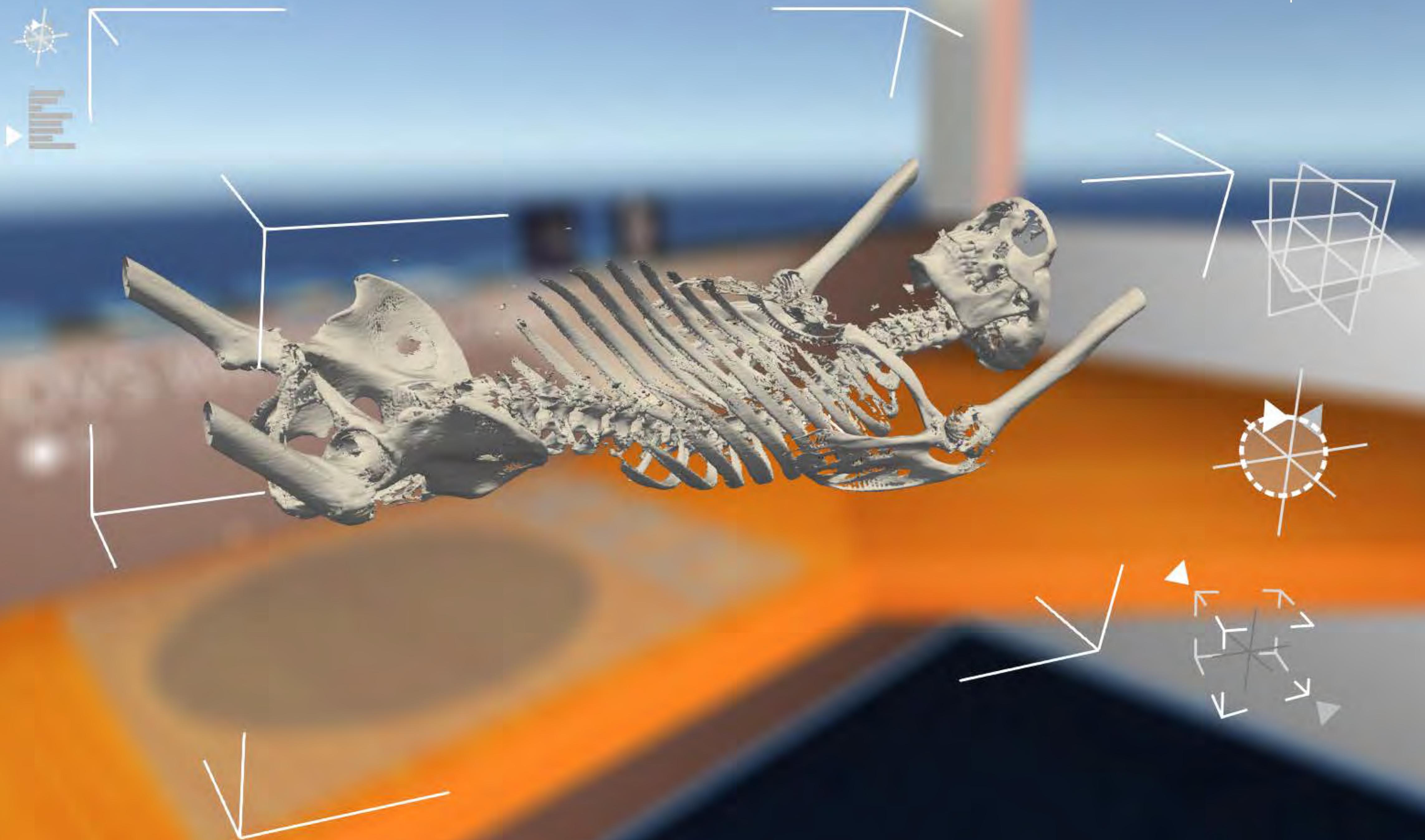
_walkthrough

OVS+TUMOR | VISUAL MOCKUP

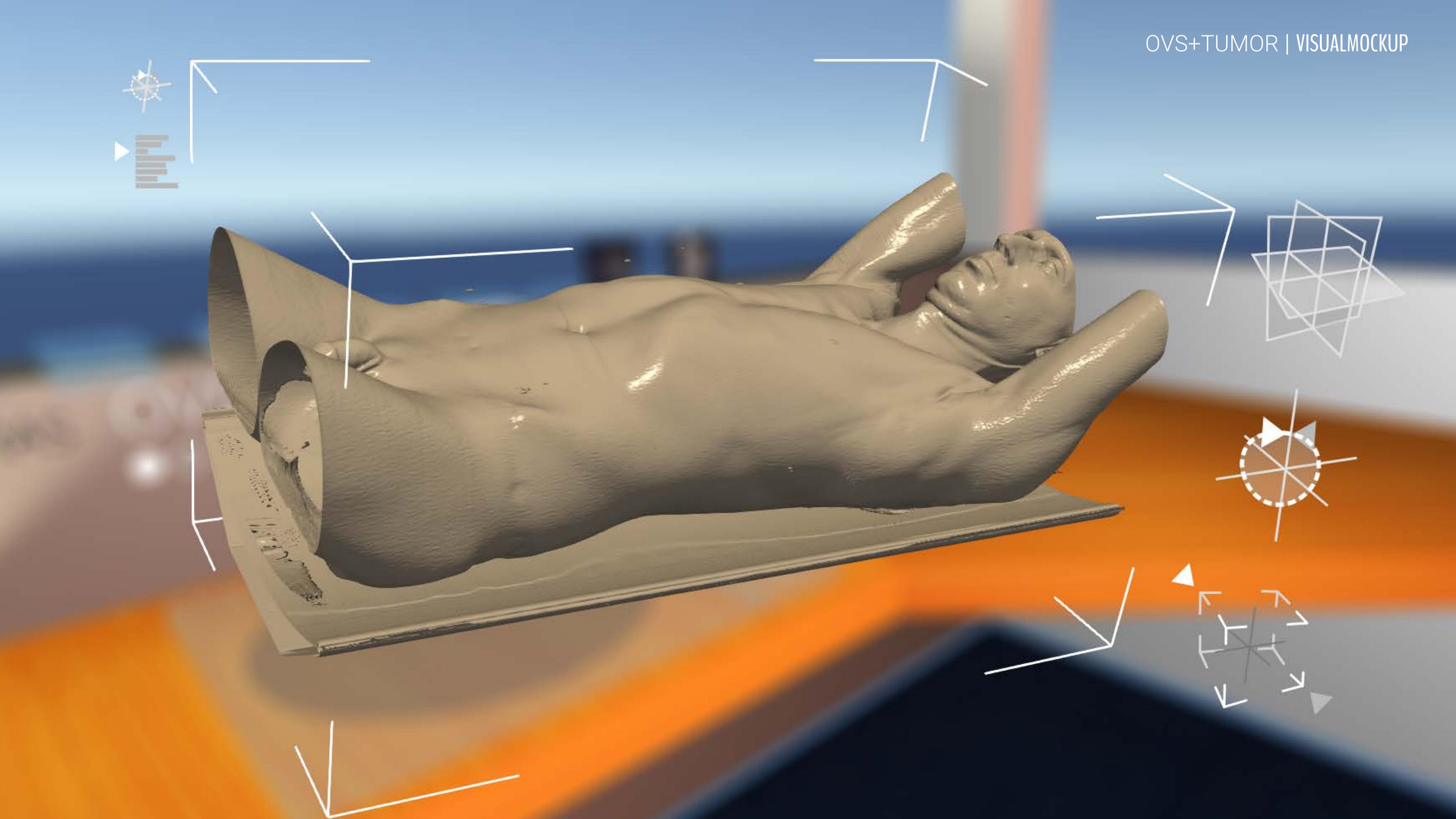


