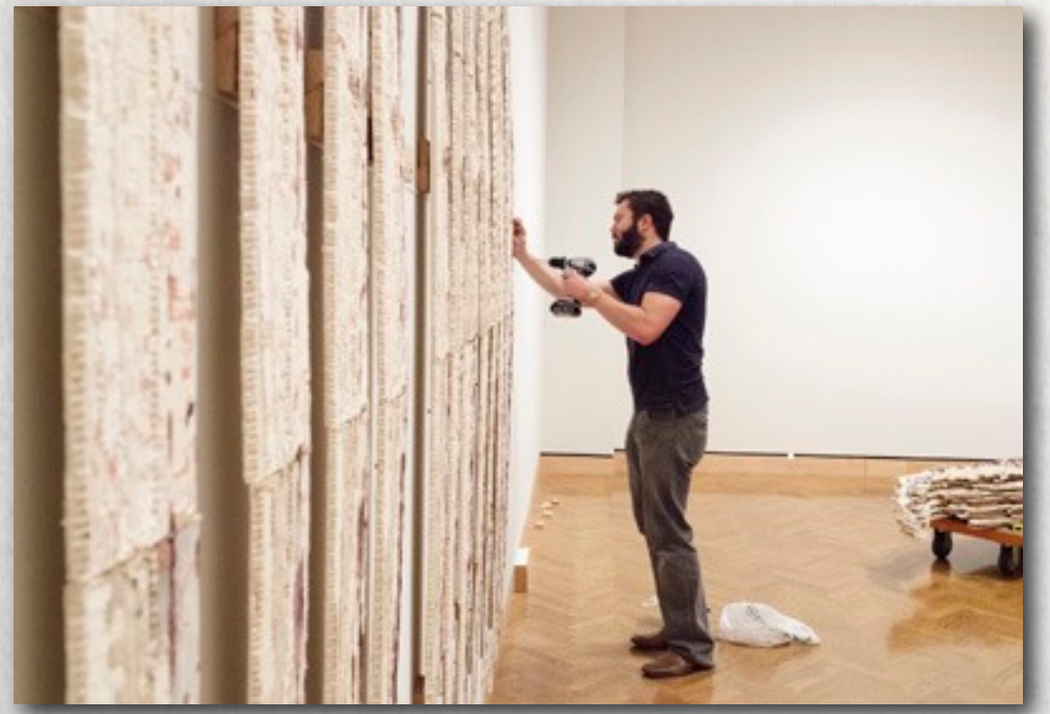
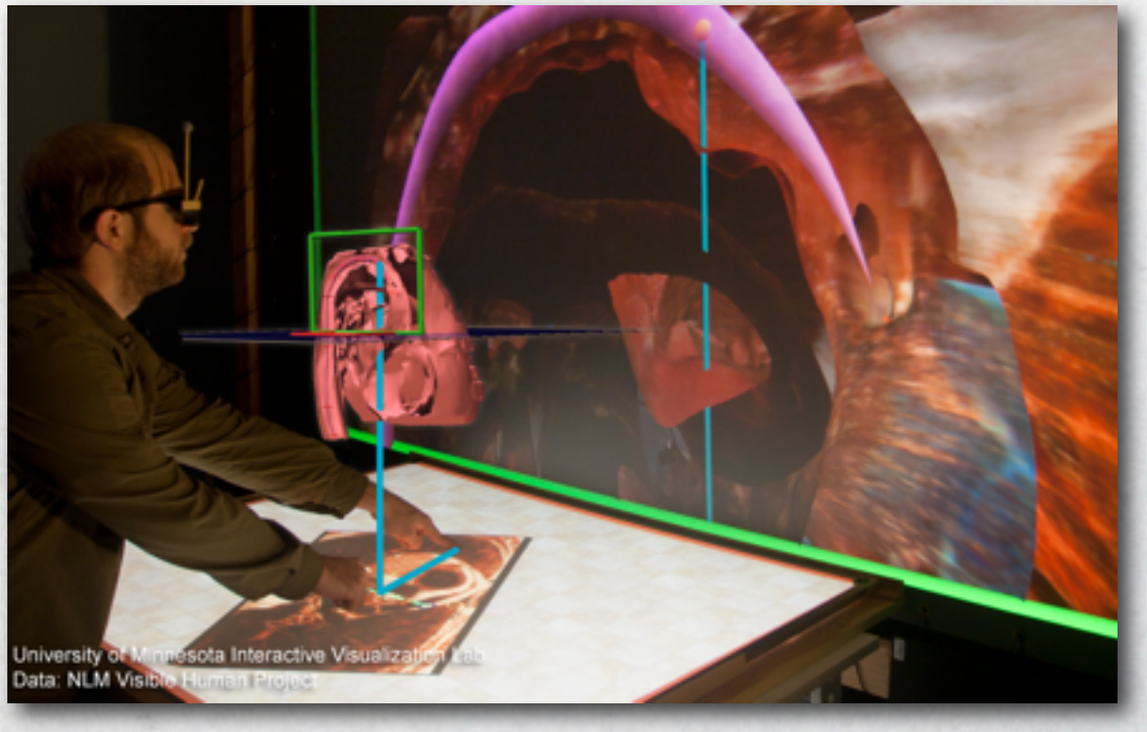
Data and Illusion in Virtual and Physical Worlds

or

What Luke Aleckson's Work Means to a Computer Scientist





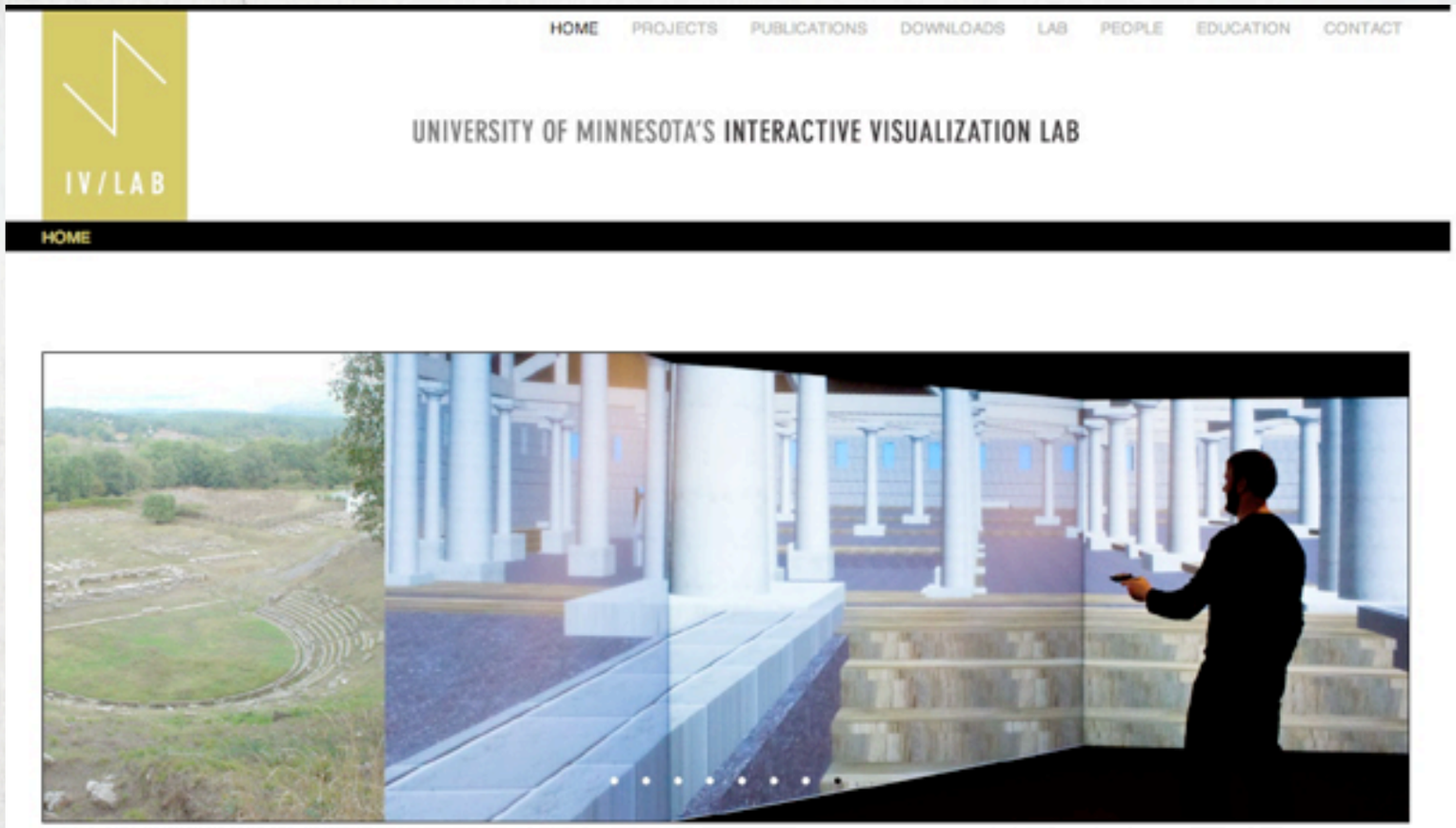
Daniel Keefe

McKnight Land-Grant Assistant Professor

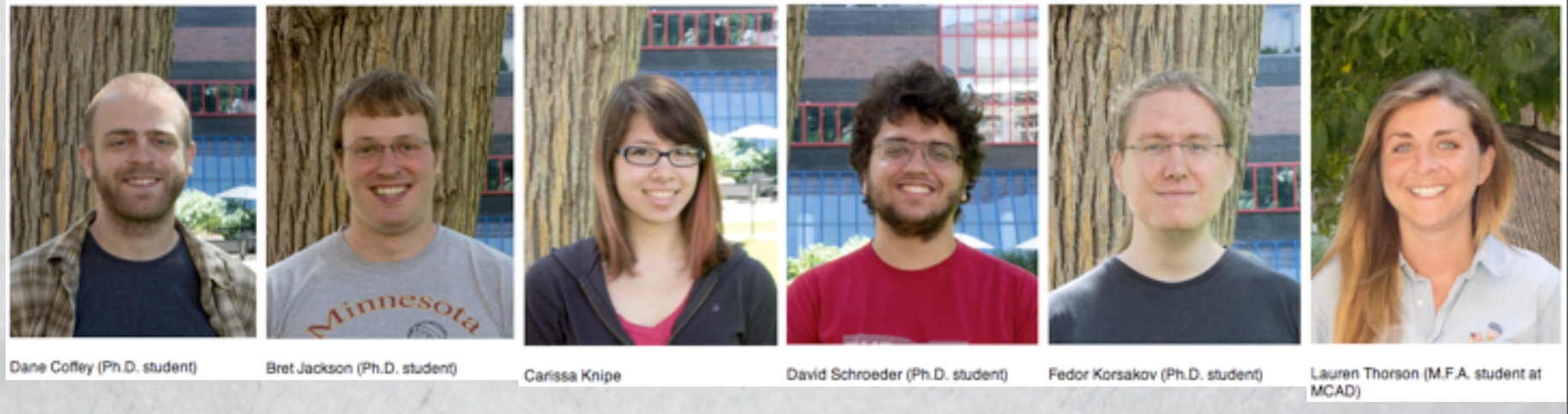
Department of Computer Science and Engineering

University of Minnesota

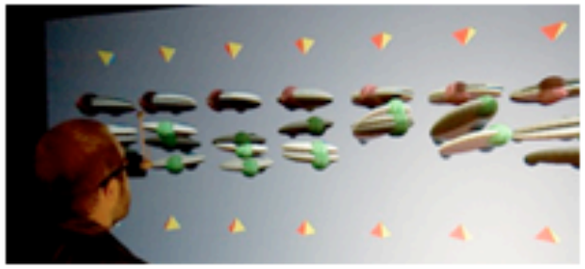
http://ivlab.cs.umn.edu



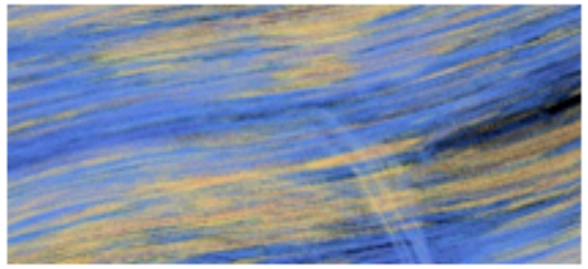
Students



Research Projects



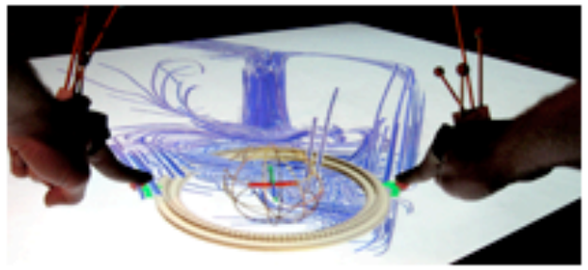
NSF CAREER: Visualizing Scientific Motions



National Academies / Keck Foundation: Intelligent Interactive Imaging (3I)

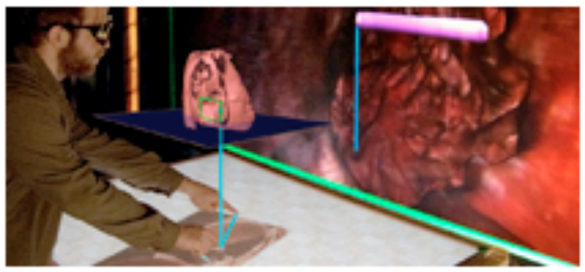
Art and Design in Visualization

3D Modeling, CavePainting, and Drawing on Air



3D User Interfaces (Multi-Touch, Haptics, Virtual Reality)

Next Generation Immersive Visualization Environments

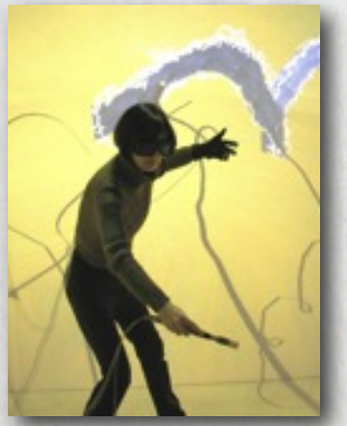


Virtual Prototyping of Medical Devices

Virtual Classics

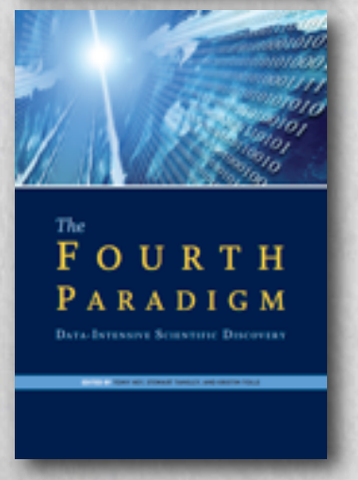
Data-Driven Surgical Training

Today: 3 Common Themes



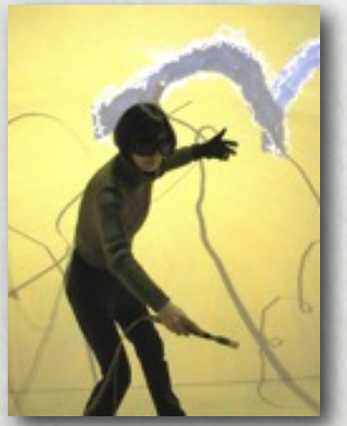
Linking the Virtual and the Physical

3D Vision, Illusion, and Multiple Scales



Art, Data, Information, and Aesthetics: Tension or Insight?

Today: 3 Common Themes



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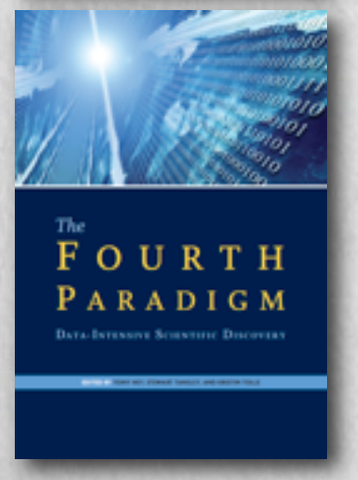


Art, Data, Information, and Aesthetics: Tension or Insight?

The C.A.V.E.

The C.A.V.E.

CAVE Automated Virtual Environment

The C.A.V.E.

CAVE Automated Virtual Environment

U.N.P.A.C.

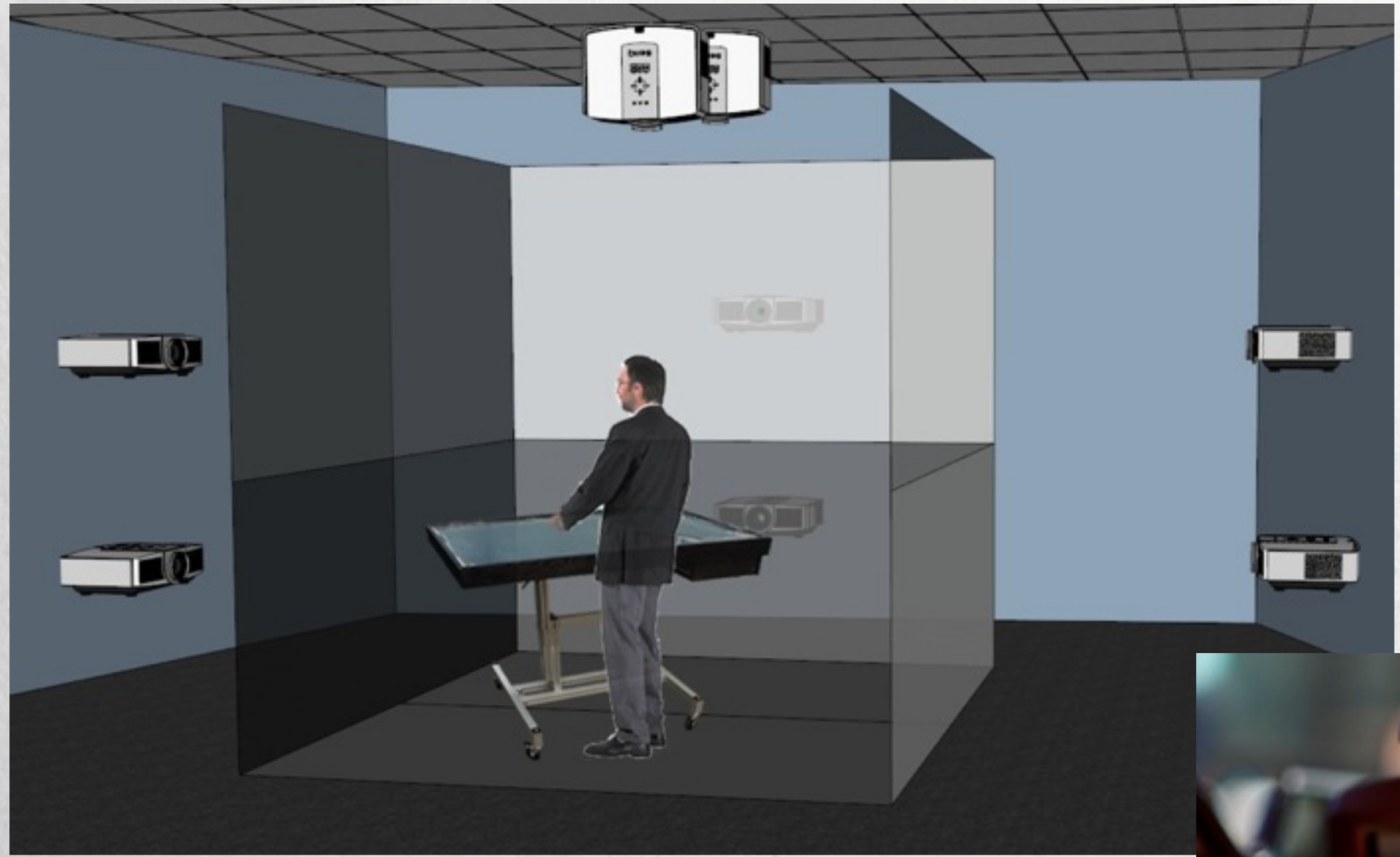
The C.A.V.E.

CAVE Automated Virtual Environment

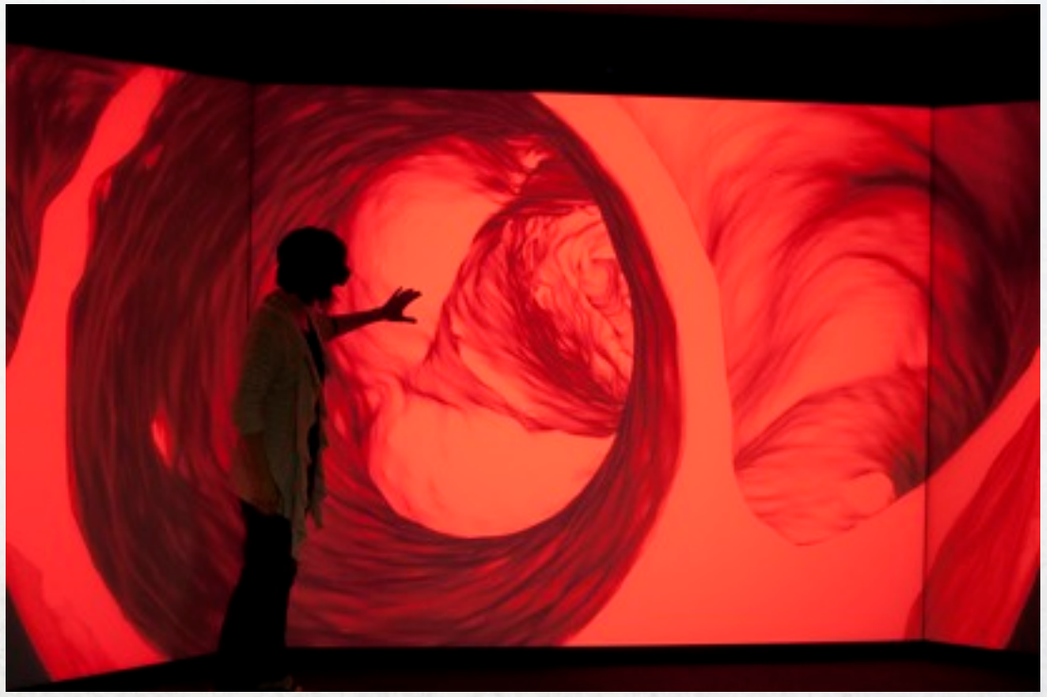
U.N.P.A.C.

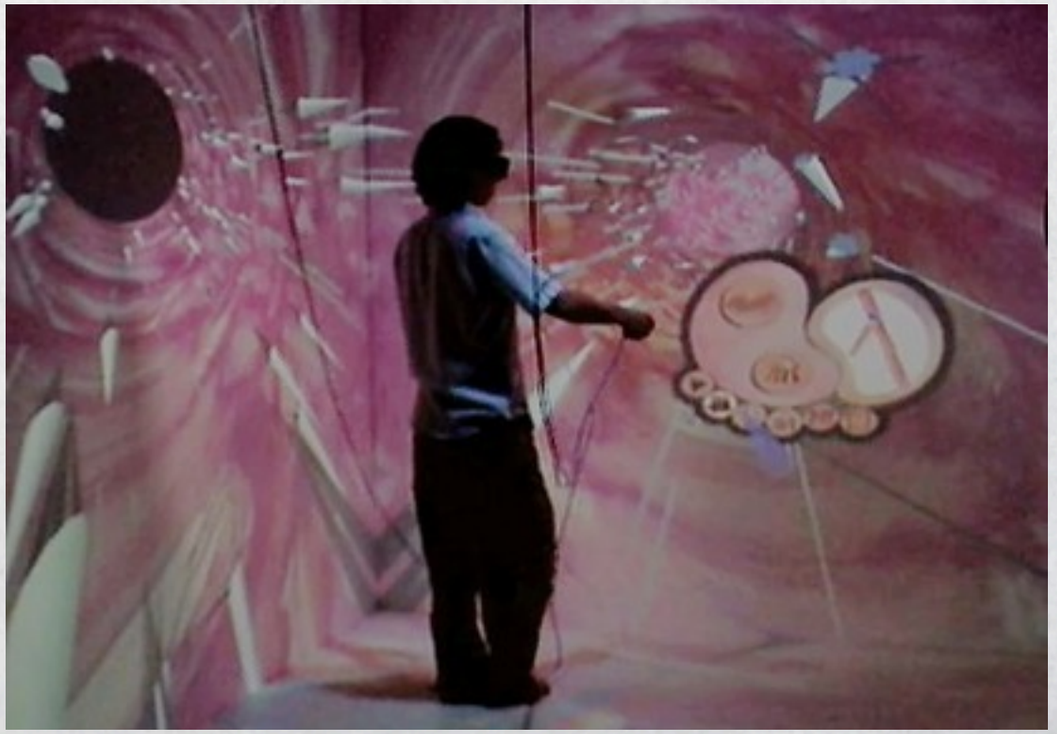
Uniform Non-Coding Parallax Autostereogrammic Cyclopti-crypograms

The CAVE: A Virtual World Made of Computer Graphics



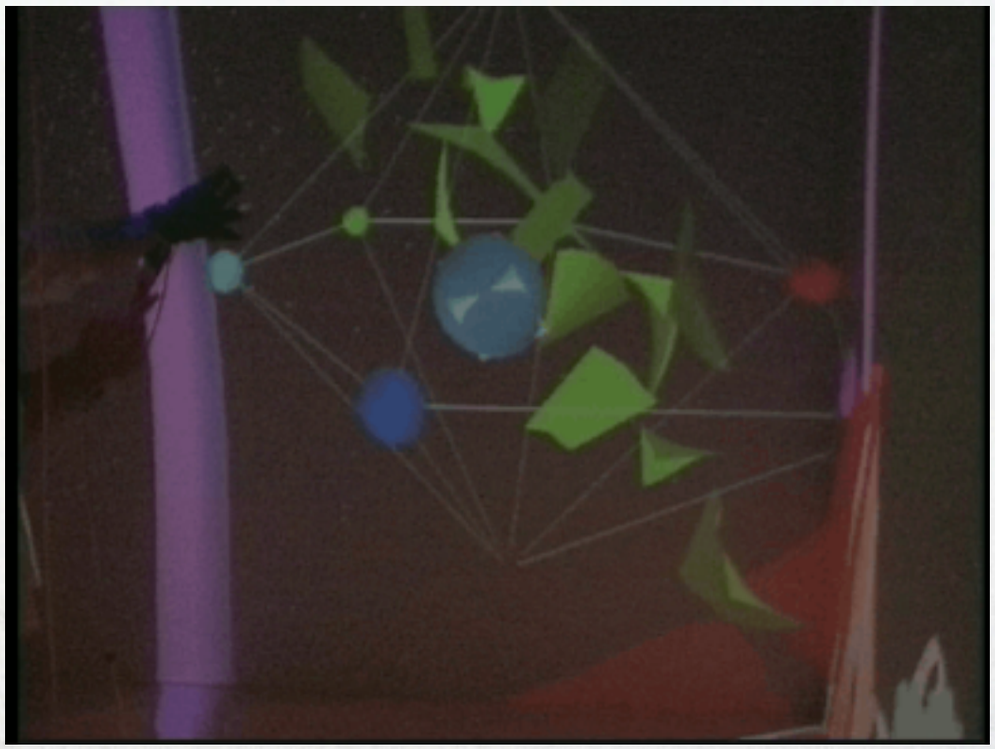
Virtual Worlds for Science





Virtual reality environments at Brown University and the University of Minnesota

CavePainting

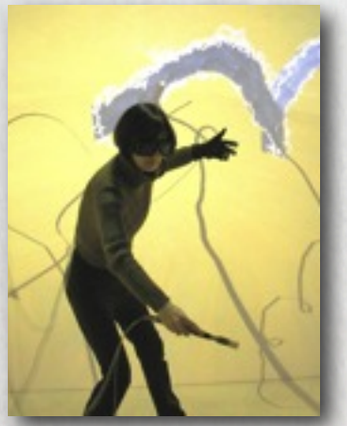


Dancer: Kevin Aldeman

Daniel F. Keefe, