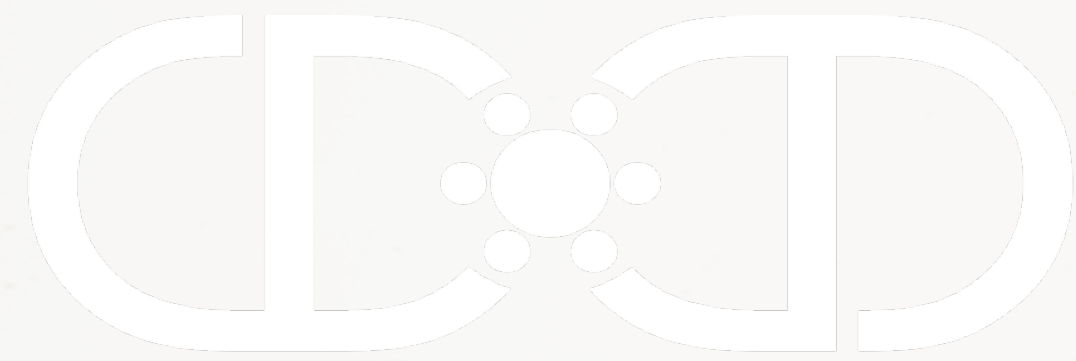


SANTIAGO LOMBEYDA



METHODS OF COMPUTATIONAL SCIENCE
INTRO TO VISUALIZATION

2020 ADDENDUM

OVERVIEW

SECTION 1

WHAT IS VISUALIZATION?

SECTION 2

UNDERSTANDING THE LANDSCAPE

SECTION 3

A TOOL TOOL TAXONOMY

SECTION 4

PRINCIPLES OF DATA REPRESENTATION

NOTES

..ON COLOR

NOTES

..ON MAPPING MULTIPLE DIMENSIONS

SECTION 5

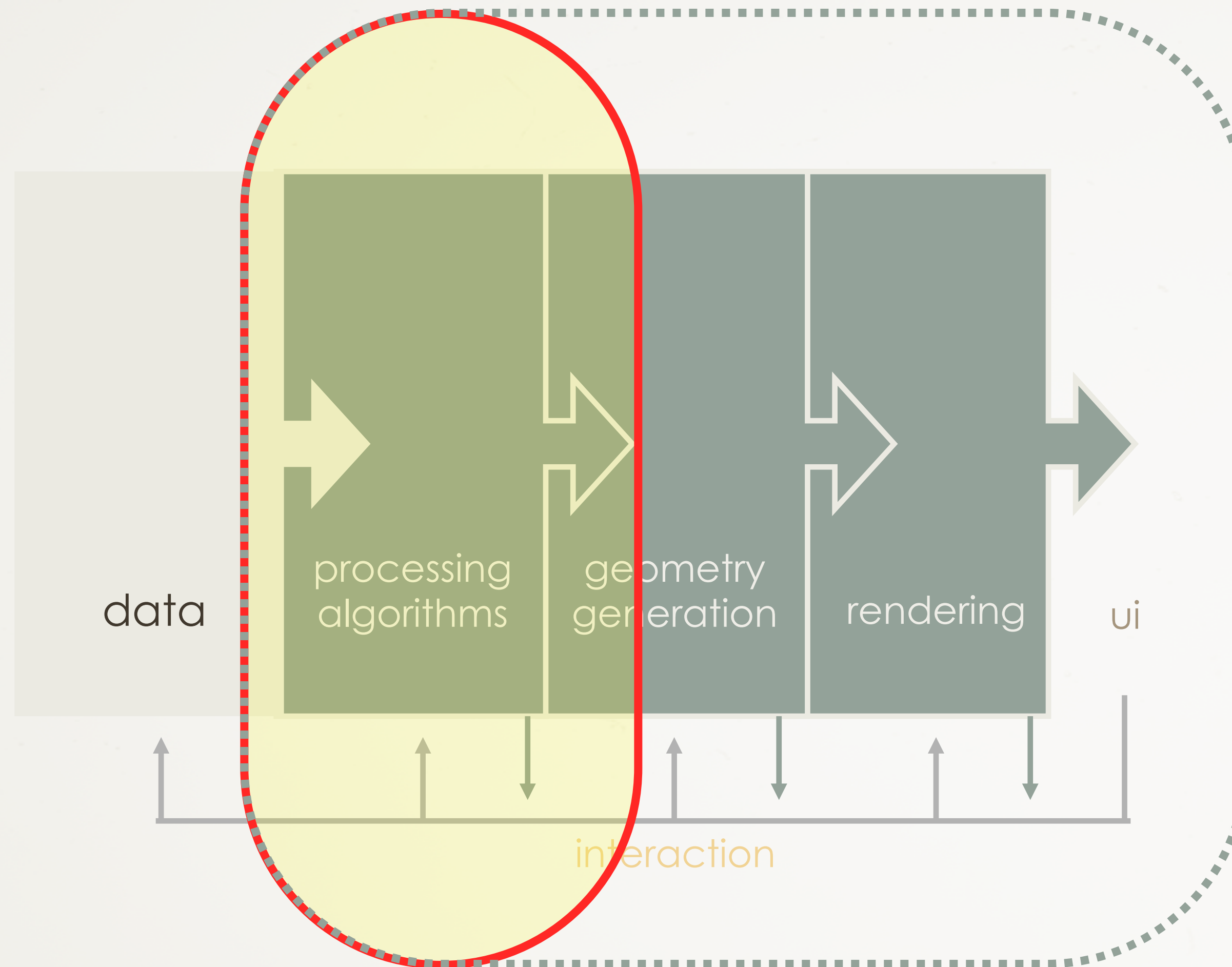
ADDRESSING BOTTLENECKS

SECTION 6

PUTTING IT ALL TOGETHER

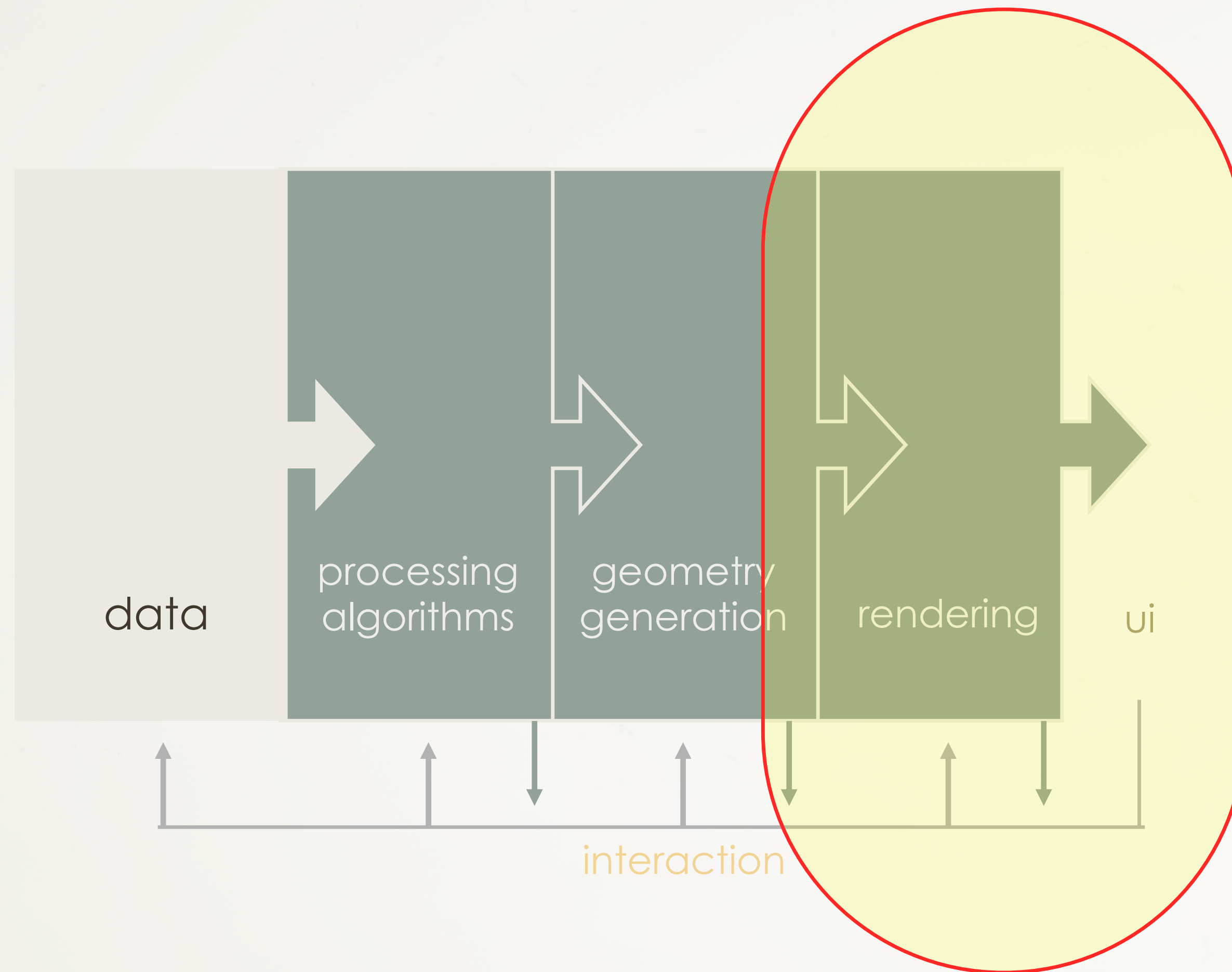


"THE" VISUALIZATION TOOLKIT



- VTK ○
- c/c++
- tcl/tk
- python
- java
- R

INTERACTIVE RENDERERS

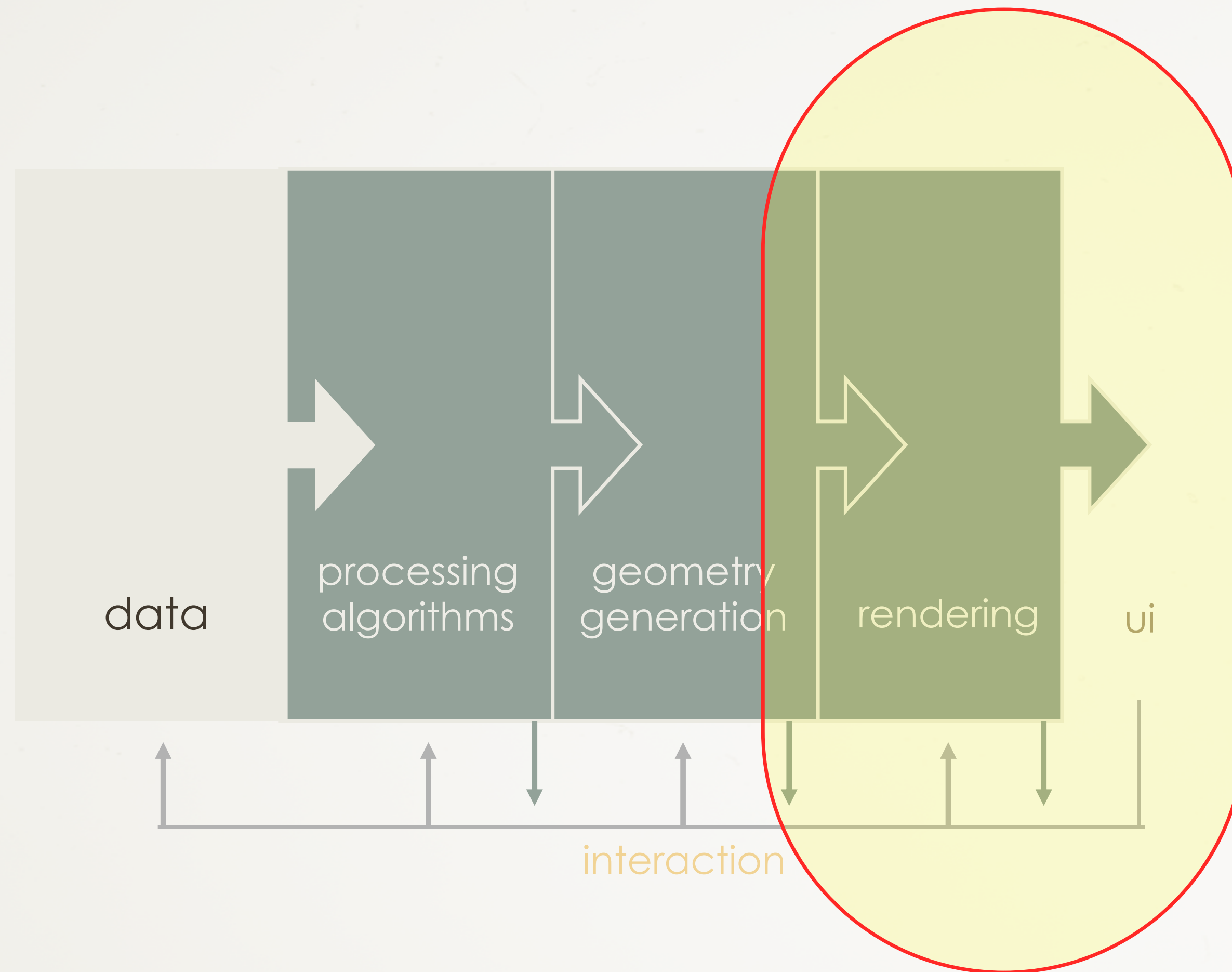


- OpenGL mesaGL
direct3D
openGL ES

HIGHER LEVEL:

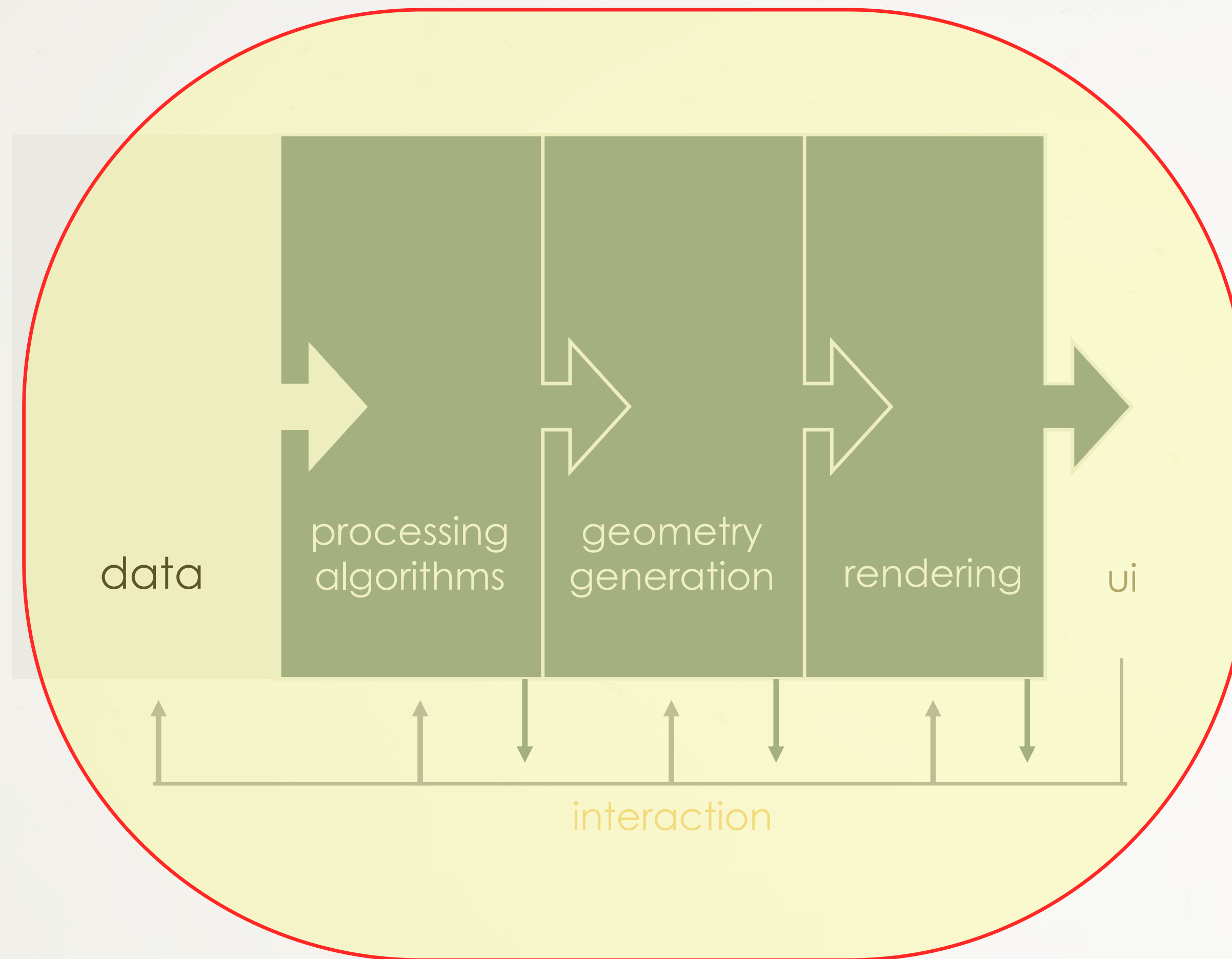
- OpenInventor
 - C++/GL
 - COIN
- Java3D
 - Java/GL
- *WebGL*
 - three.js

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}
- Enight^{\$}

- tableau^{\$}
 - D3^{www}
- Many Eyes^{www}
 - Wiki based
- Modrian^R,
TomCat,
Mollegro

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SECTION 7

3D VIEWING AND VIRTUAL REALITY



SECTION 7

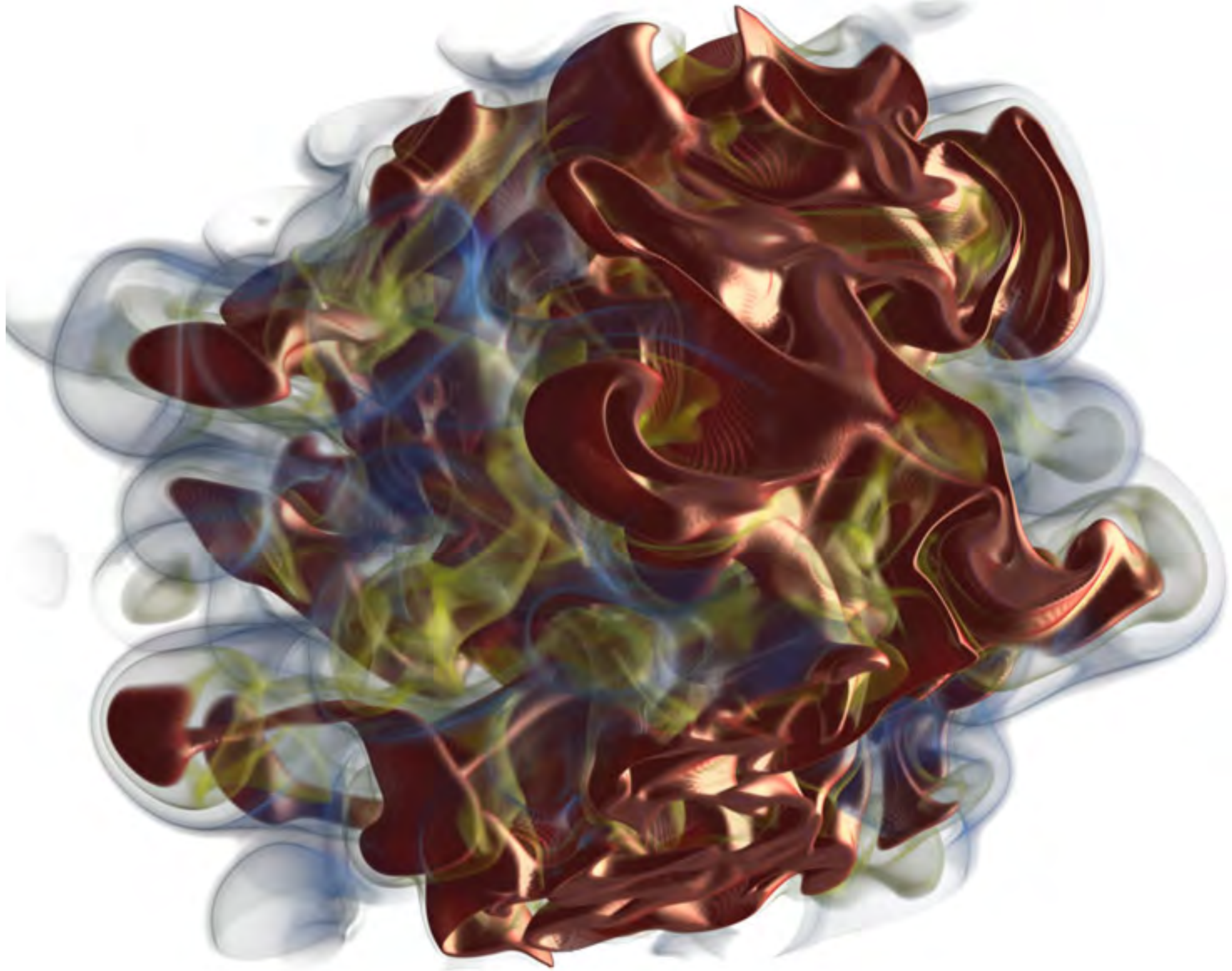
why 3D?



“WE KNOW NEXT TO NOTHING ABOUT
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quote stolen from Colin Ware’s Vis2009 keynote







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

WHY 3D

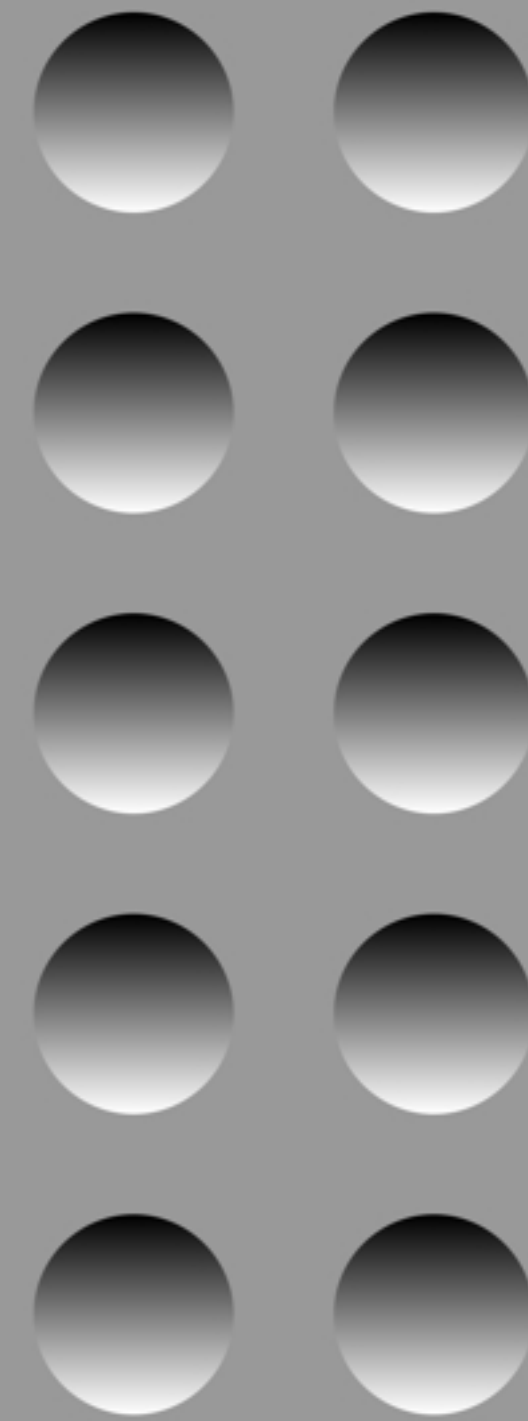
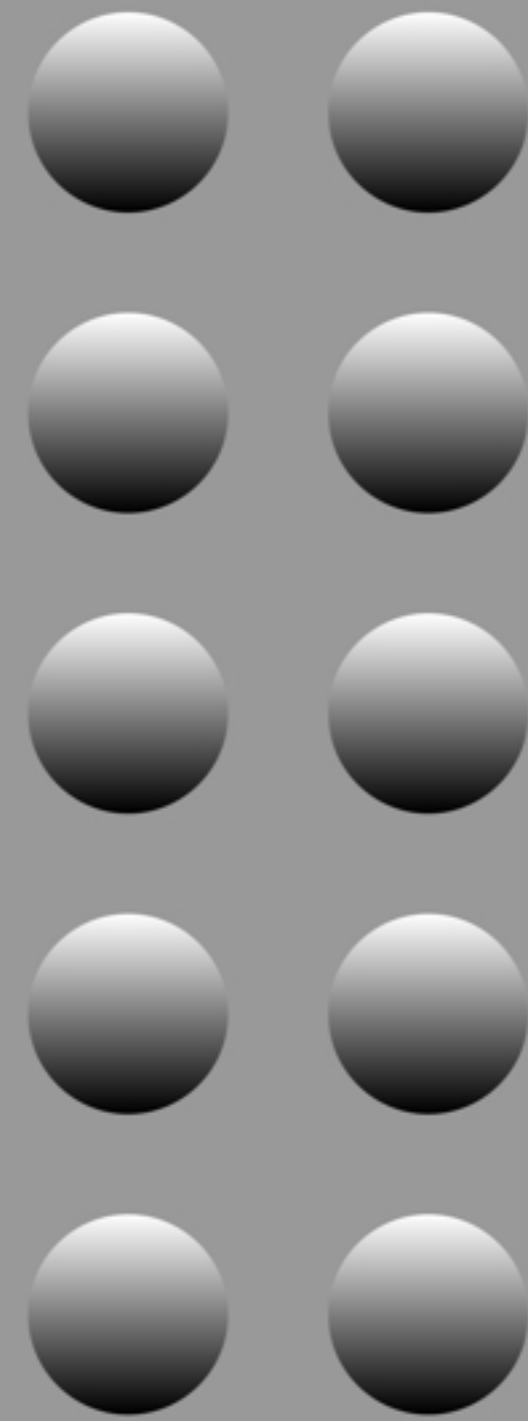
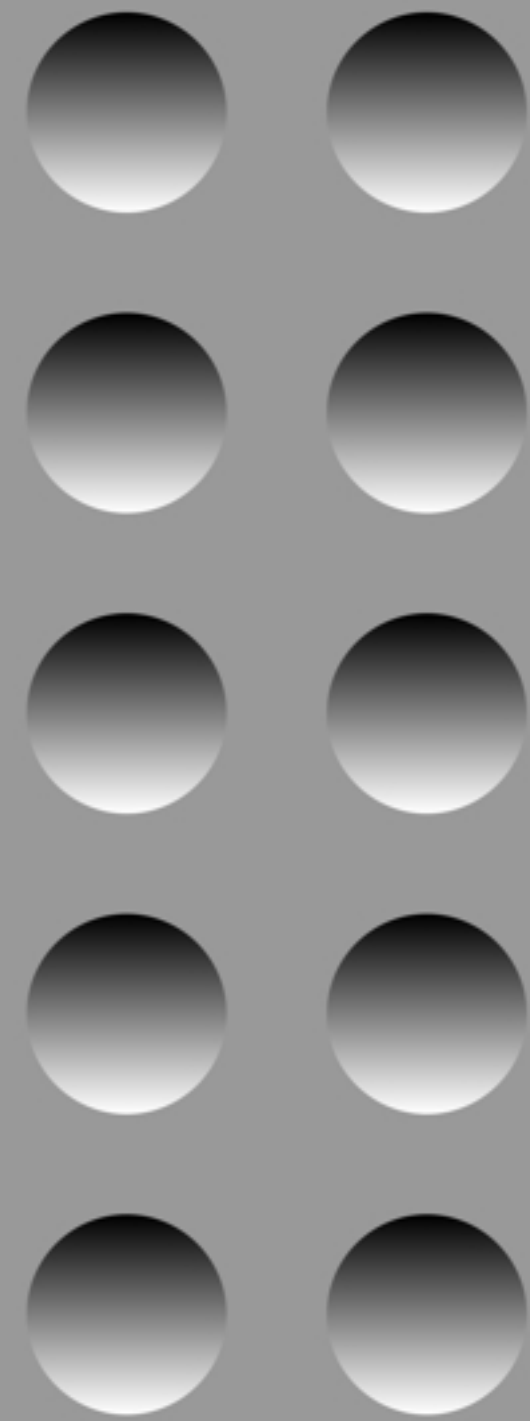
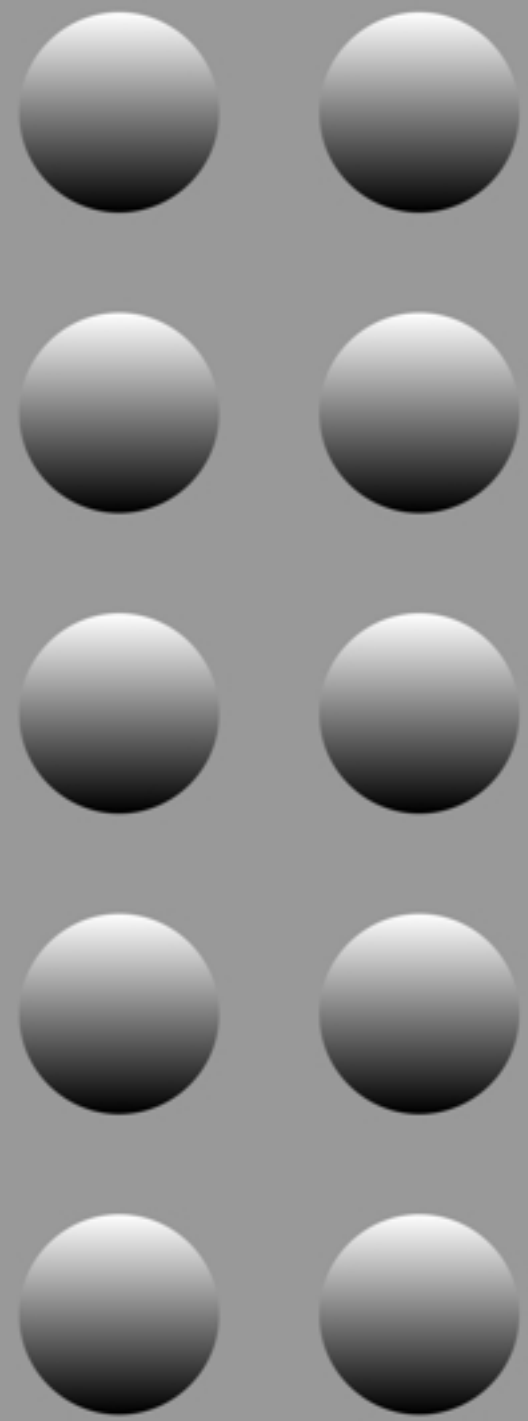
- phenomena is in 3D
- spatial relationships meaningful in 3D
- we understand 3D world



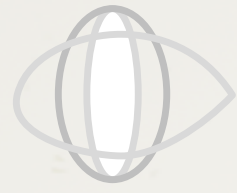
THE VOLUMEPRO VOLUME RENDERING CLUSTER | SANTIAGO LOMBEYDA & JOHN MCCORQUODALE | CALTECH | 2003

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





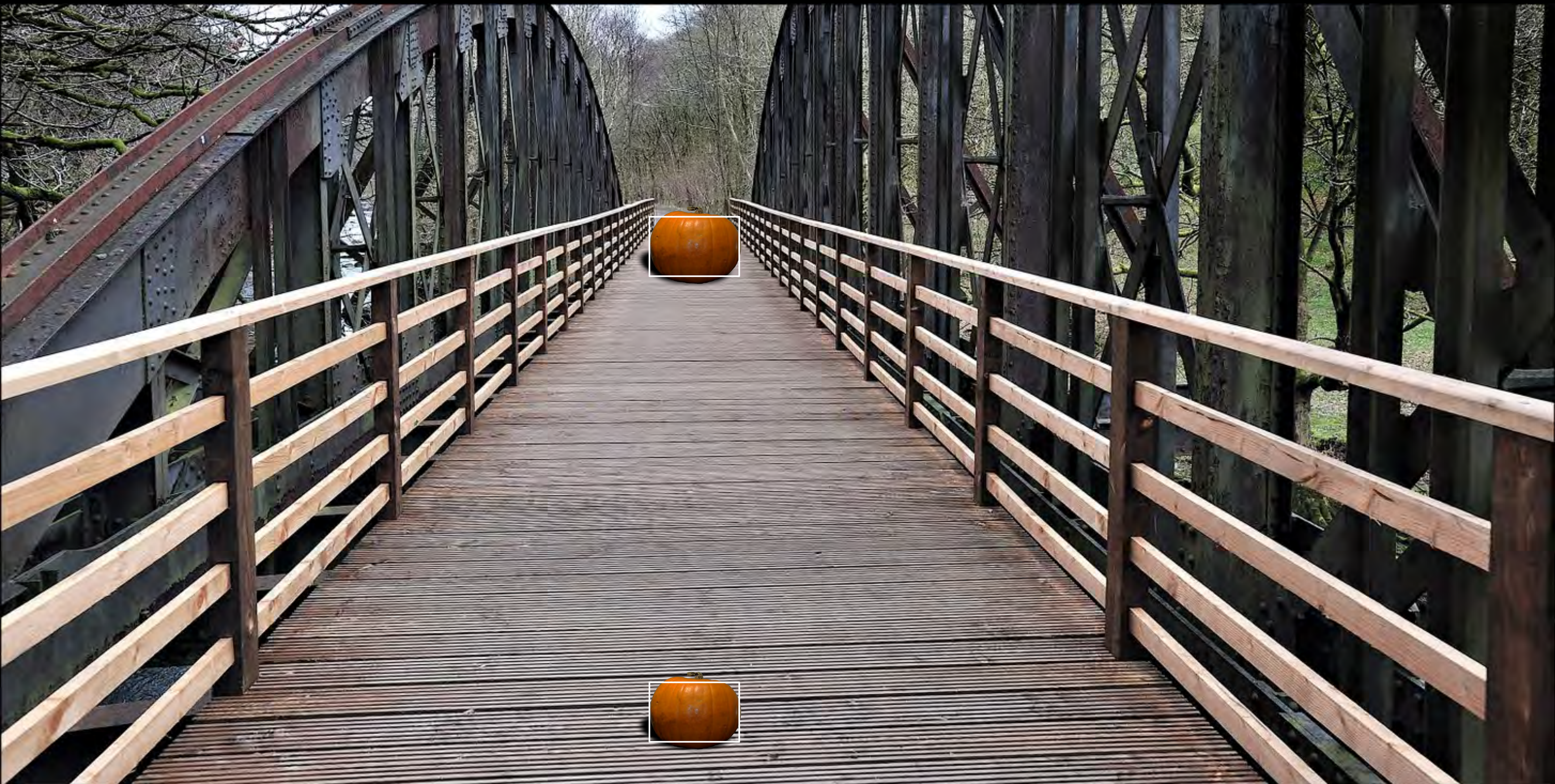
4207



_PERSPECTIVE

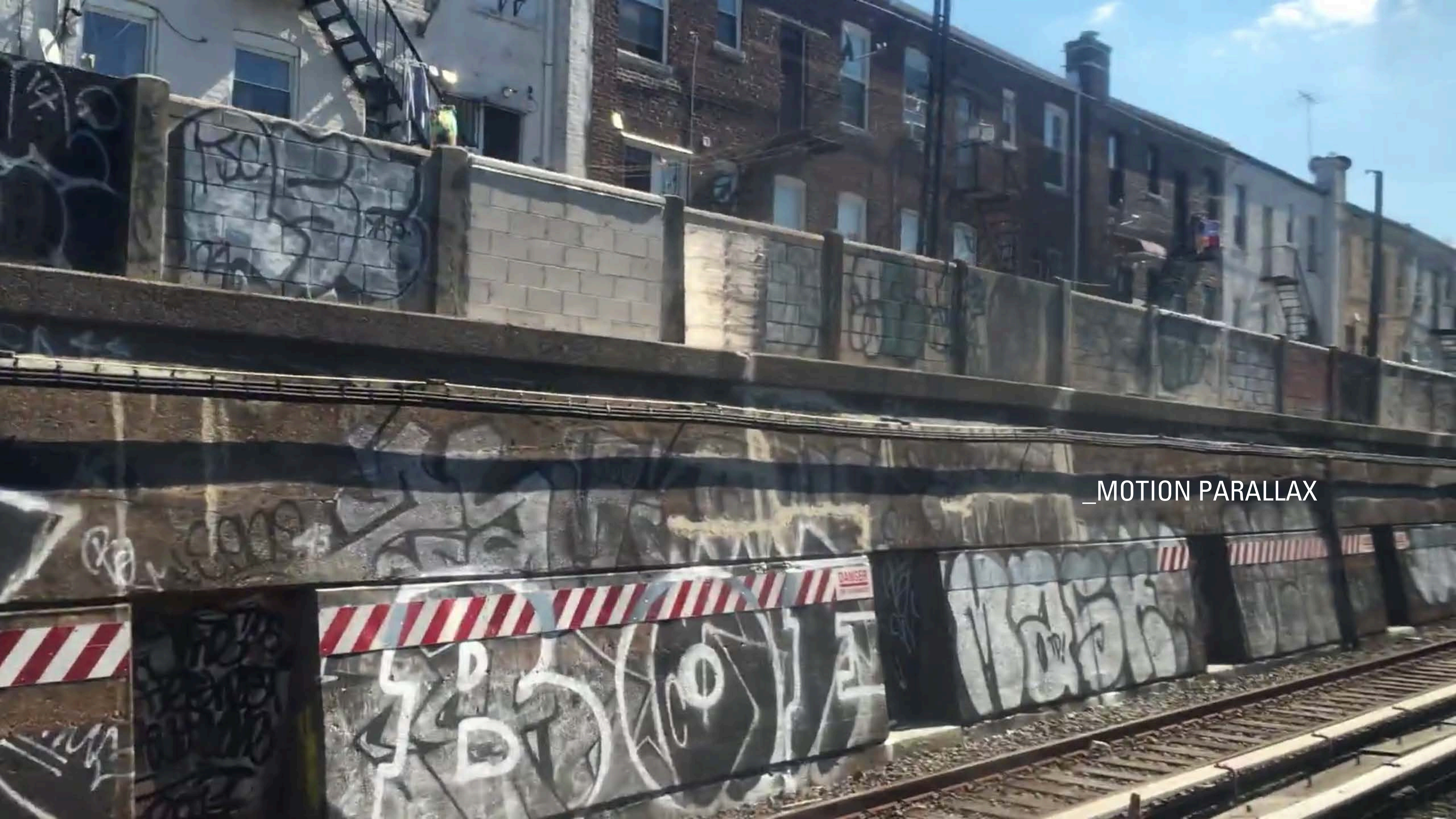










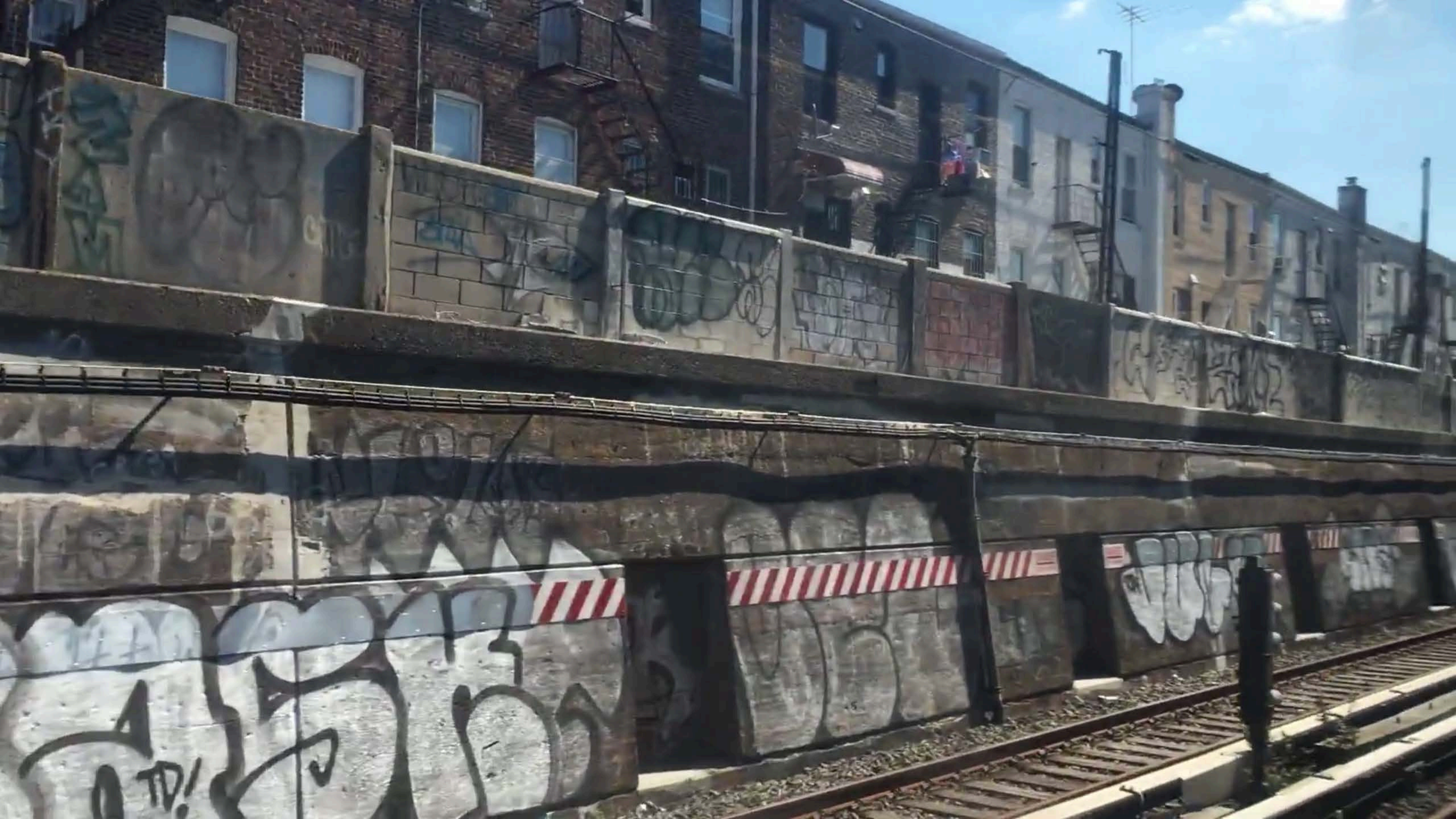


_MOTION PARALLAX



DANGER
NO CLEARANCE

W
0 TD!
W









DANGER





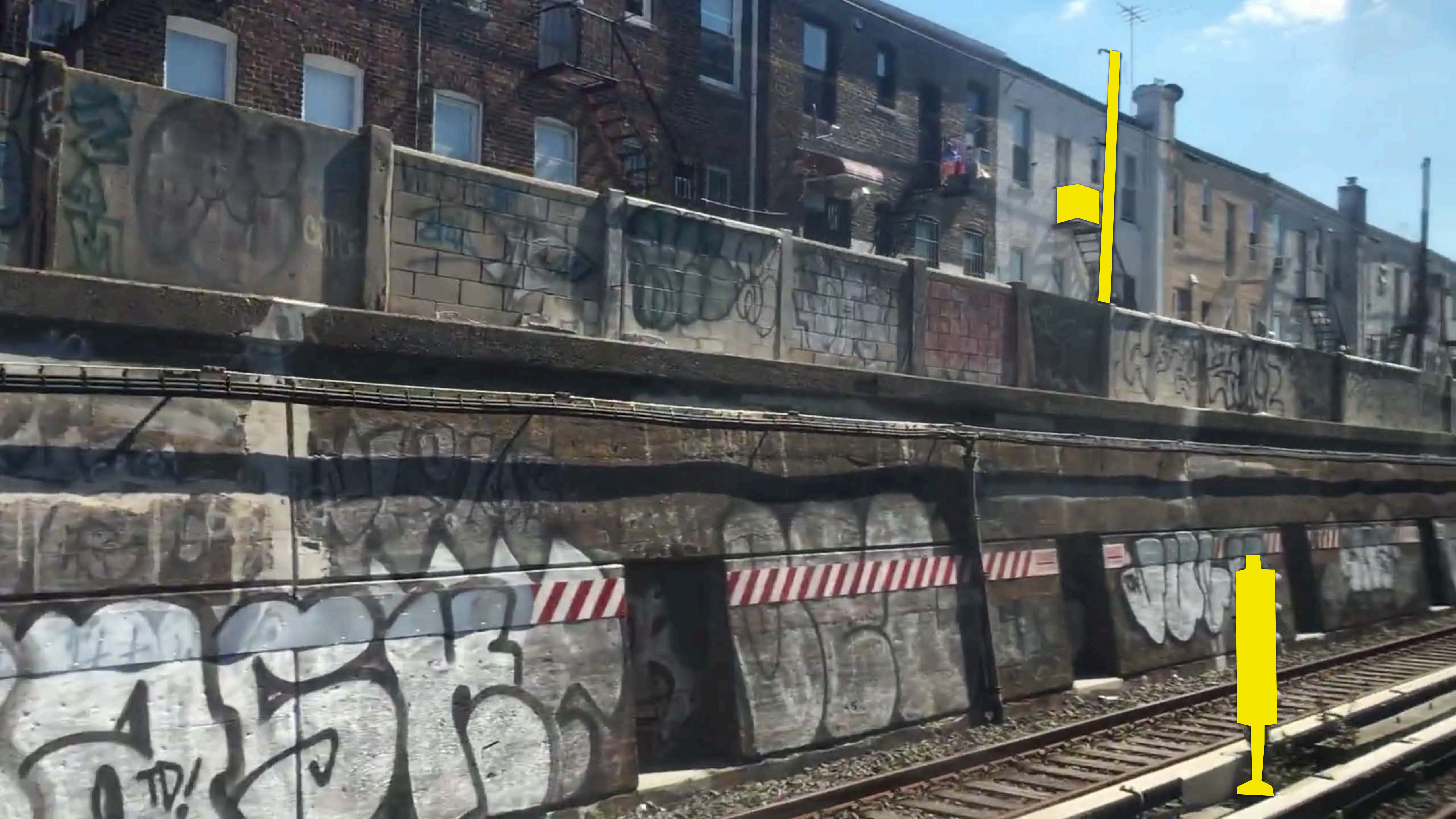
DANGER

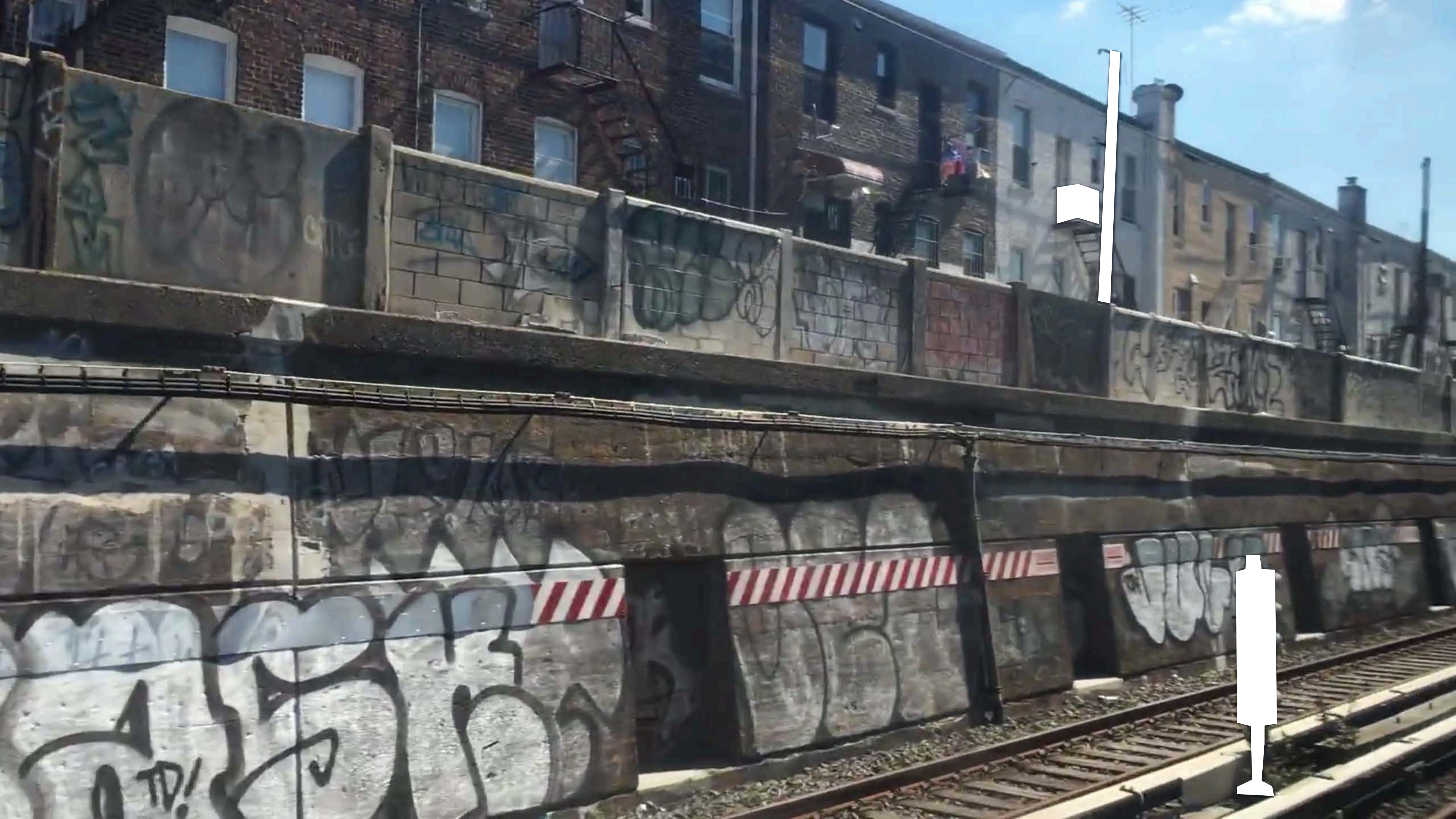
DANGER



DANGER
NO CROSSING

DANGER
NO CROSSING



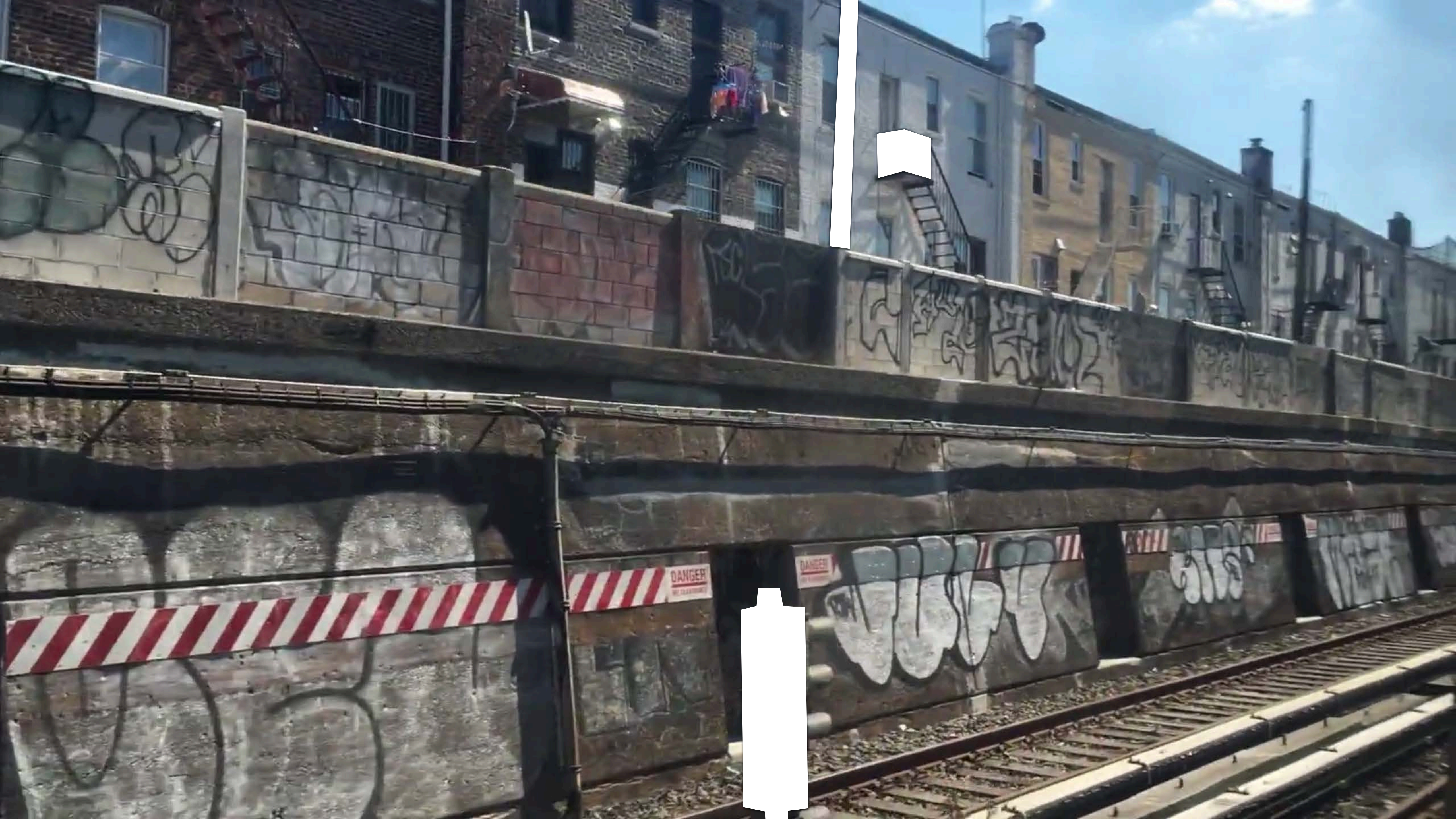














DANGER

DANGER



DANGER
NO CLIMBING

DANGER
NO CLIMBING



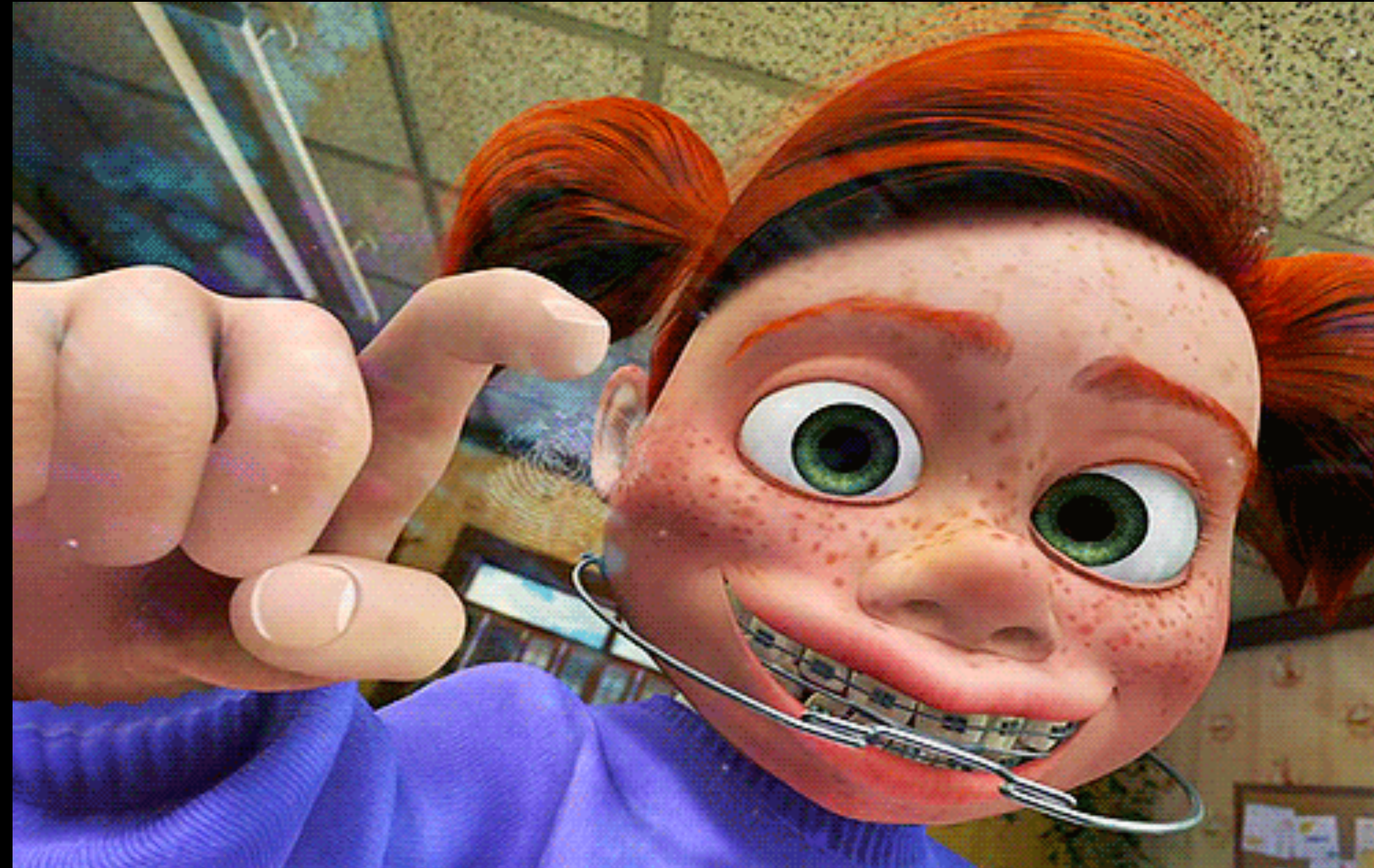
DANGER
NO CLIMBING

DANGER
NO CLIMBING

POW
WWS

WWS

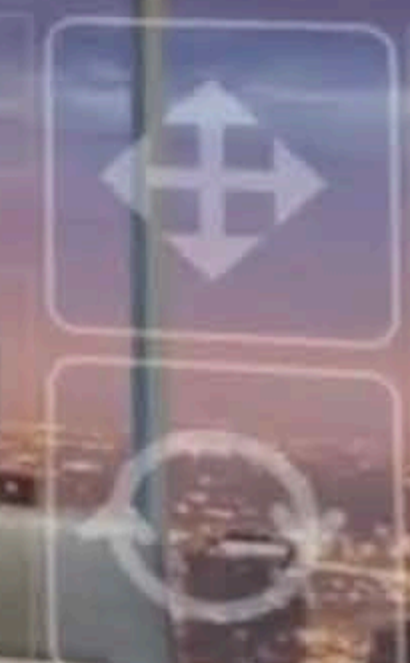
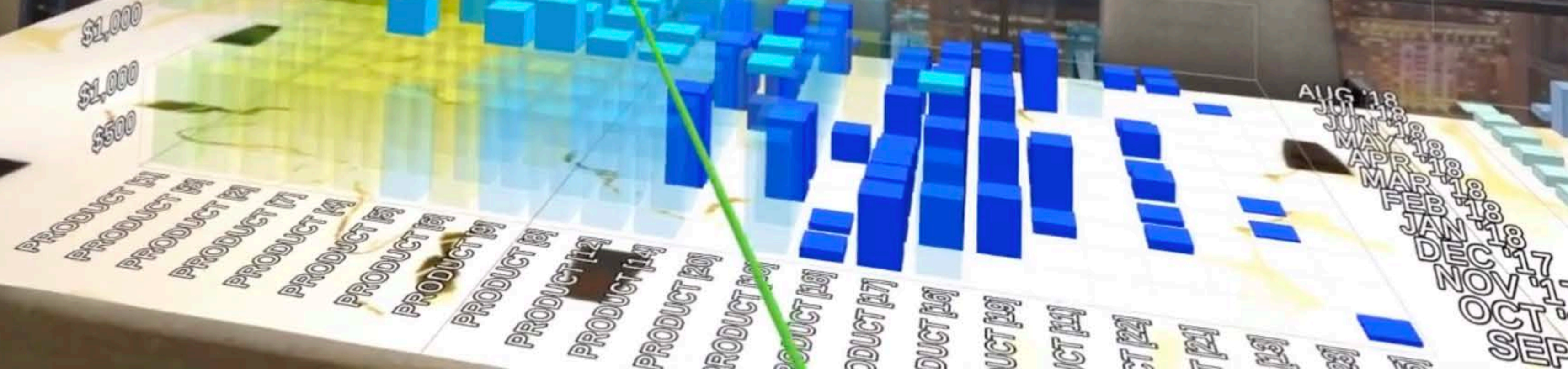
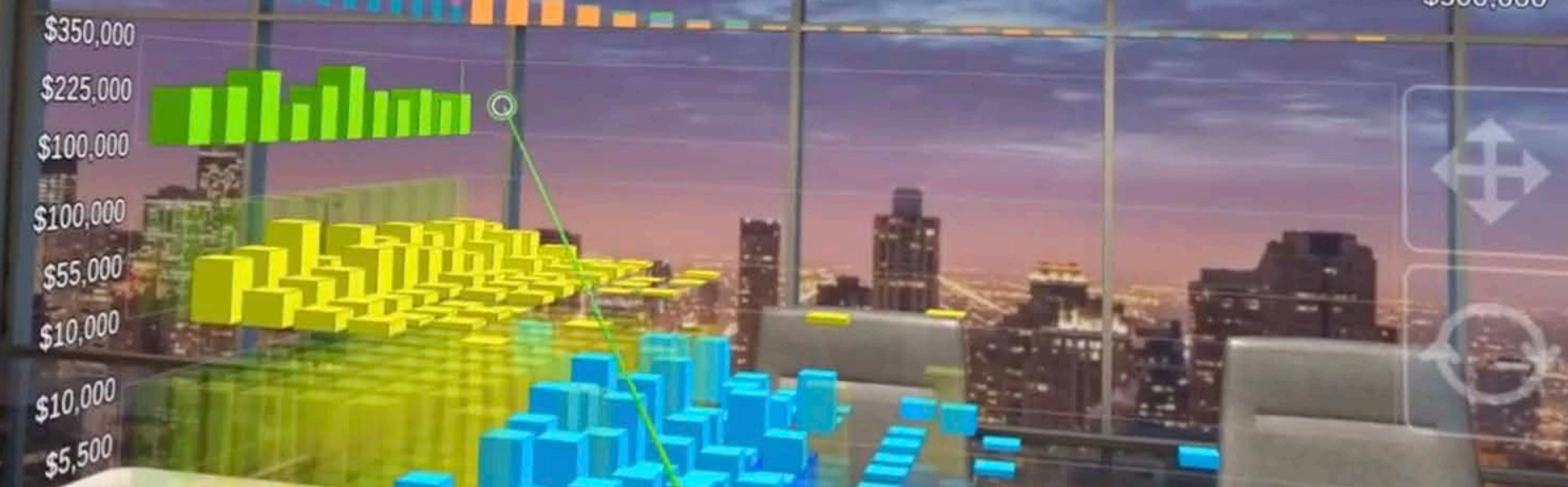
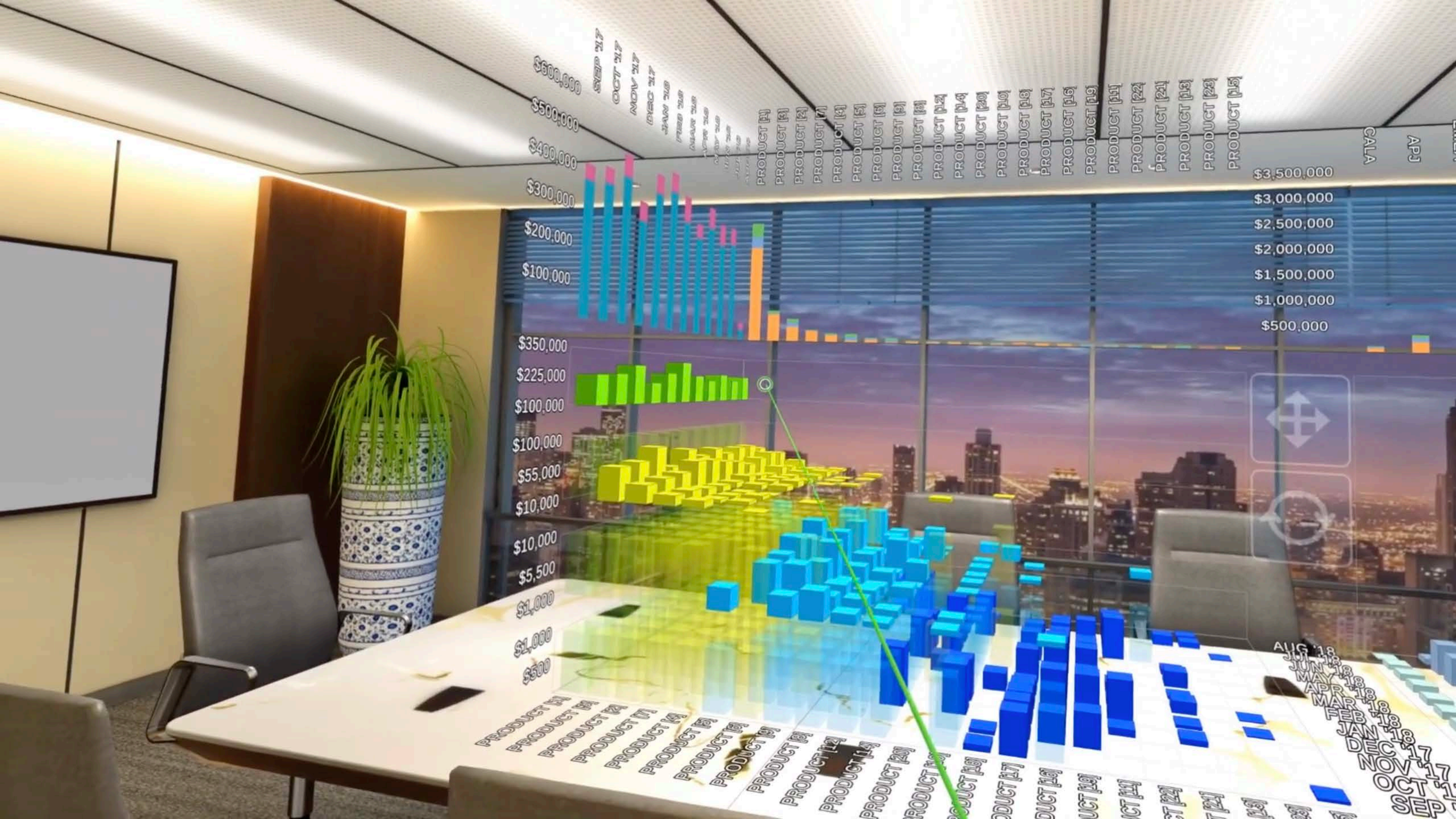
WWS

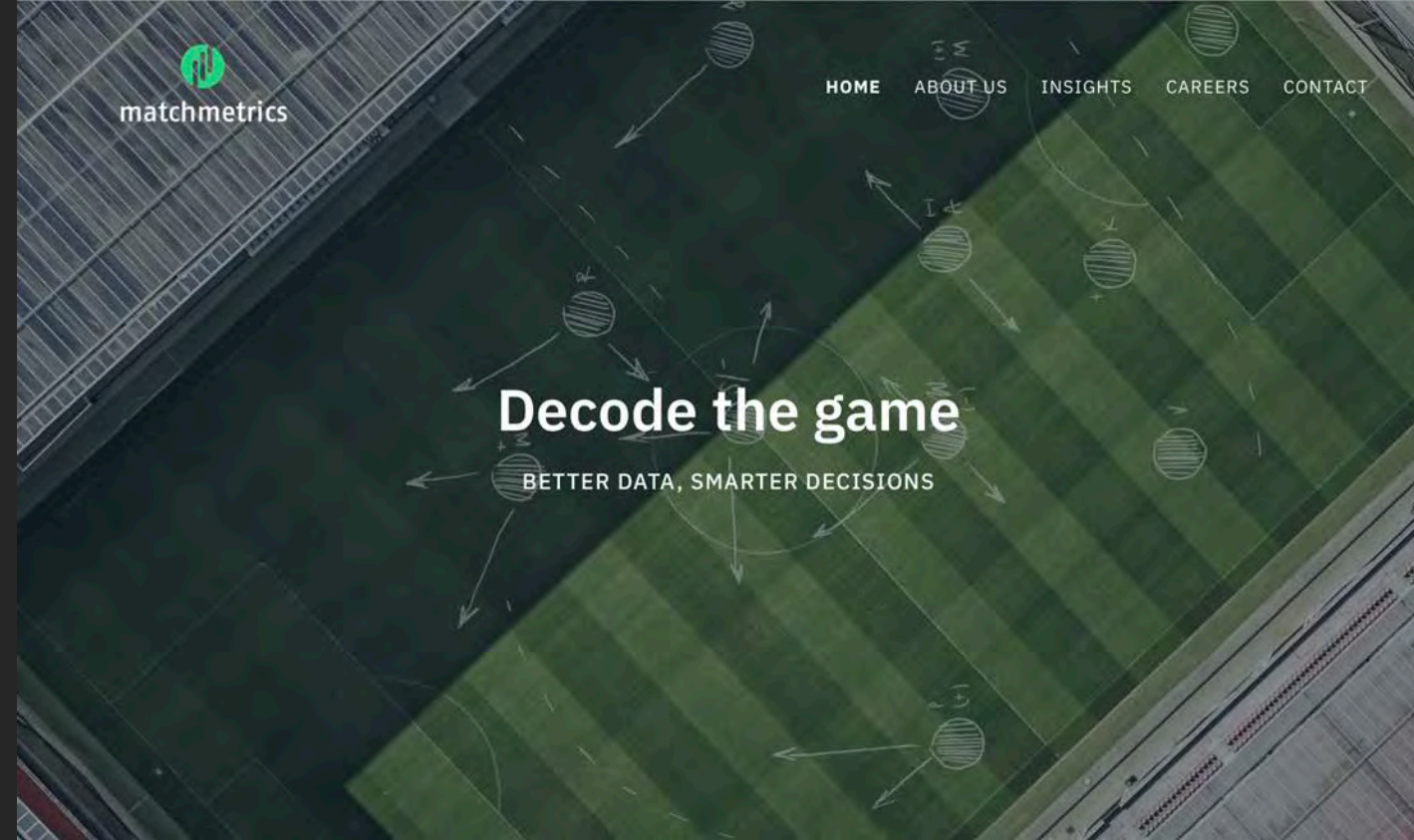






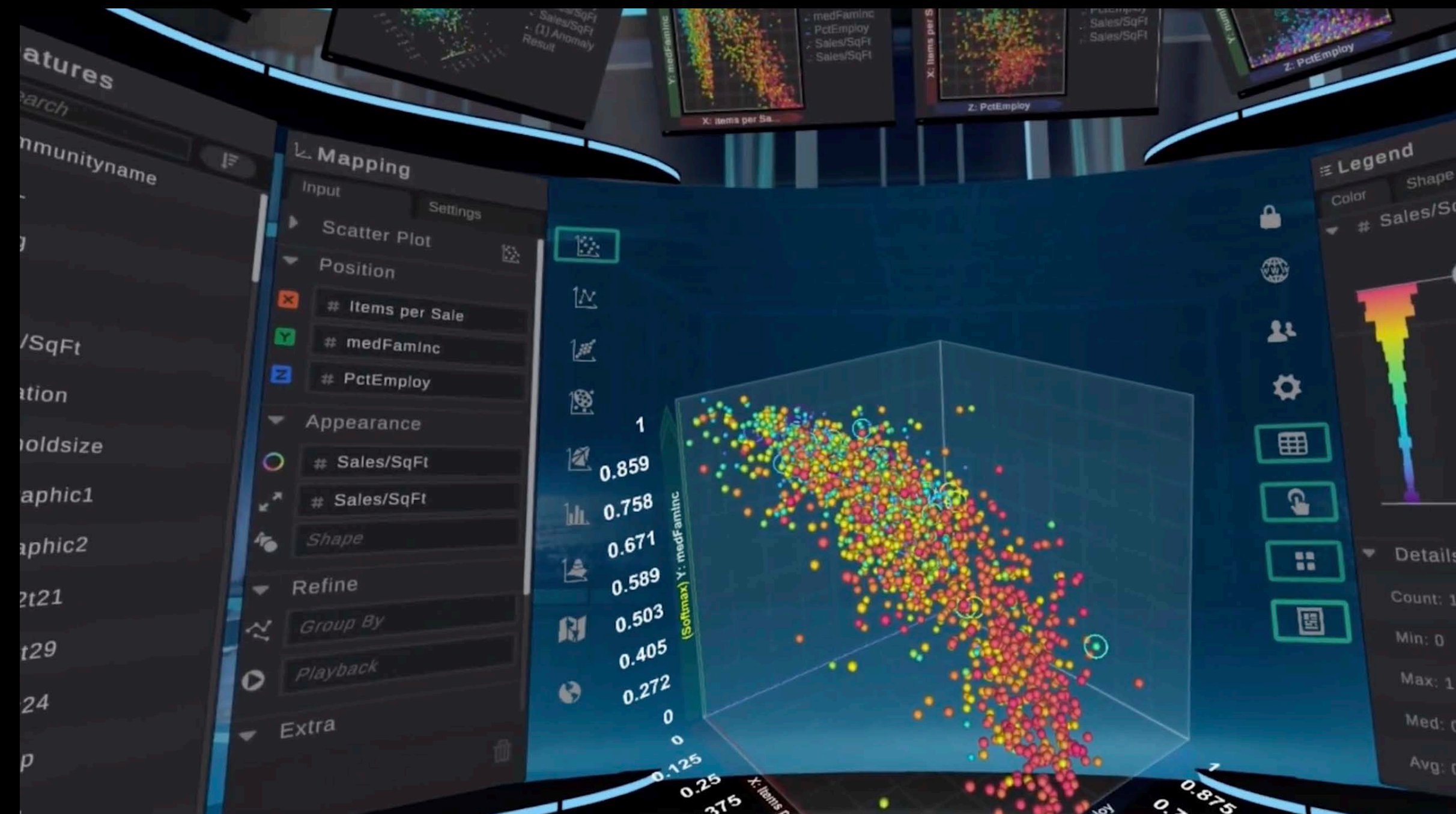
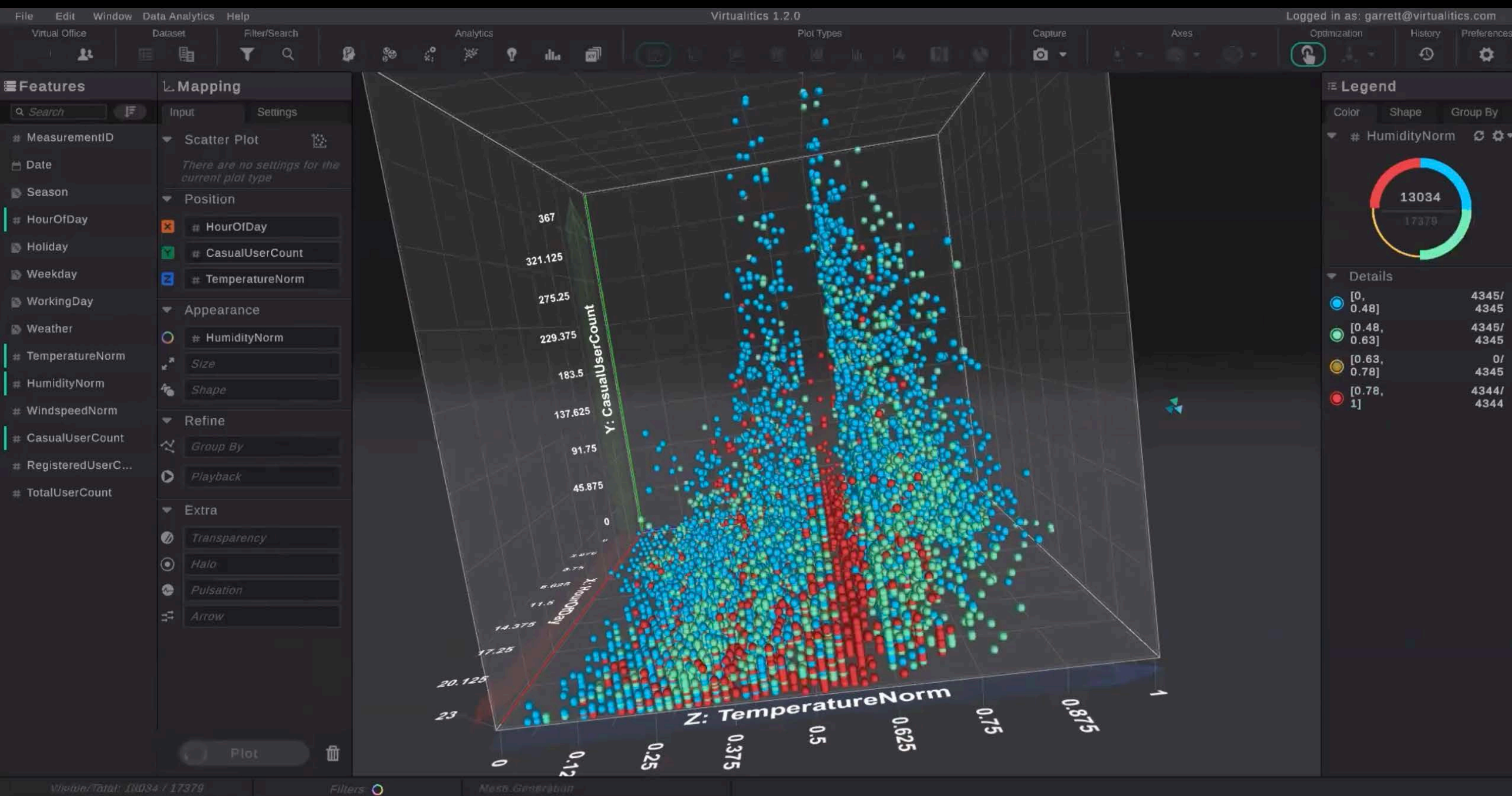








Our results also suggest that users feel more satisfied and successful when using VR data exploration tools



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

GOAL

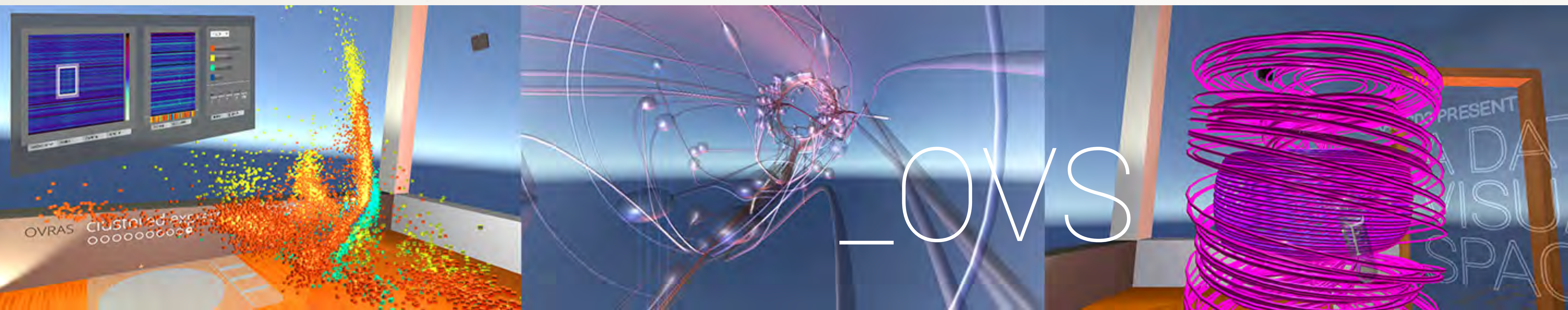
- _ experience 3d information
- _ Intuitive
- _ least intrusive manner

INMMERSIVE 3D

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

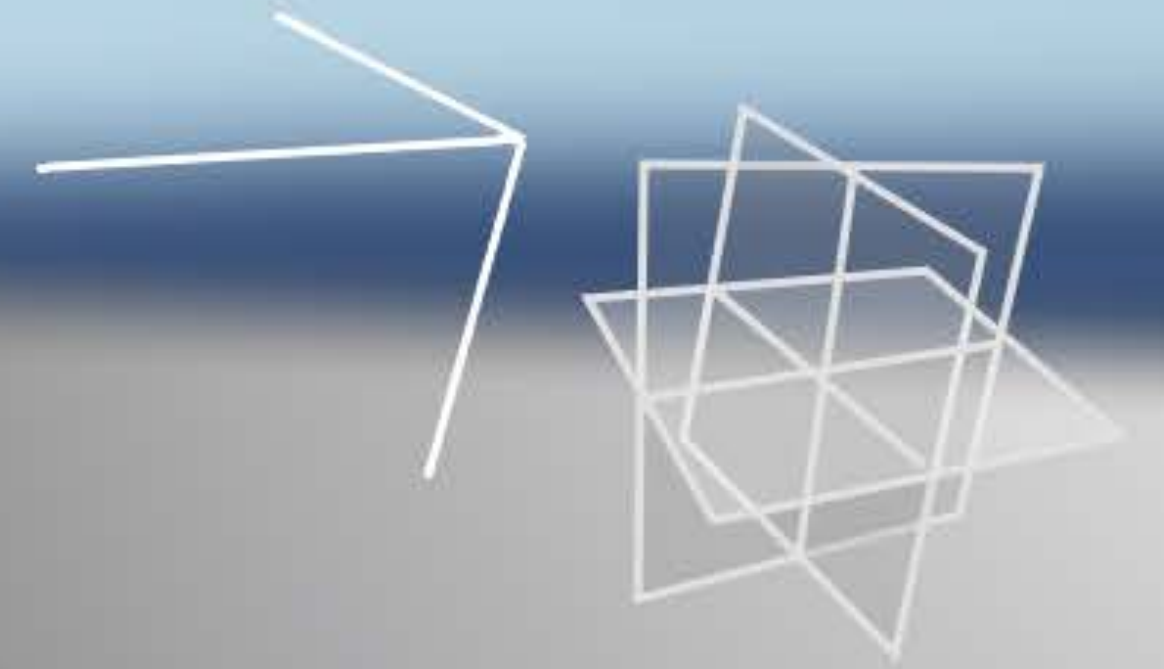
VIRTUAL REALITY

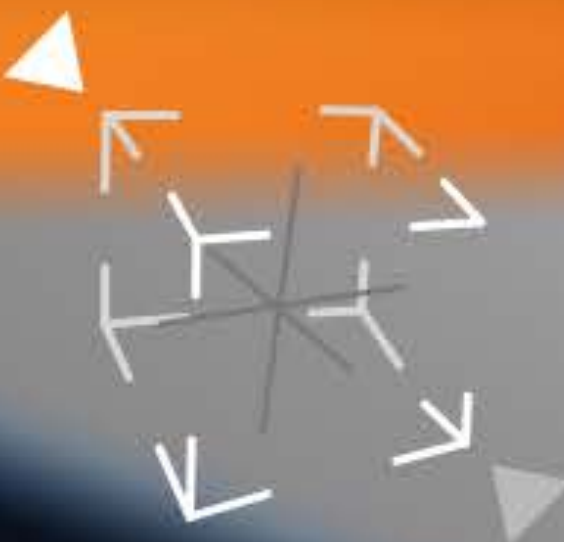
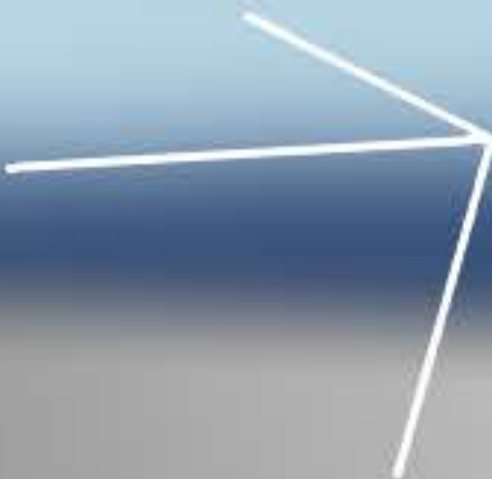
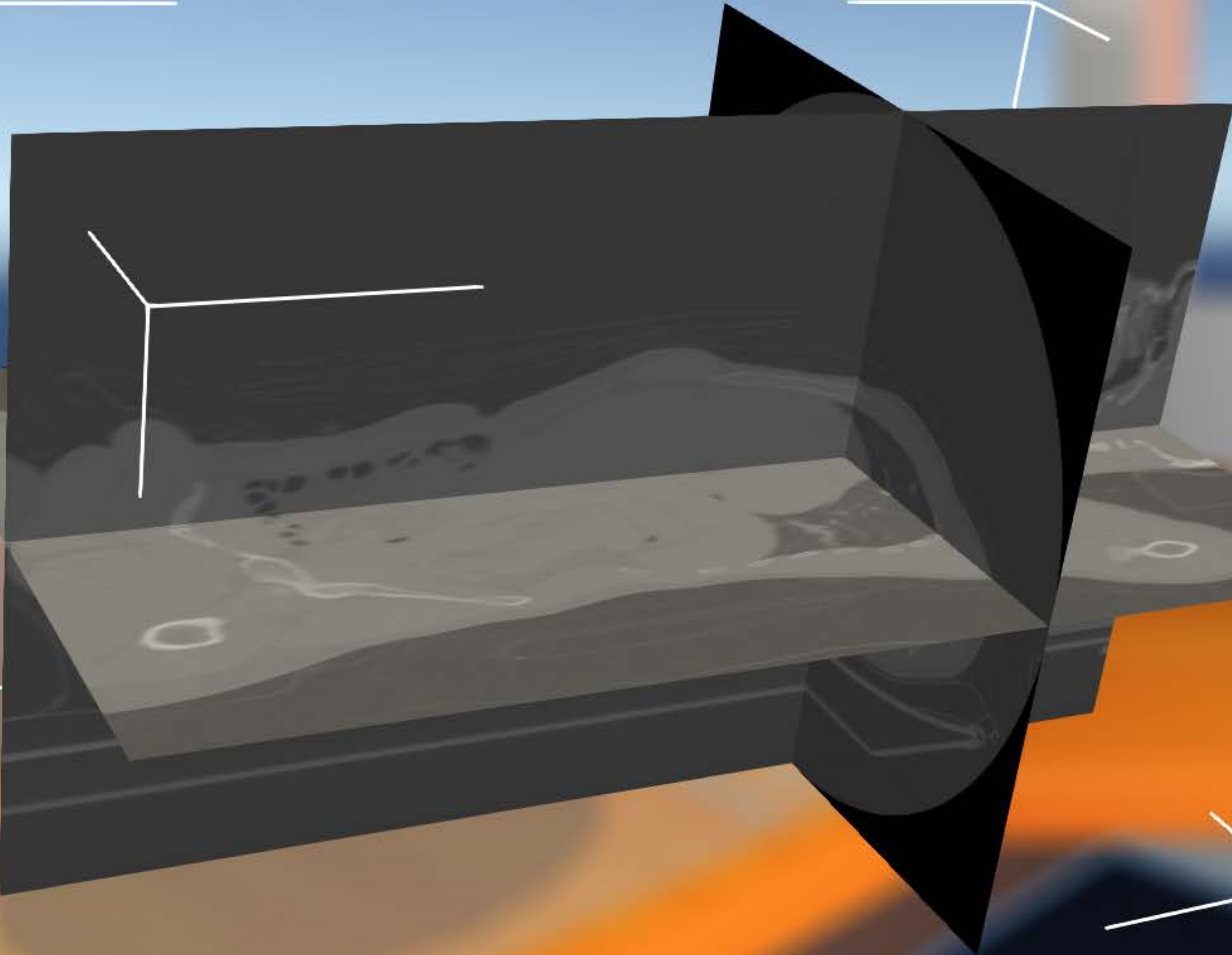
- _ direct interaction
- _ intuitive manipulation
- _ easy selection/annotation

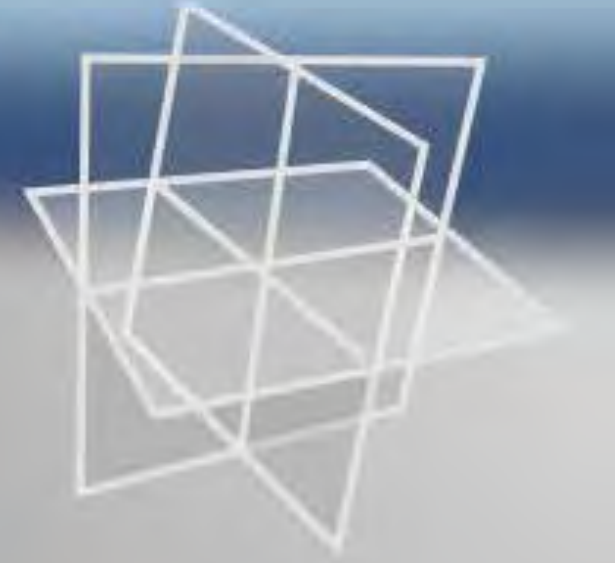
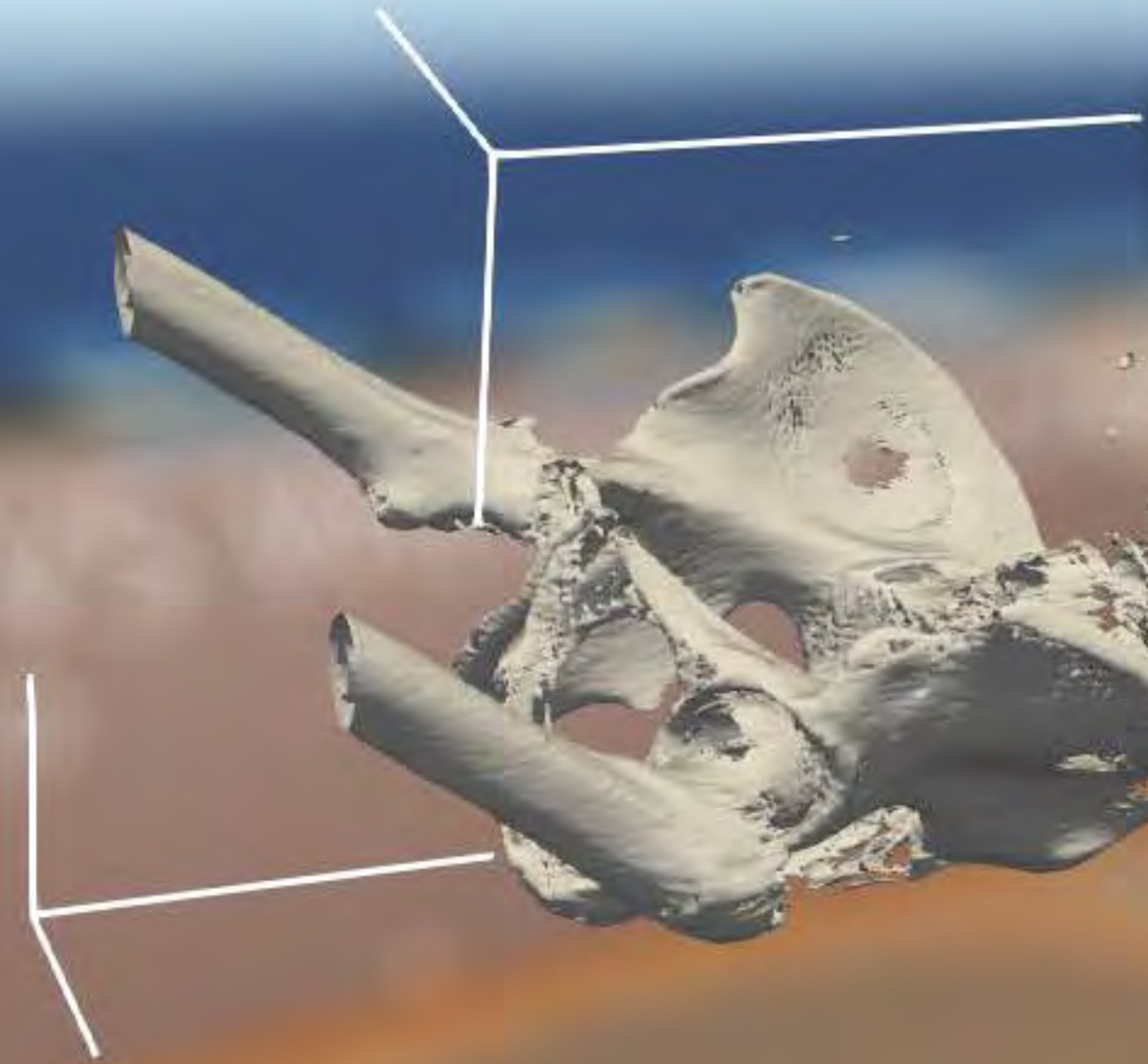


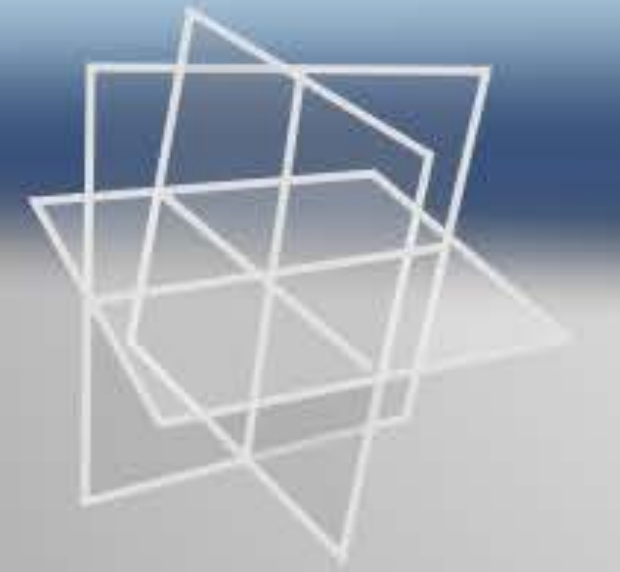
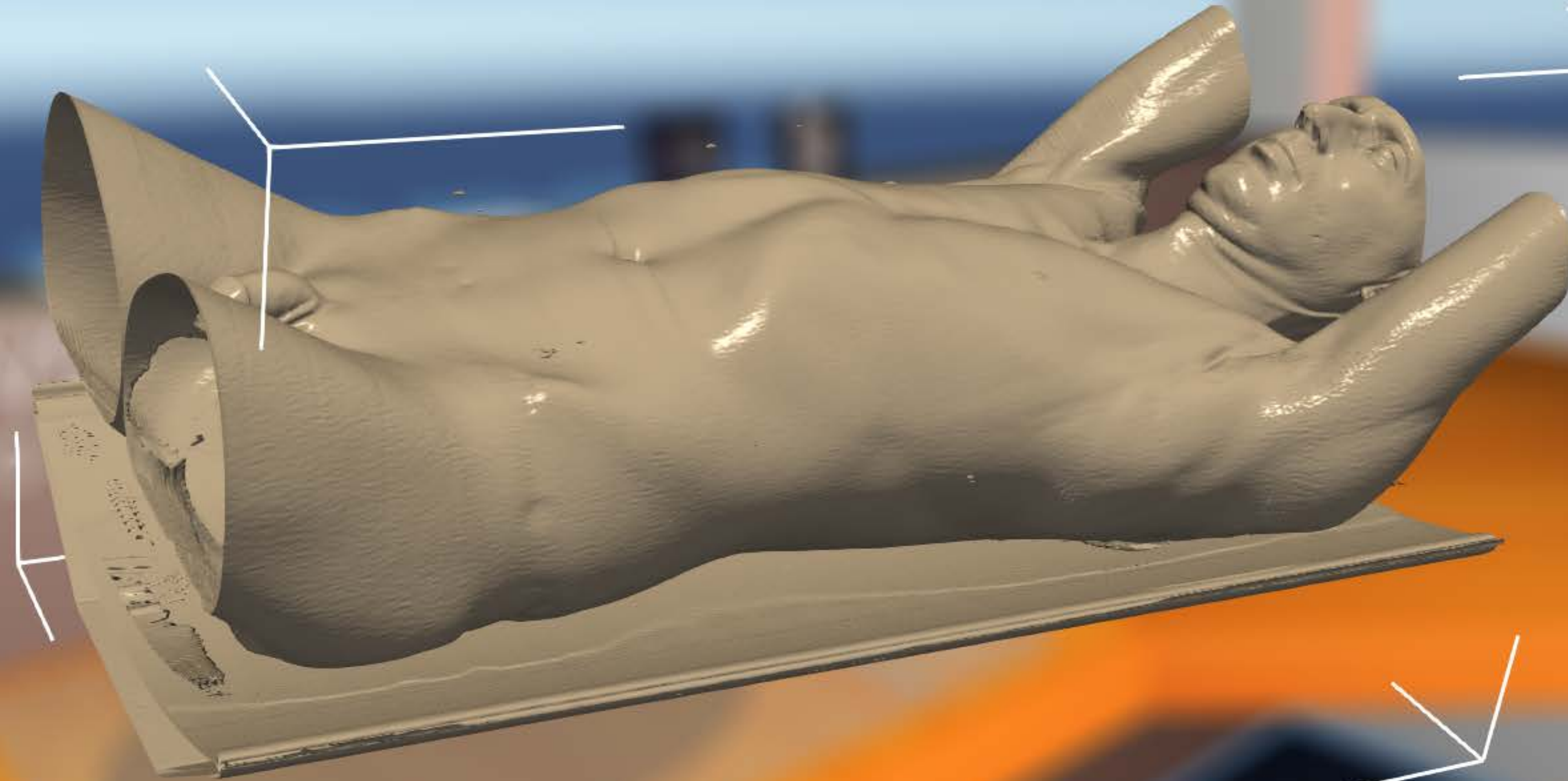
_walkthrough

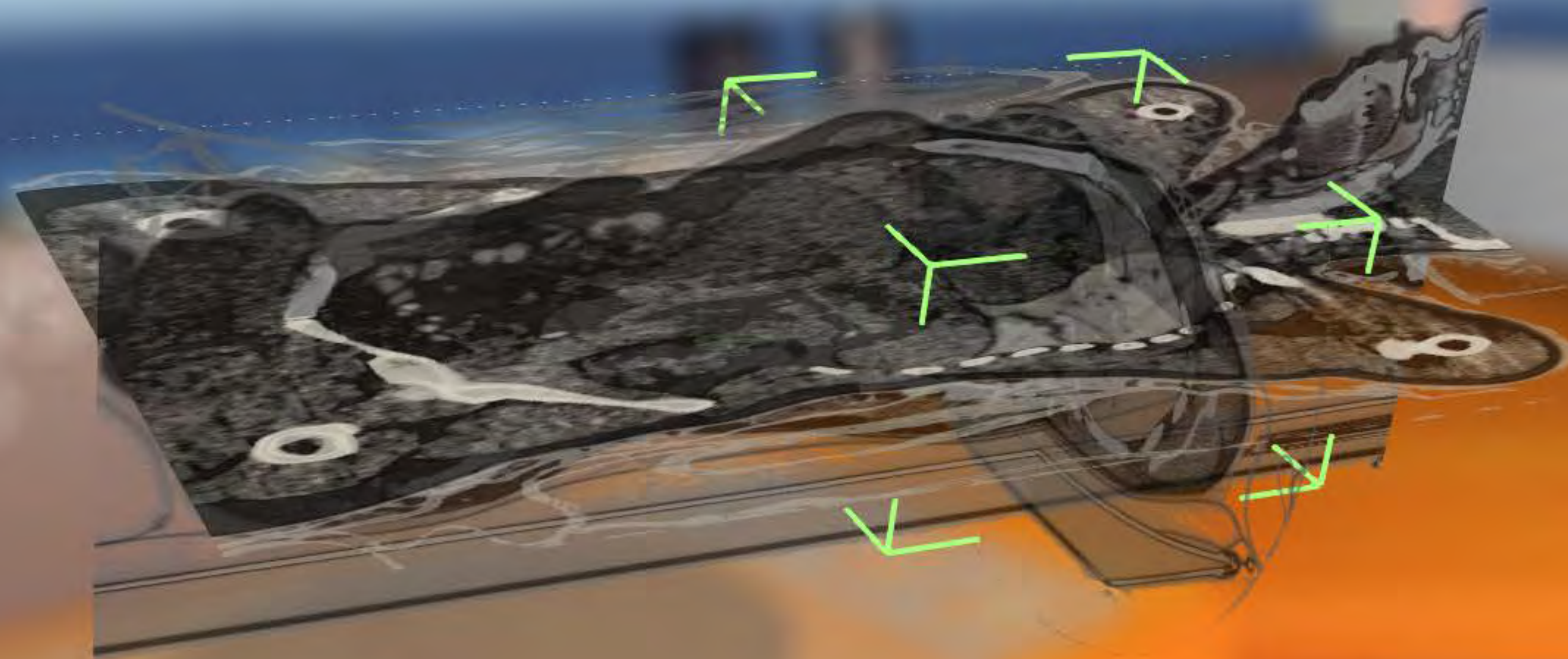


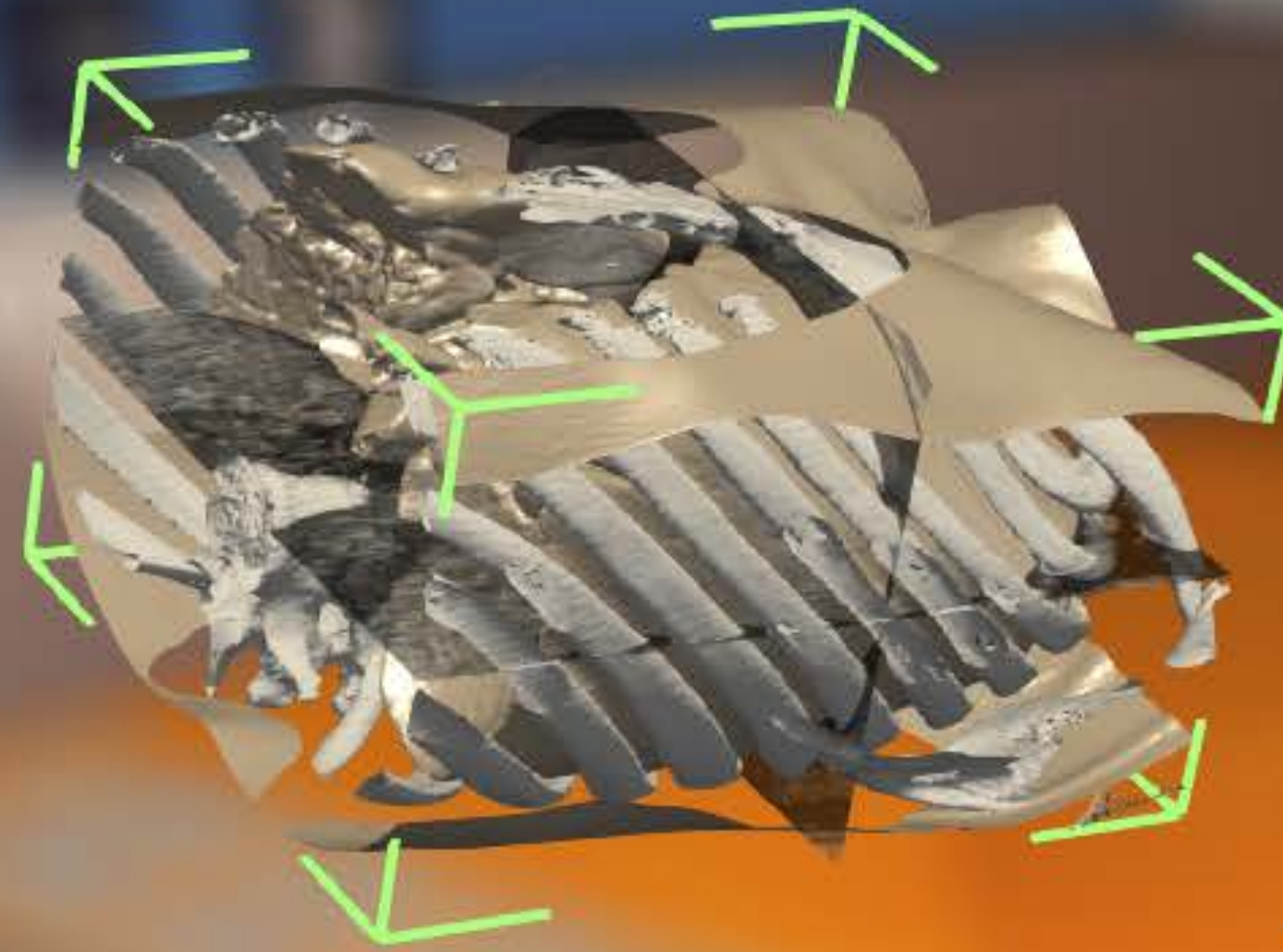


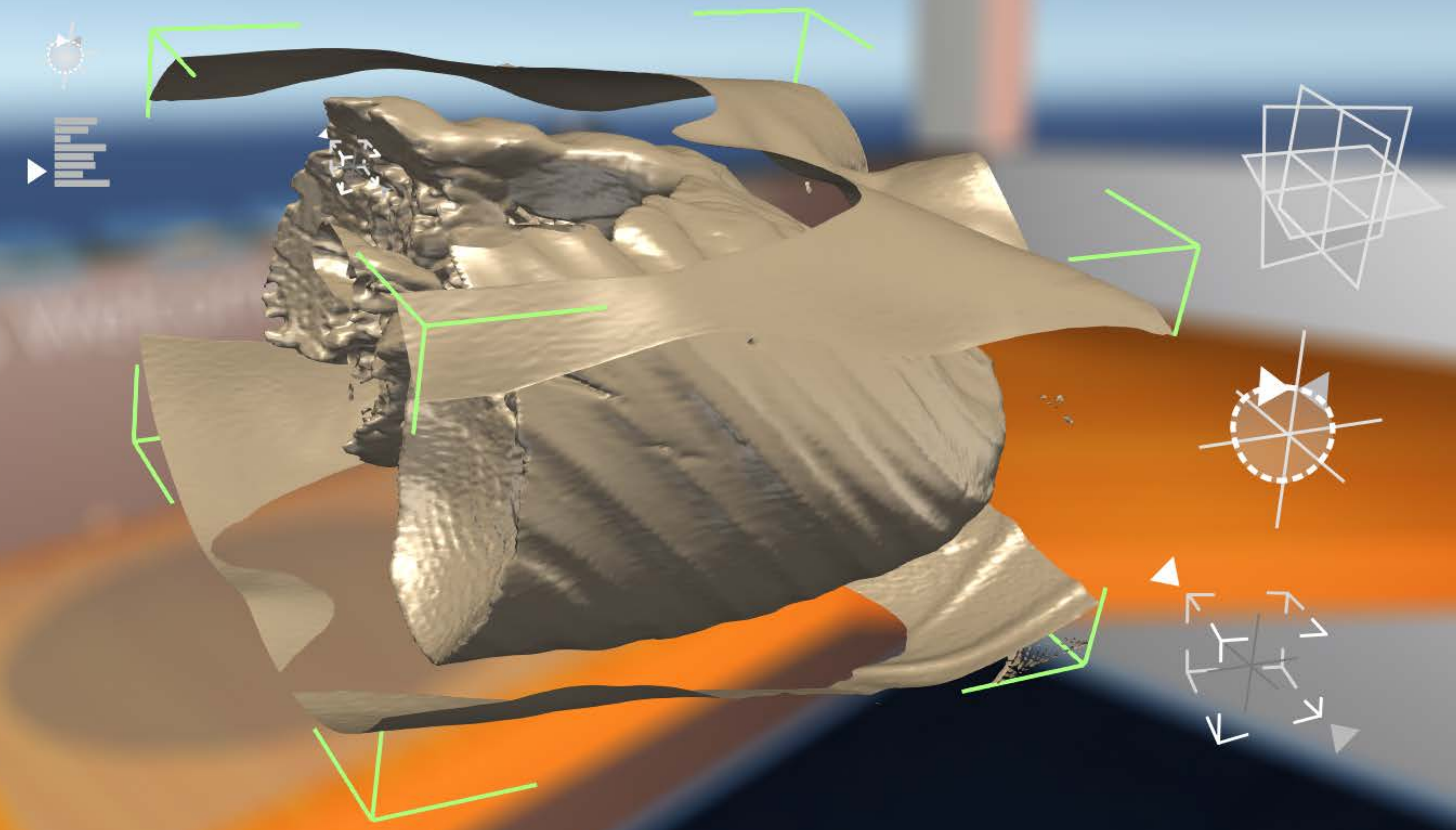


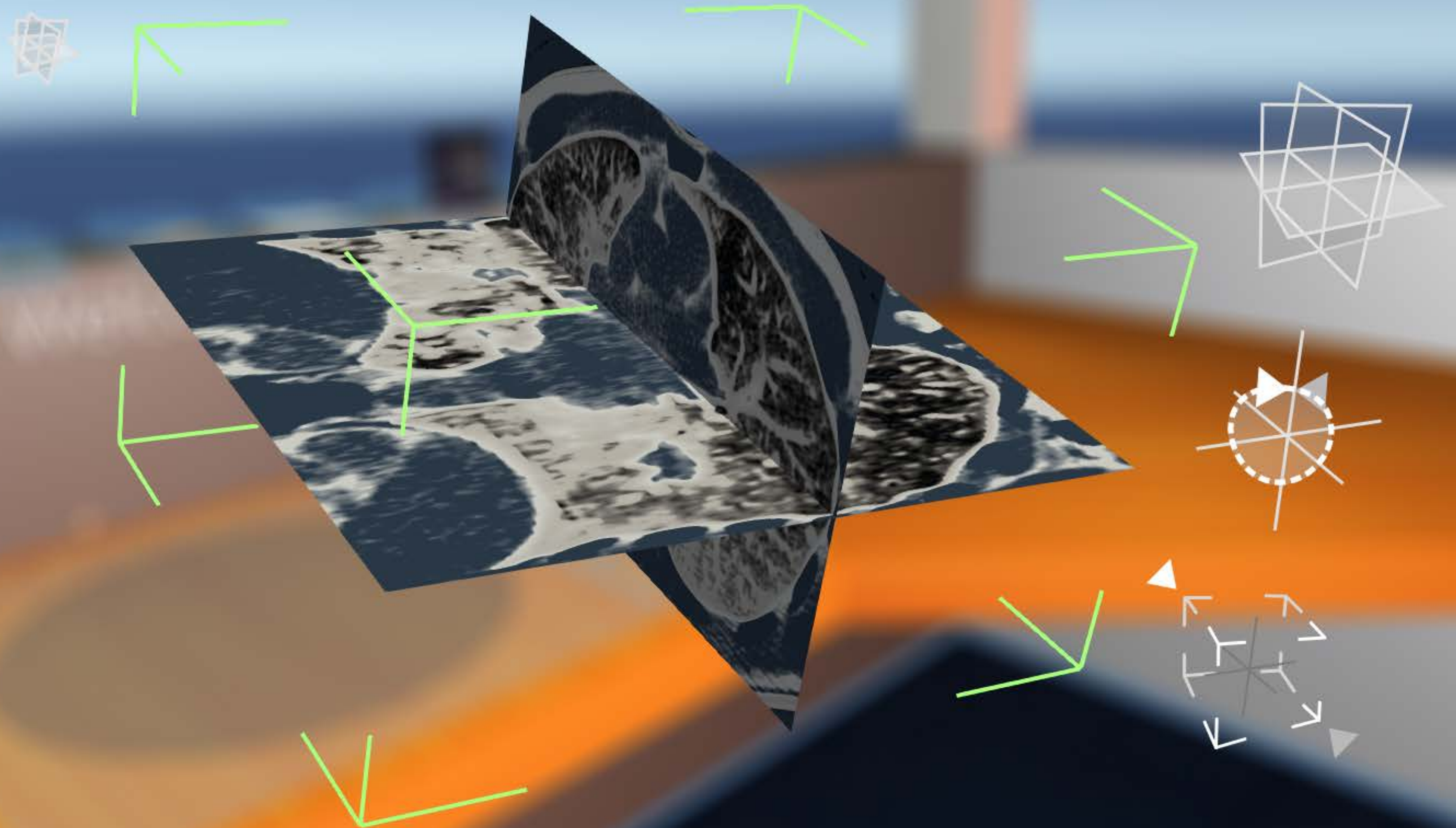


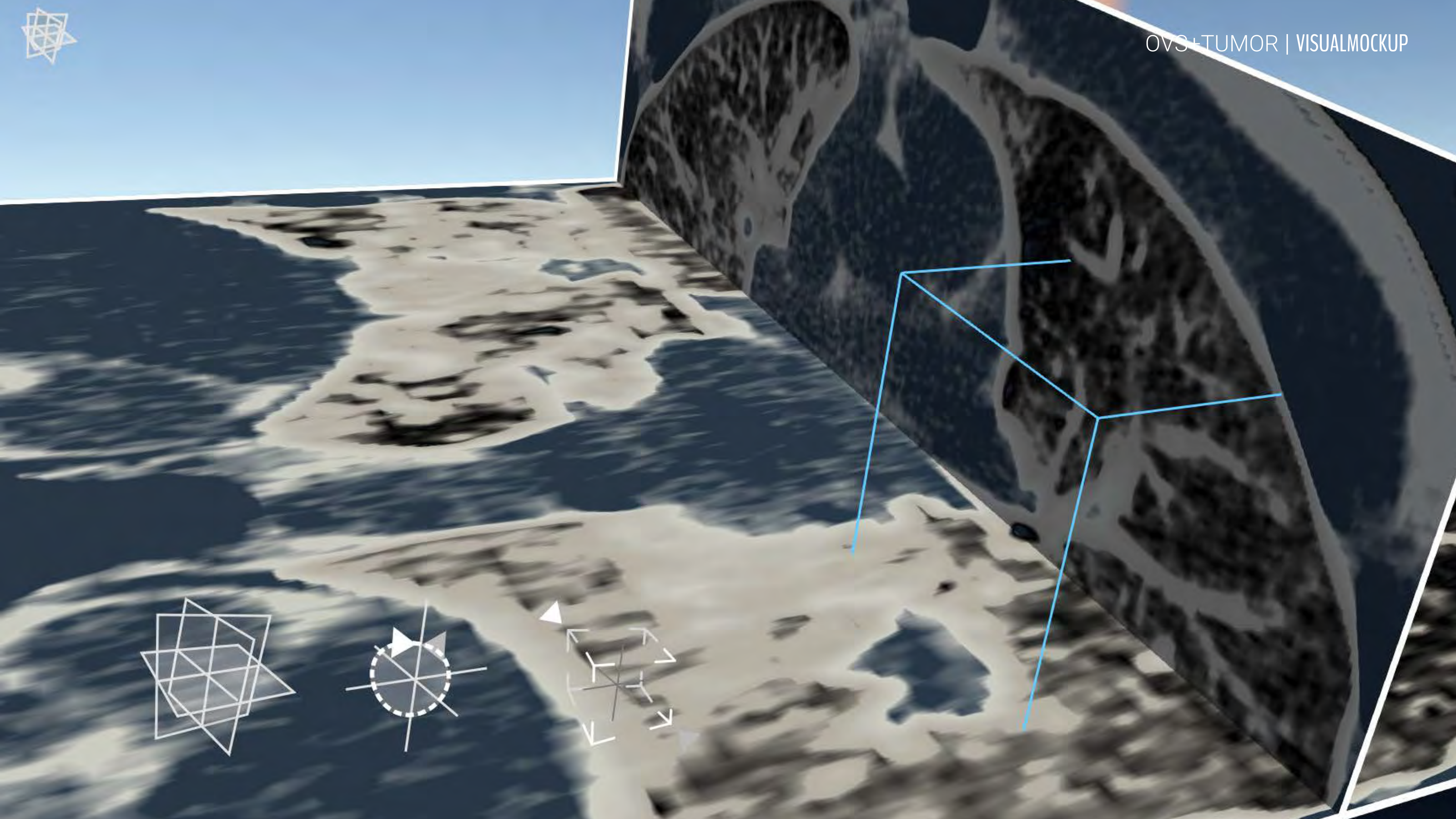


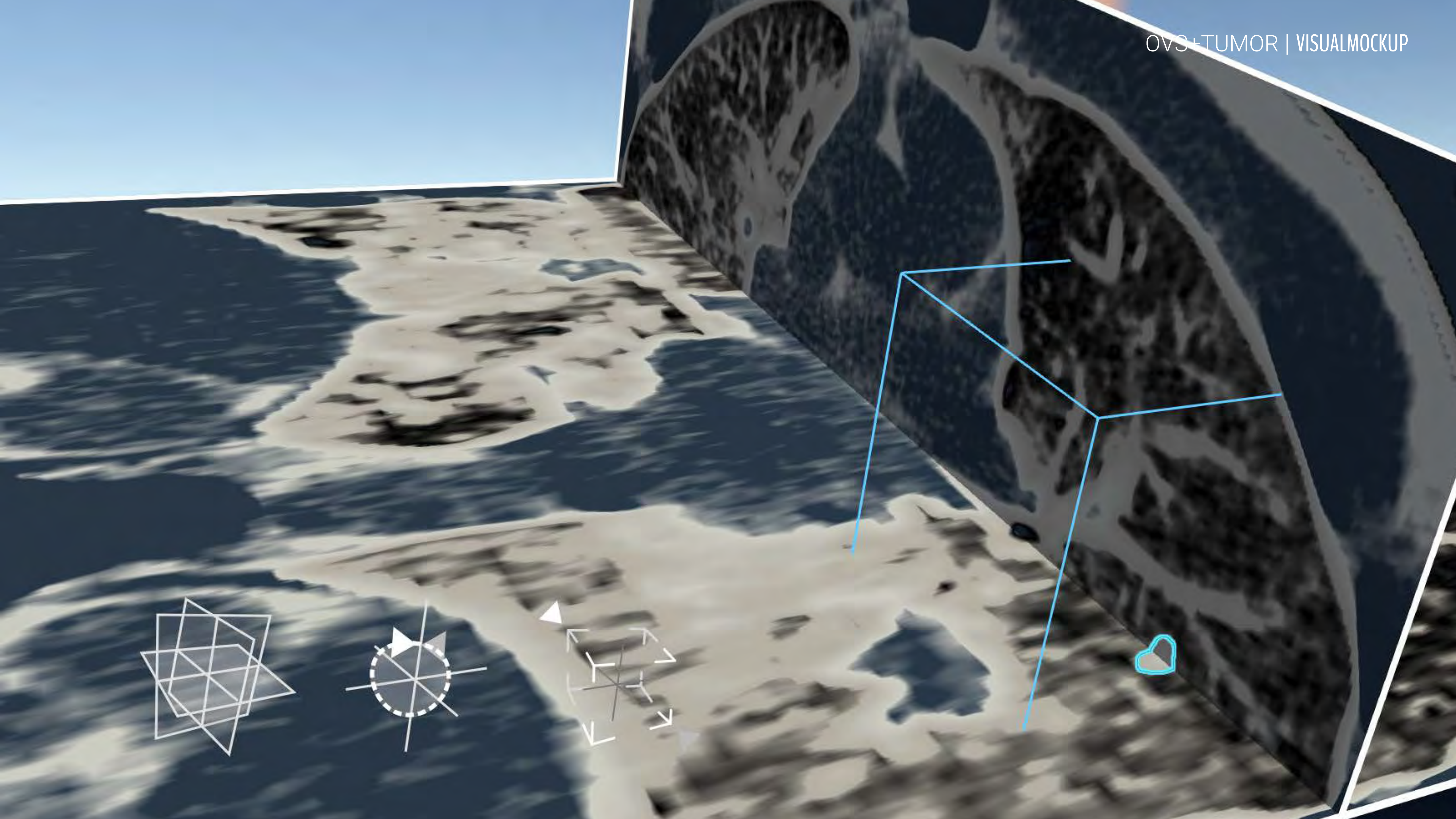


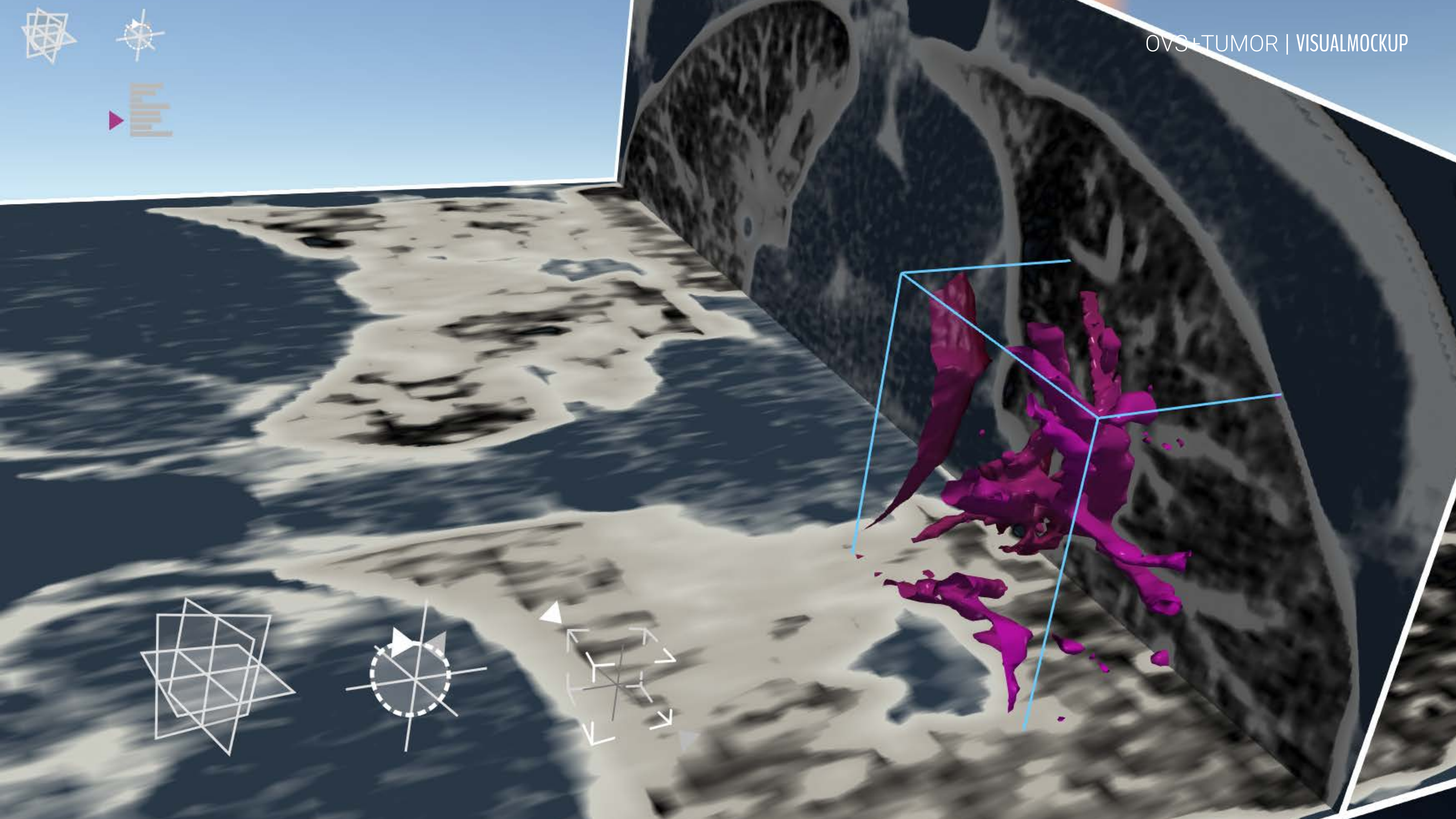


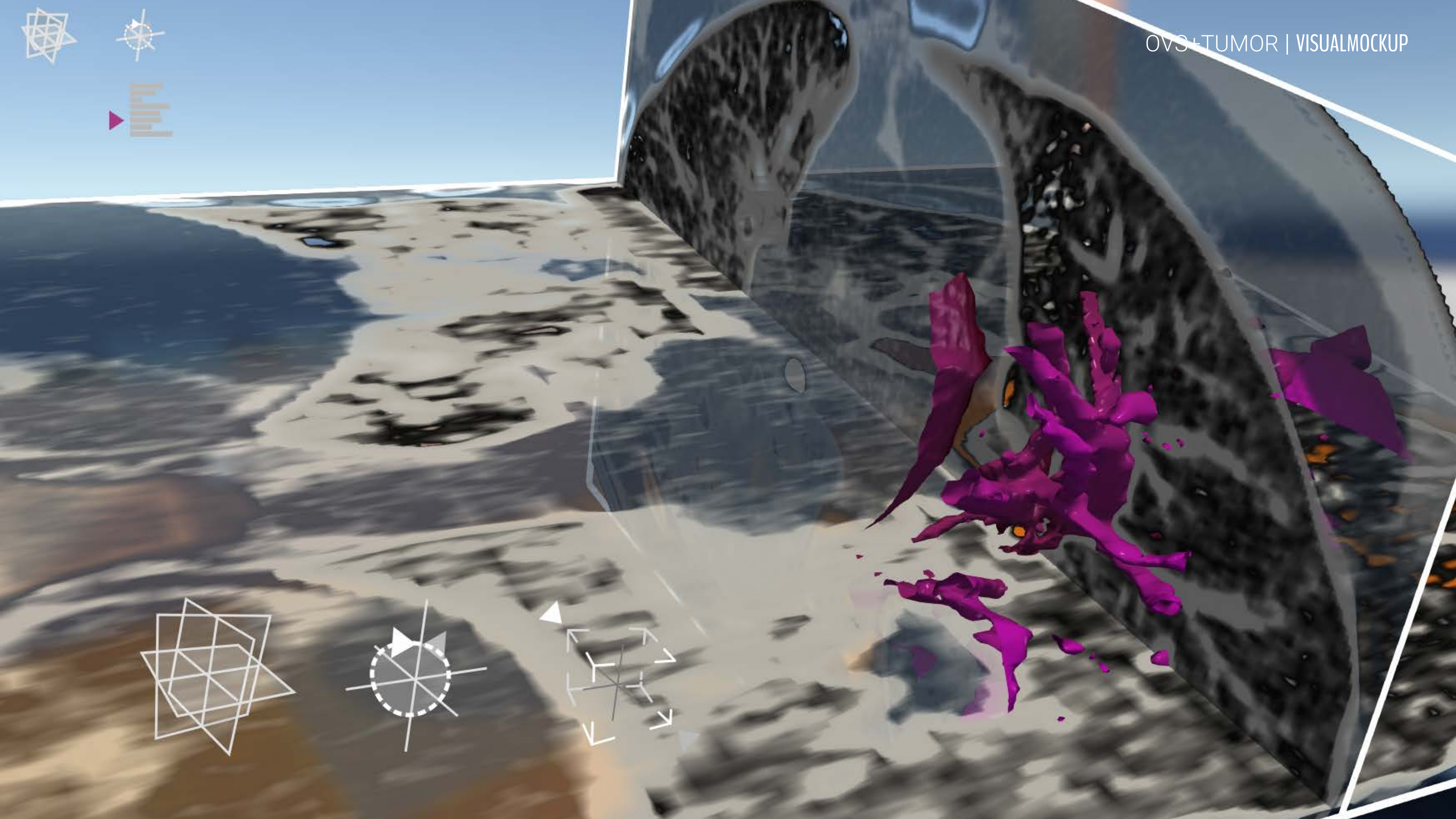


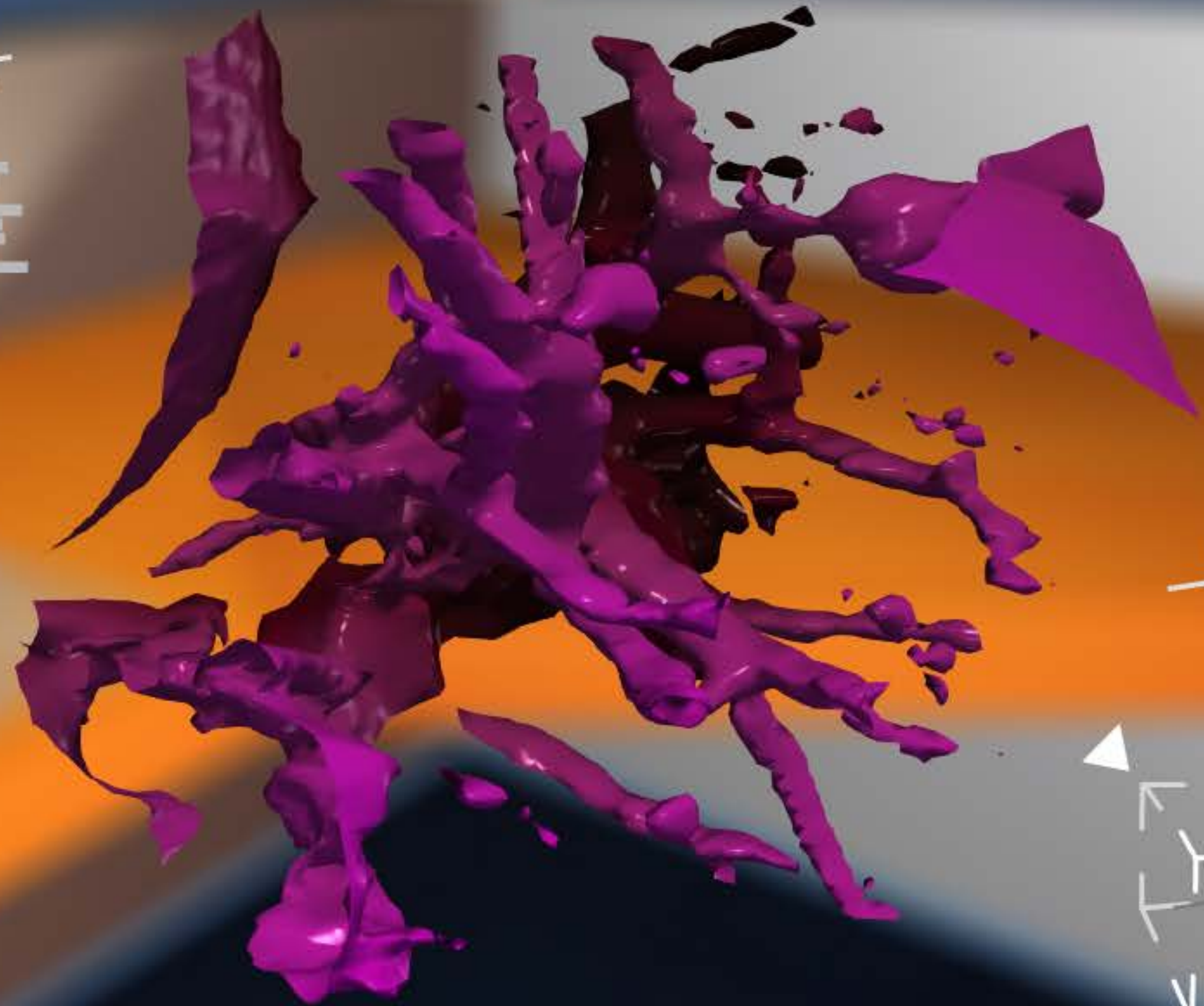


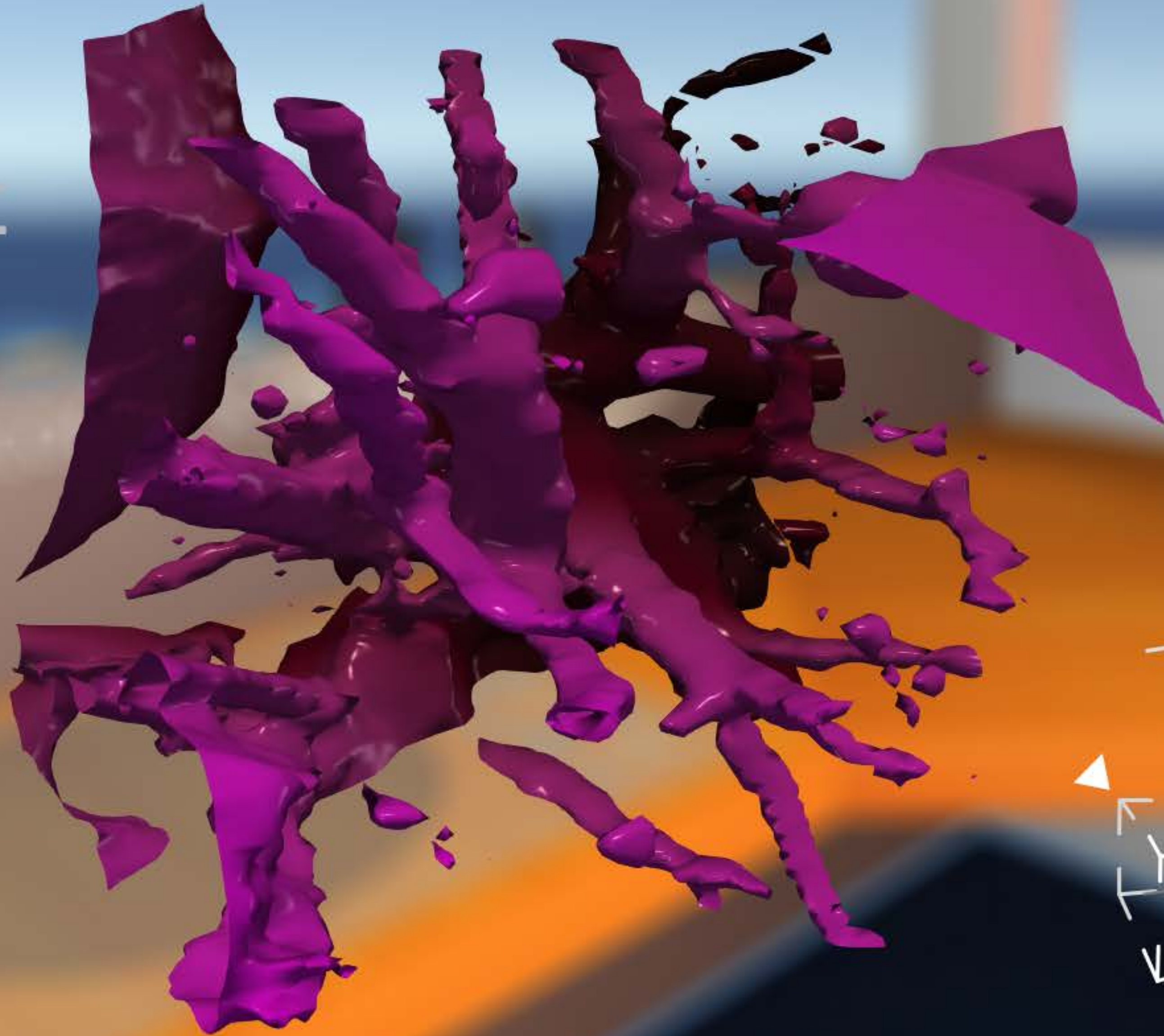


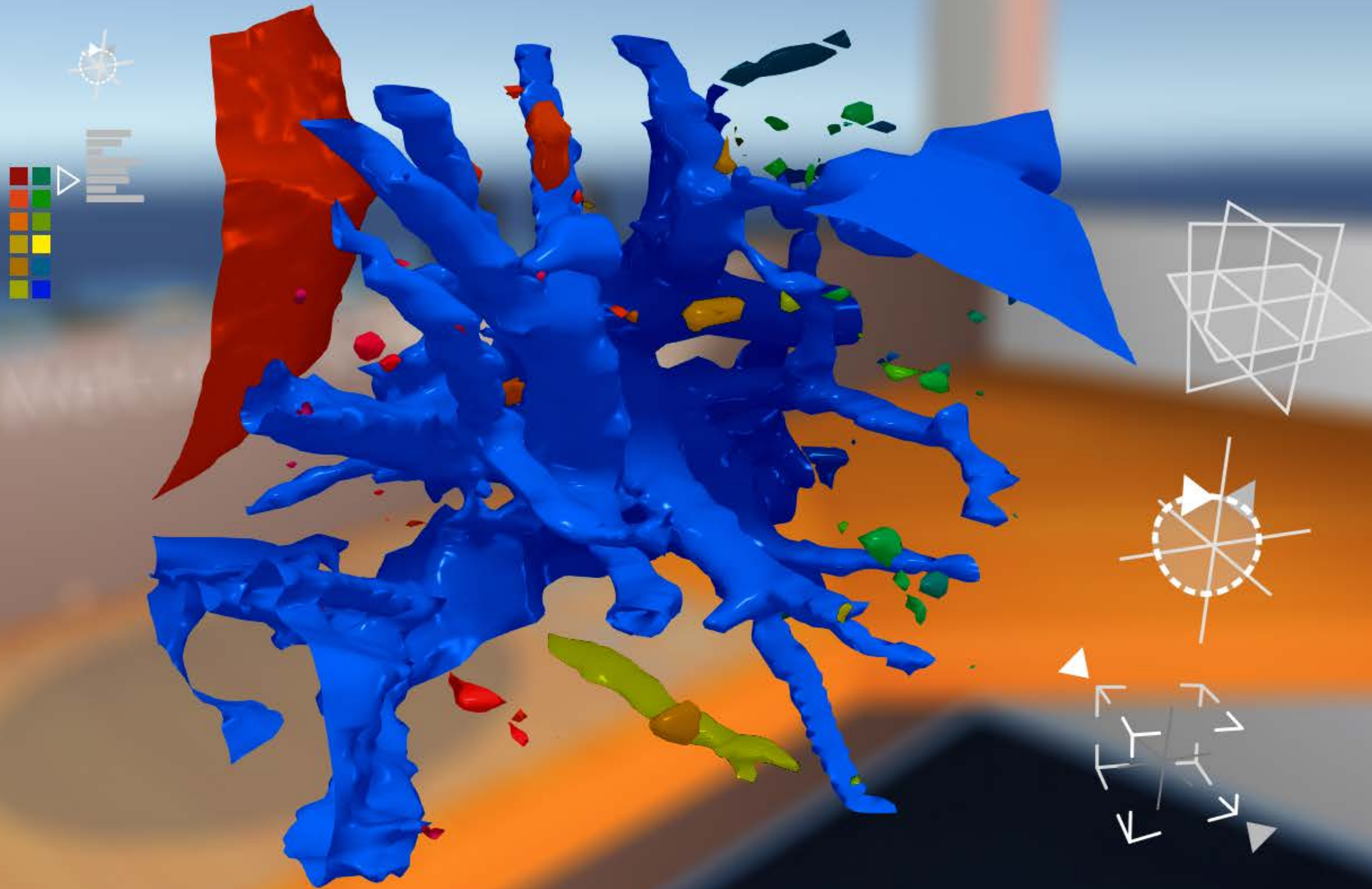


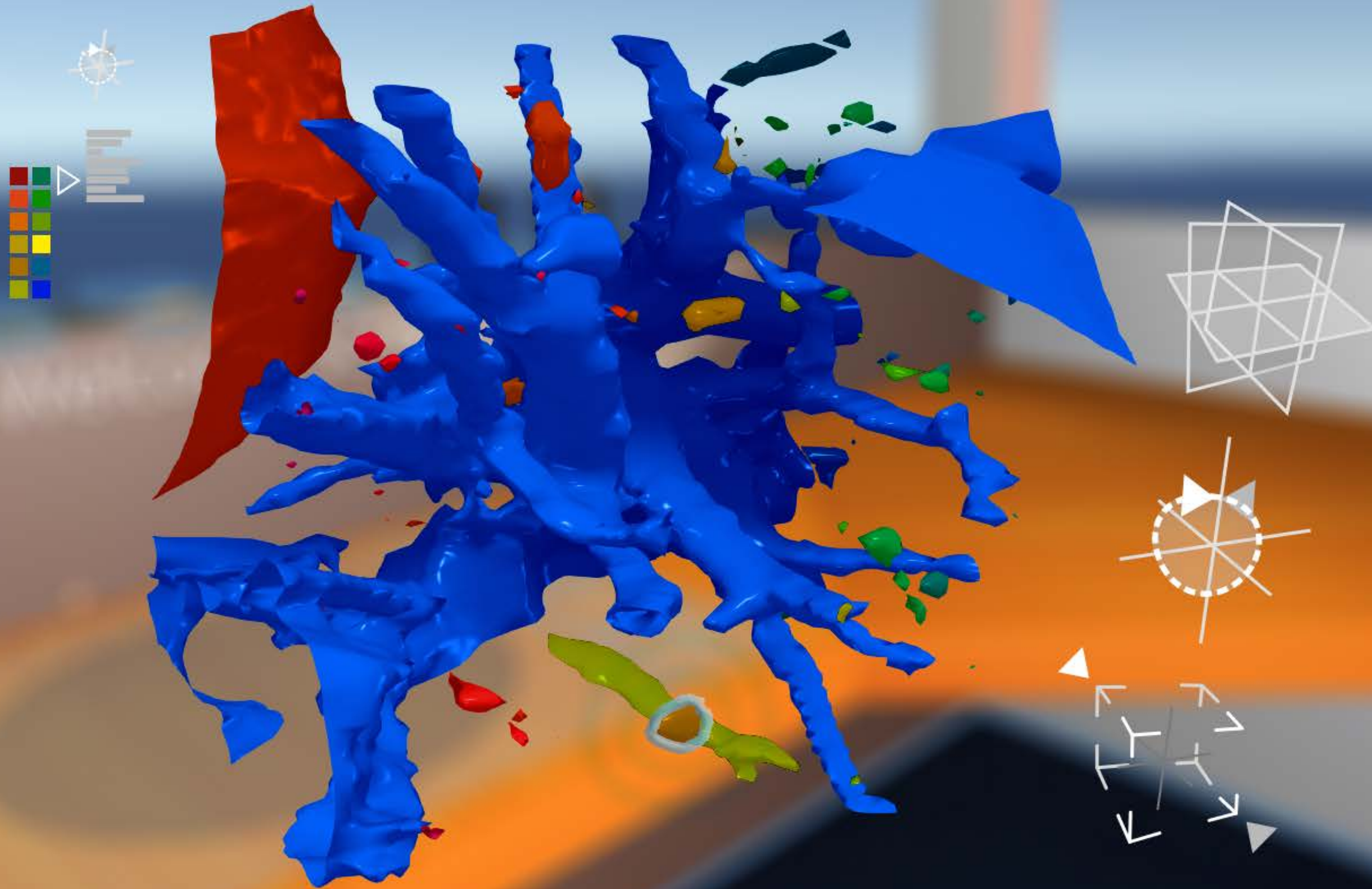












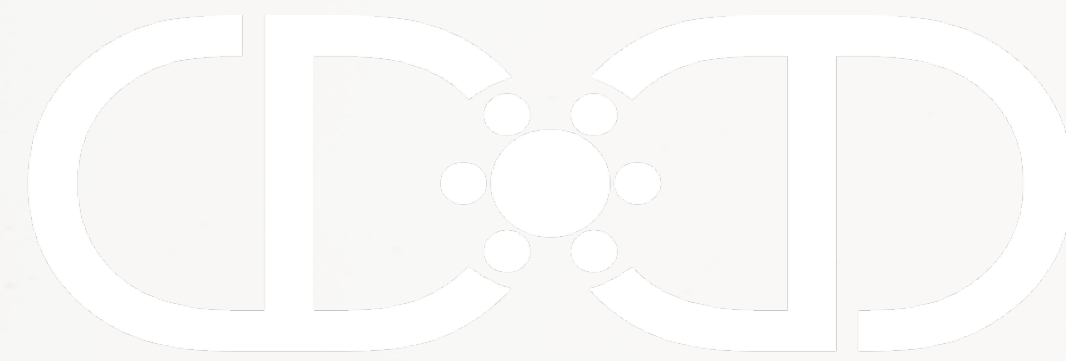
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