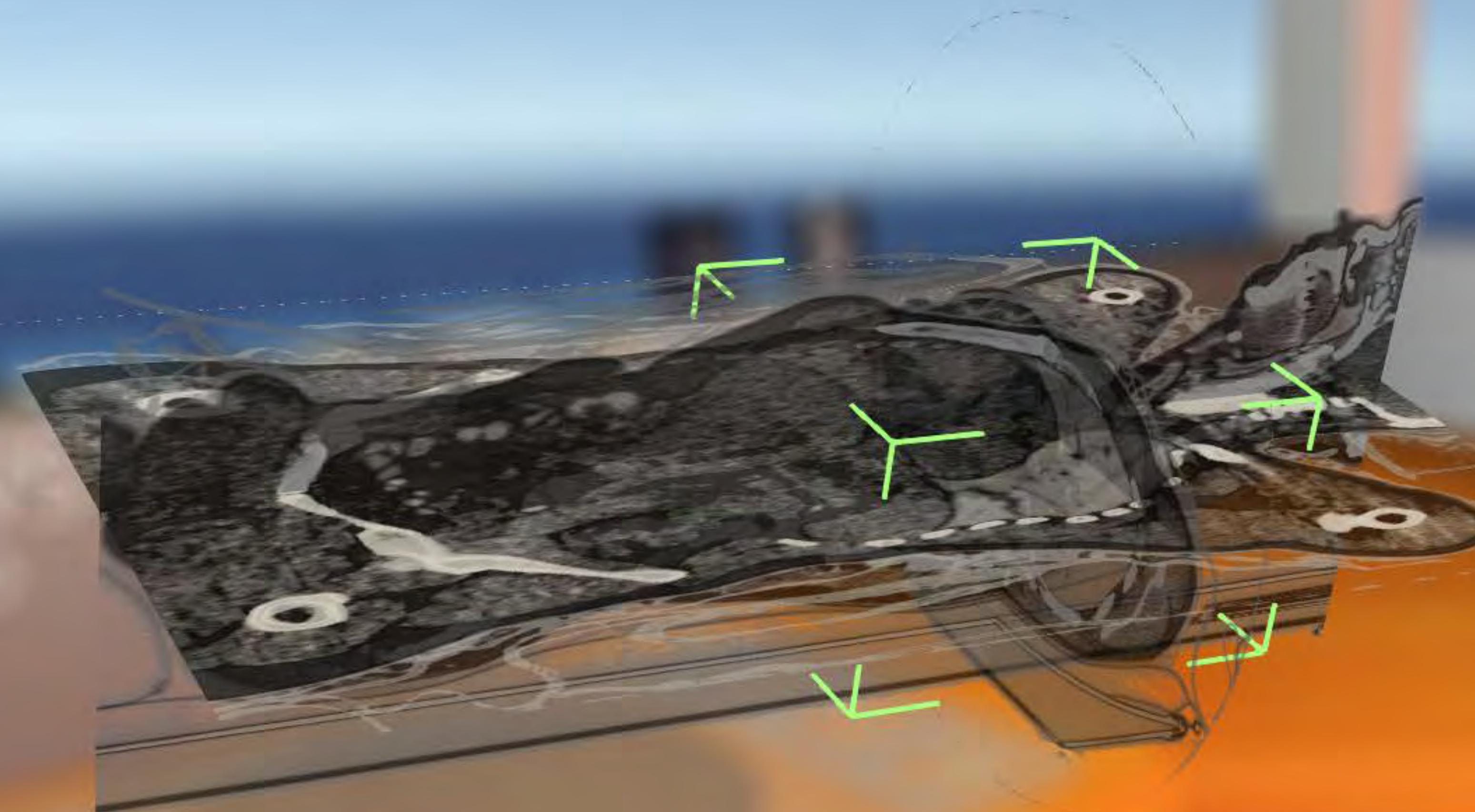
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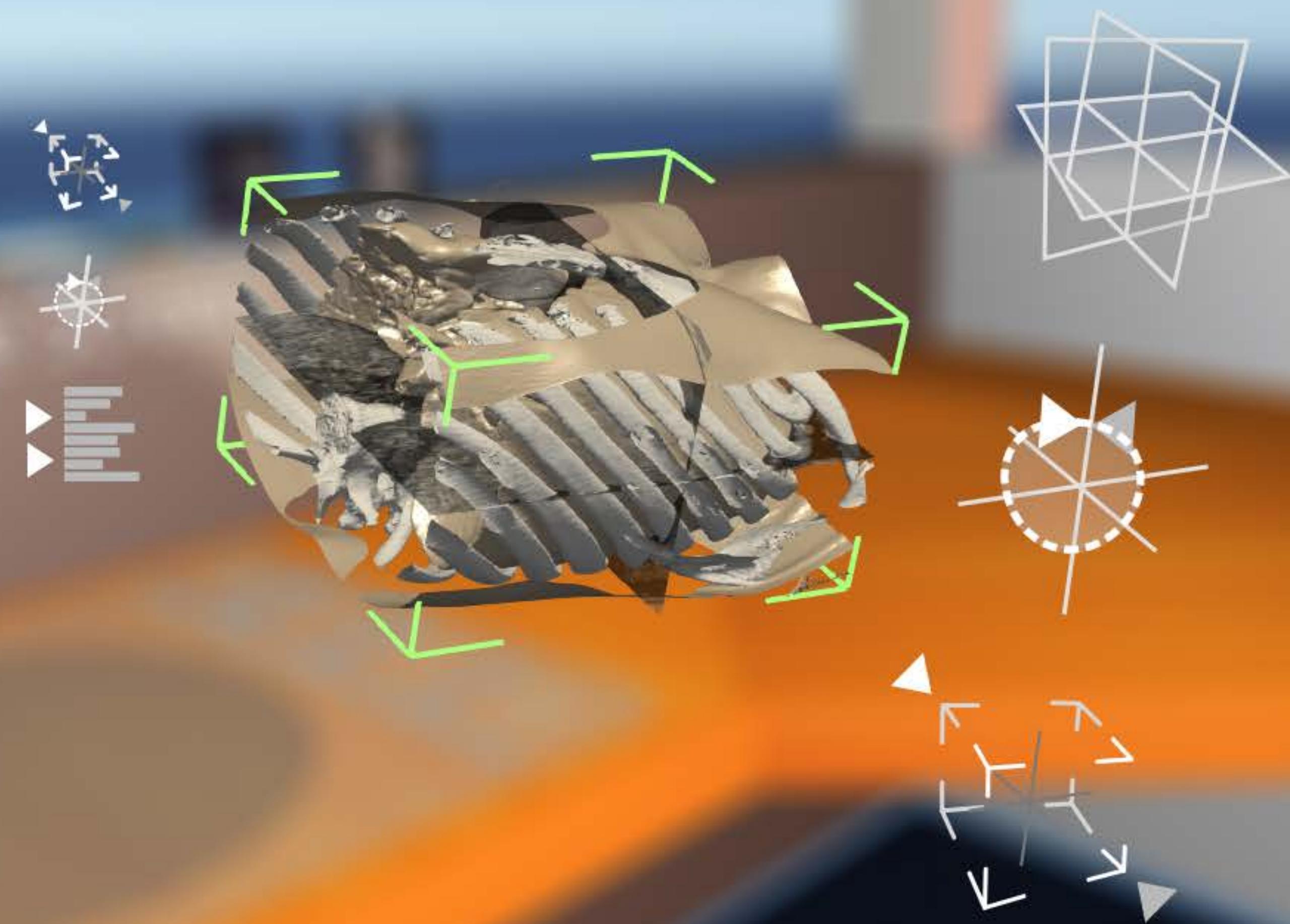


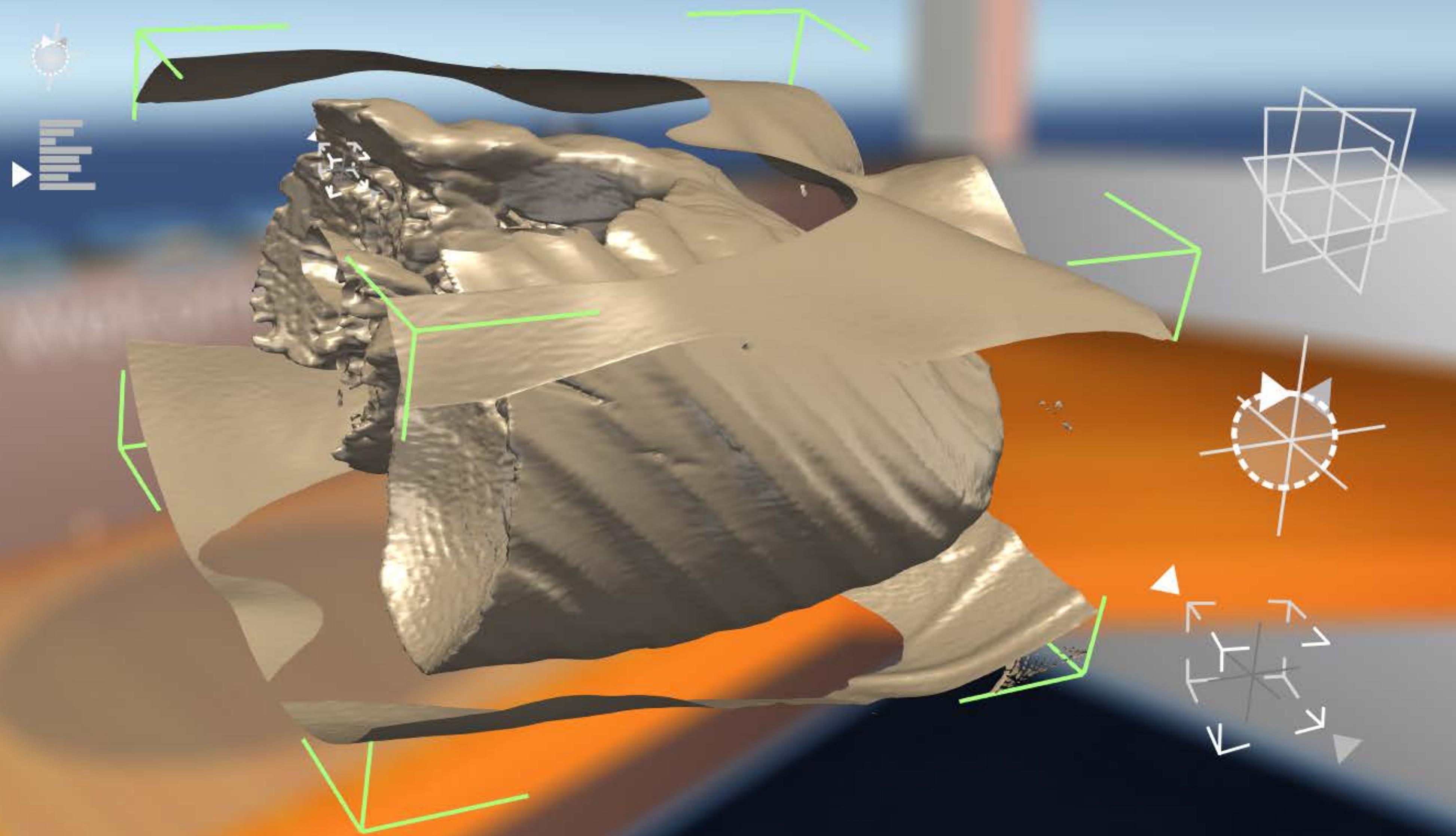


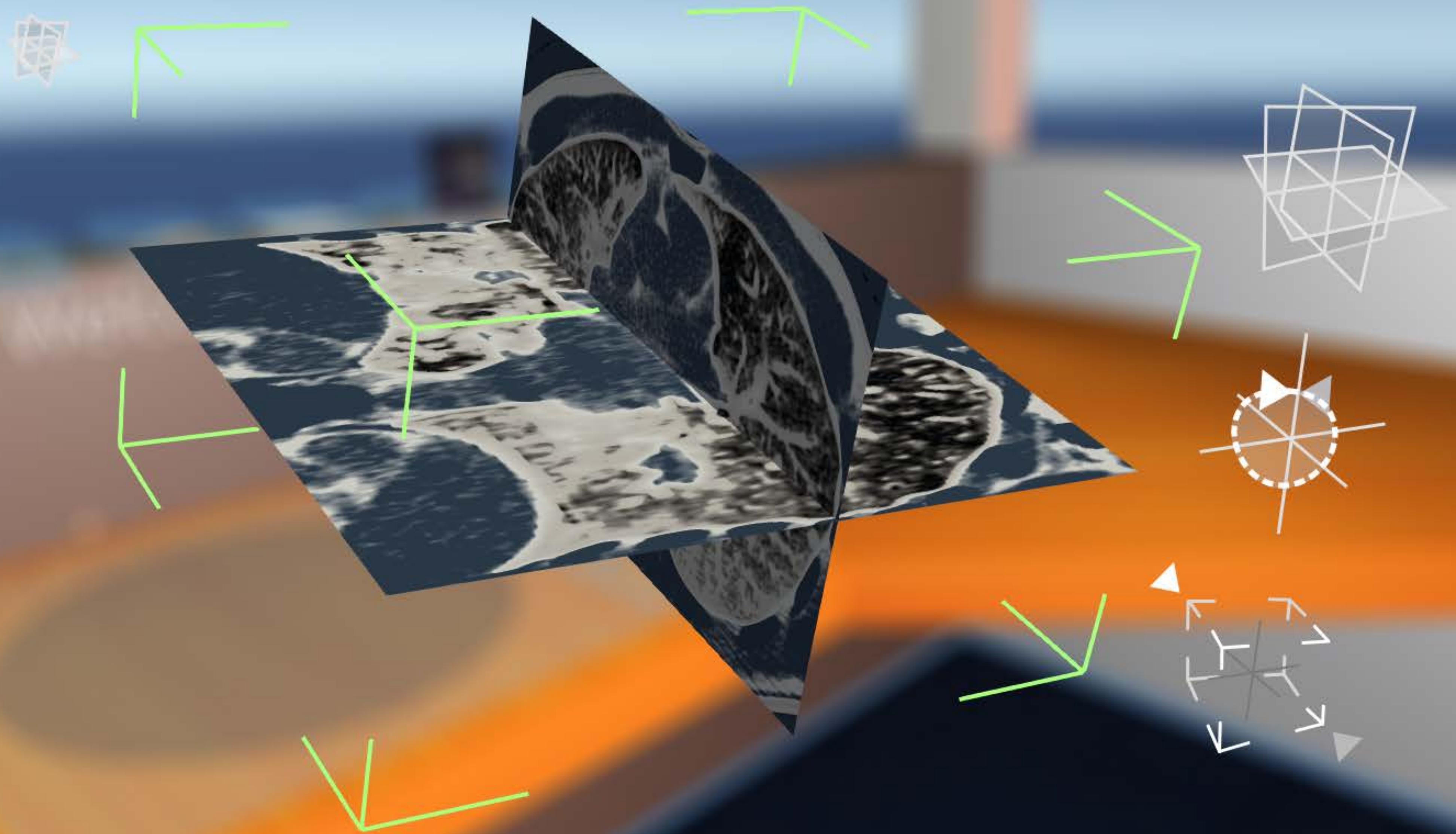
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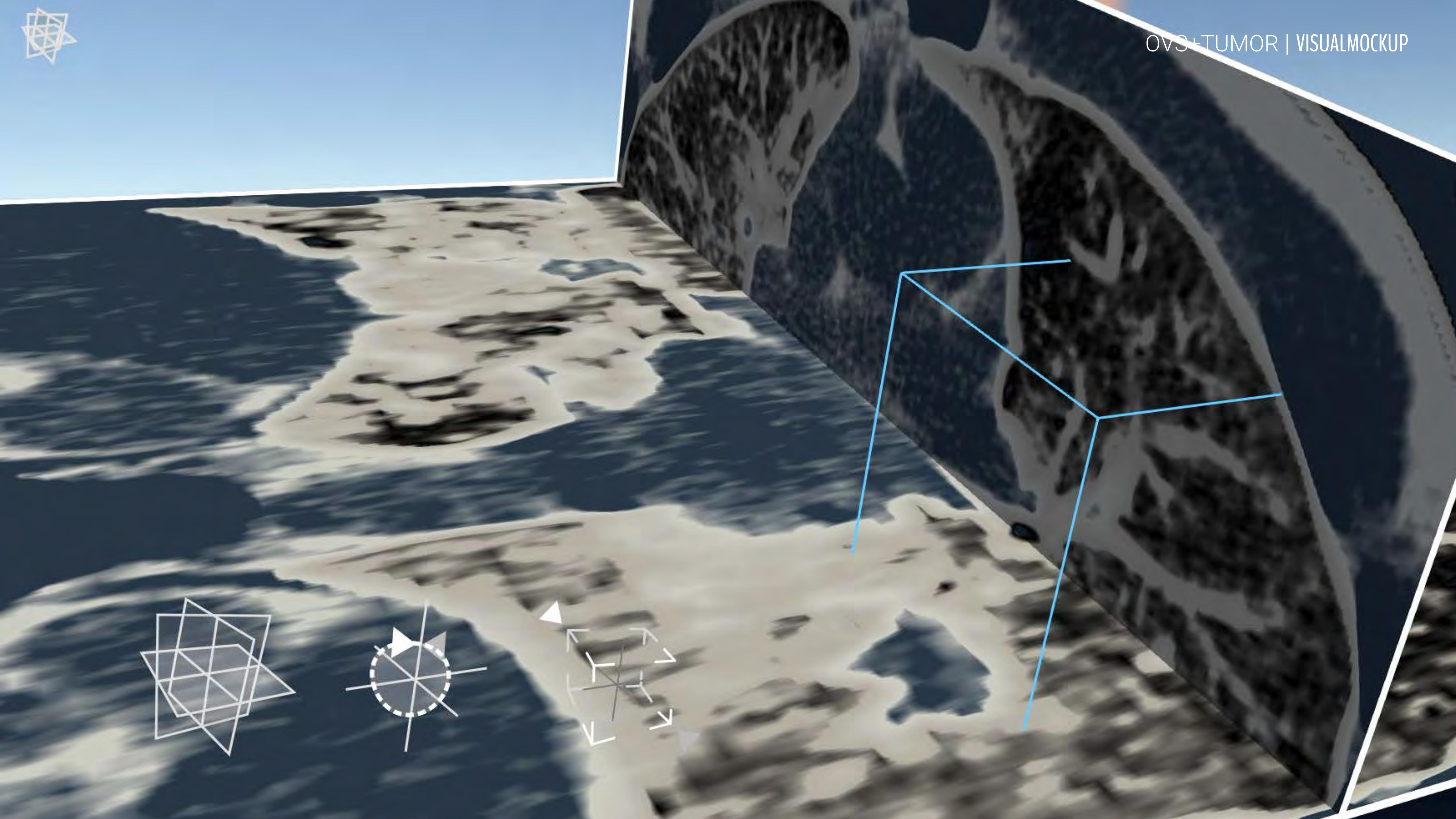


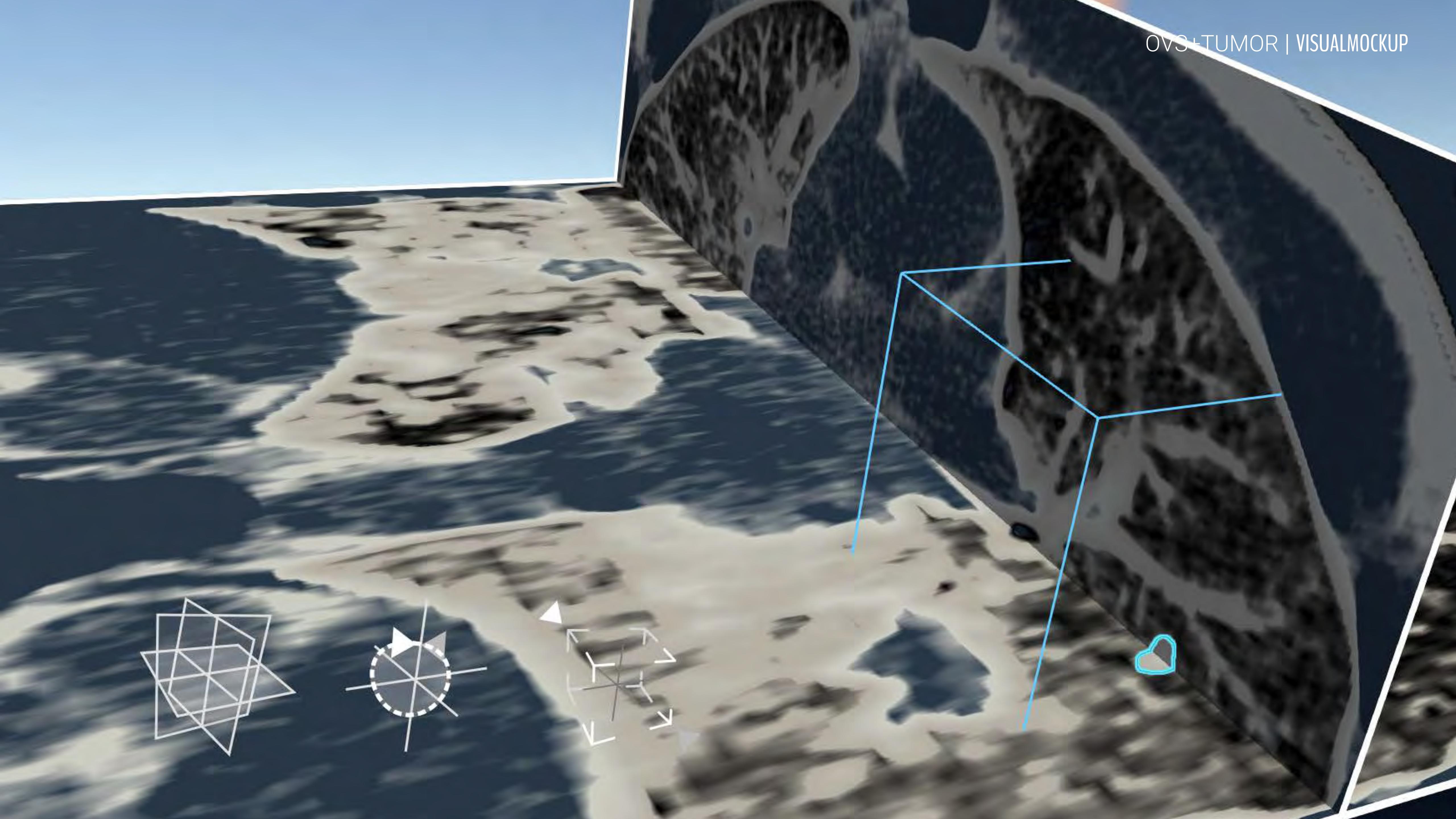




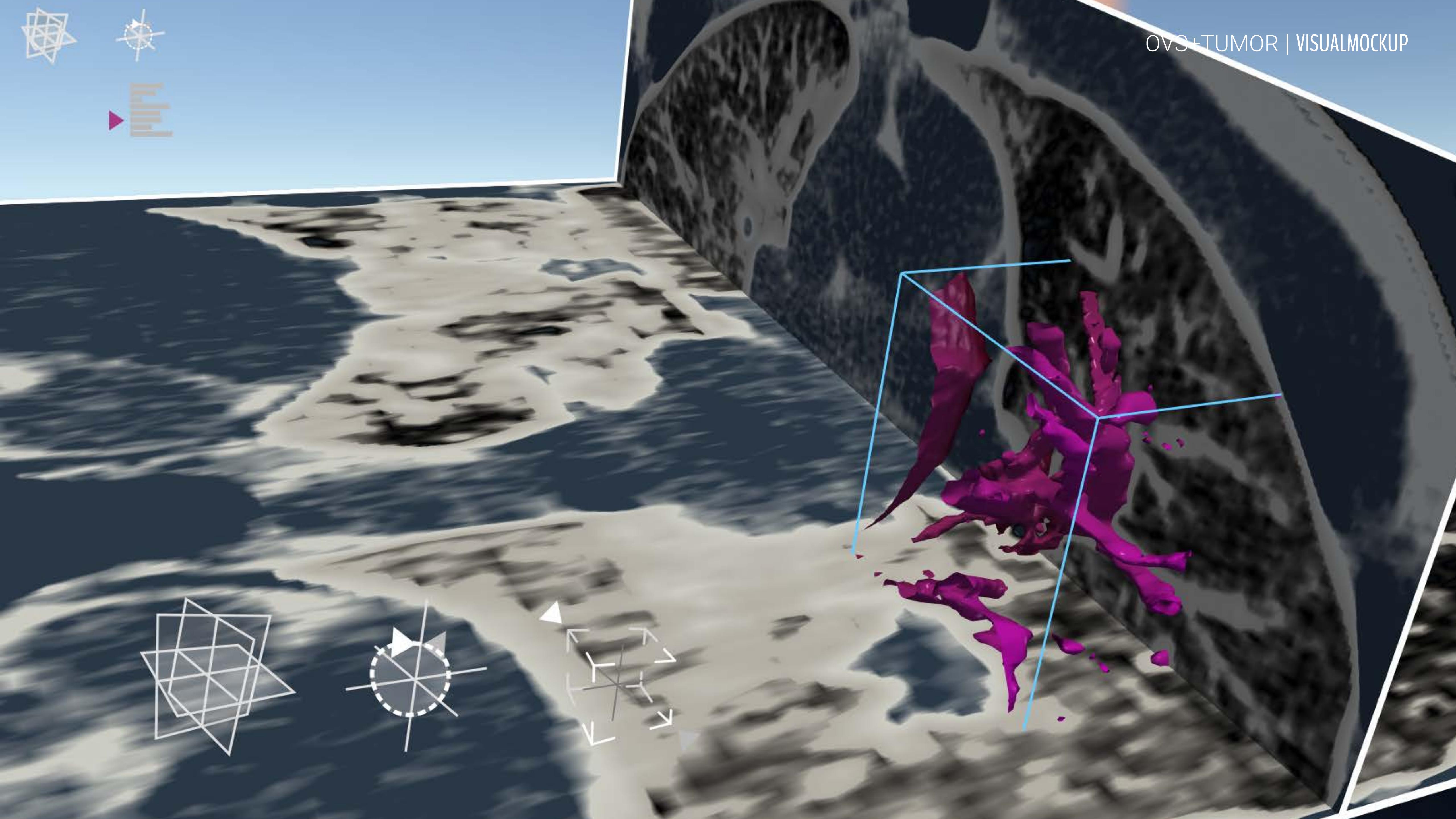


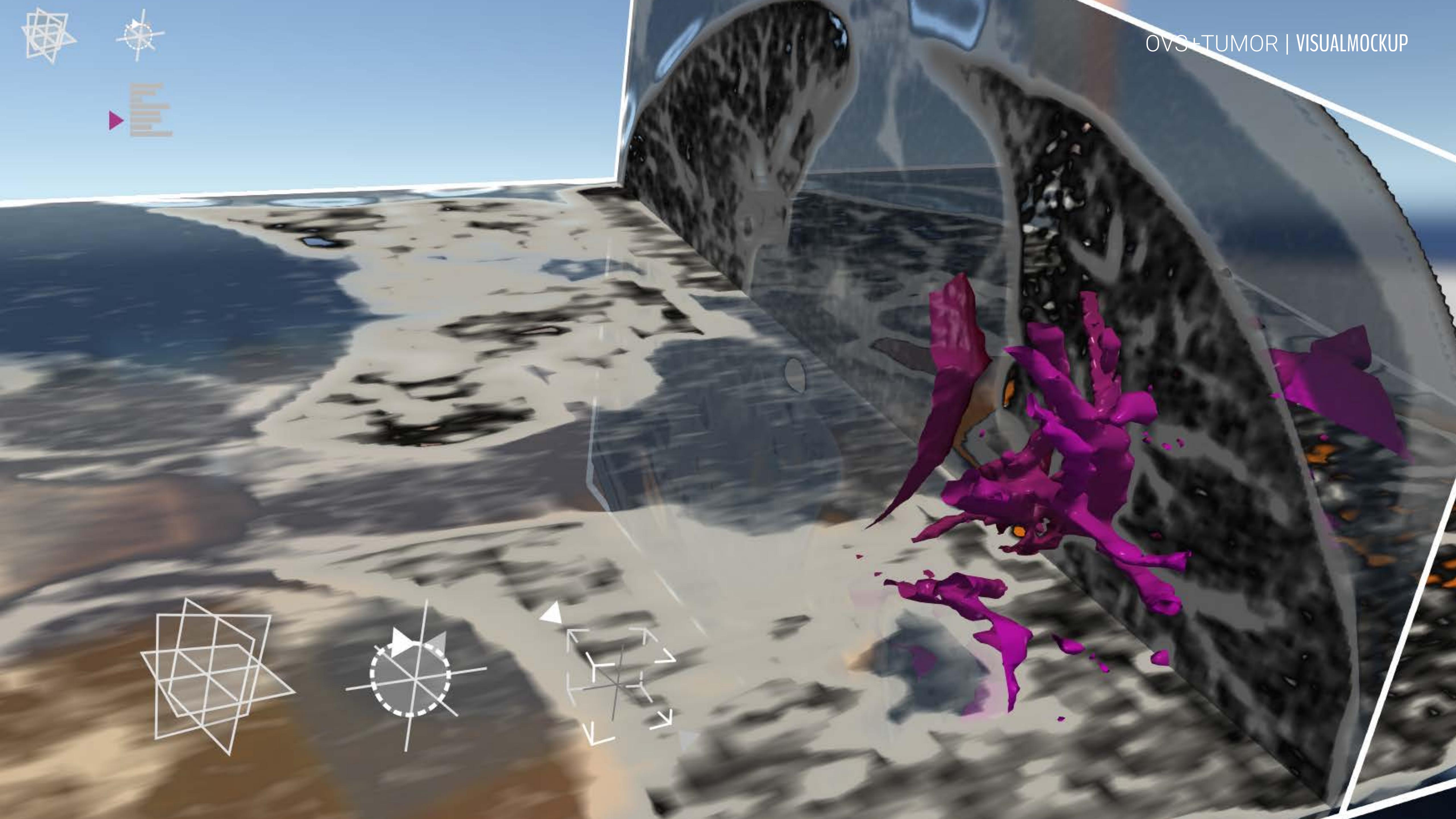
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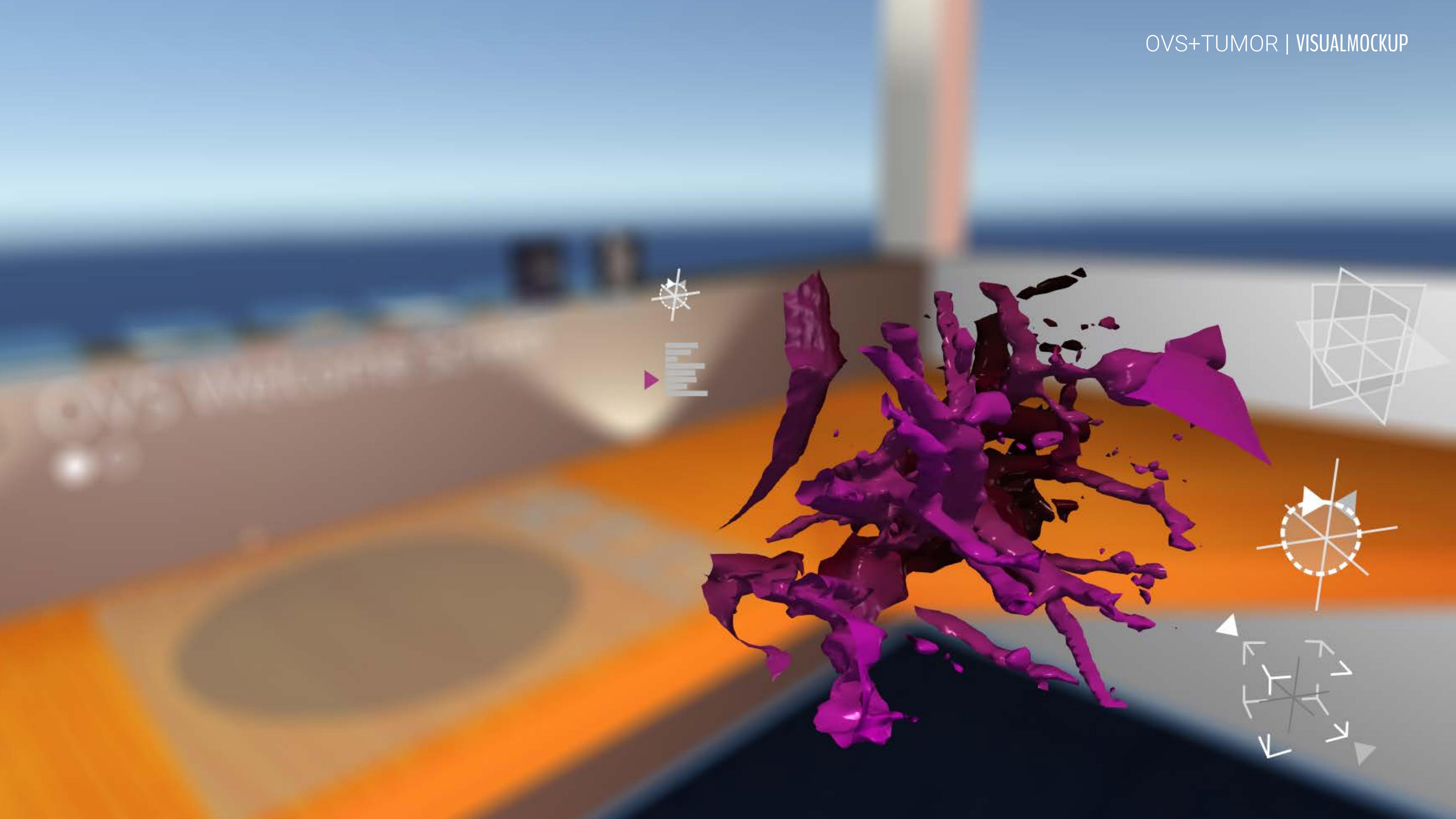


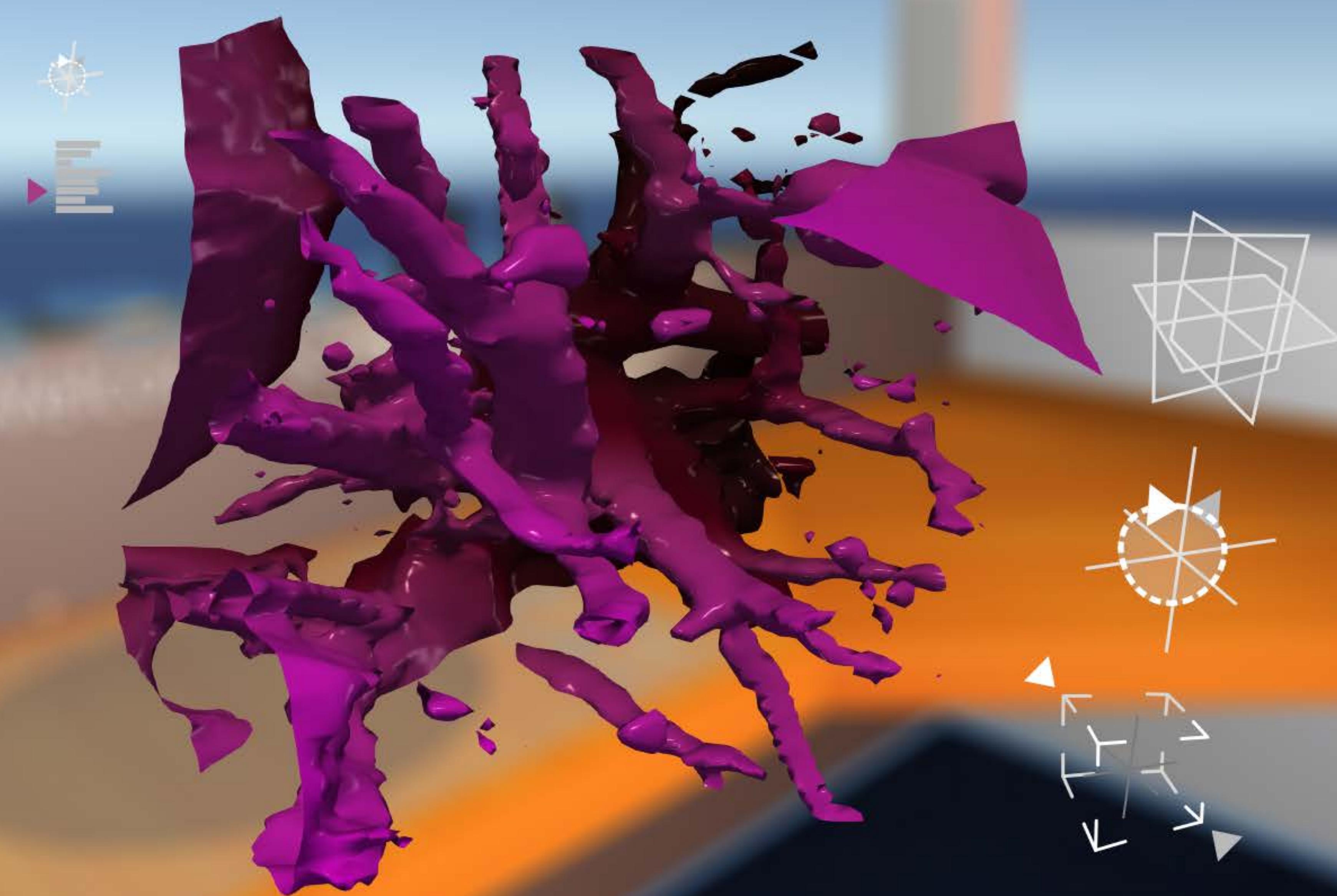


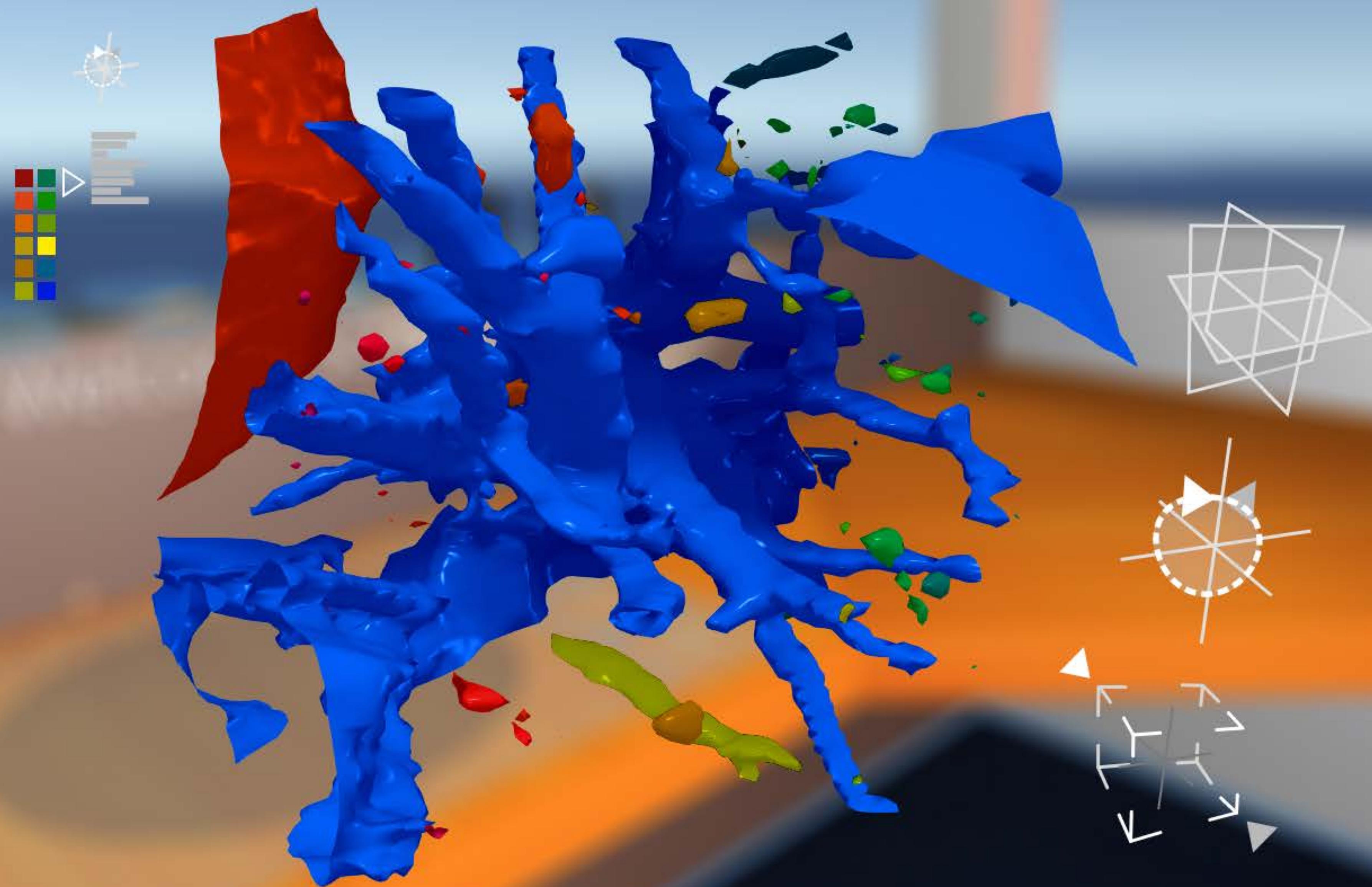
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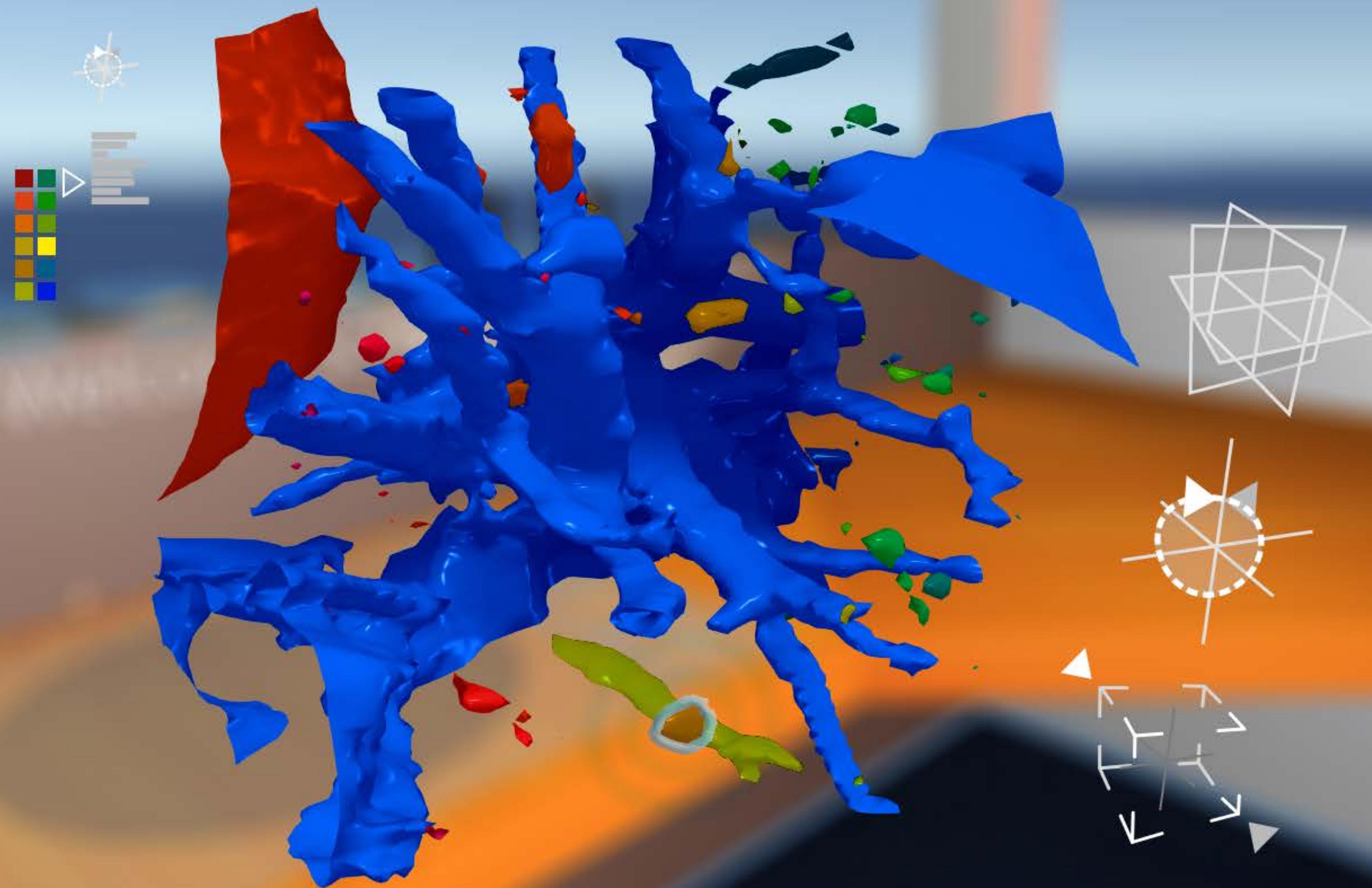








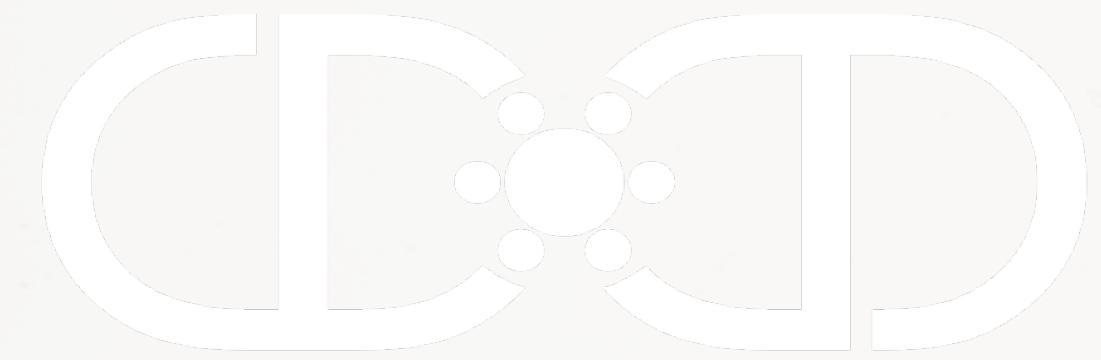




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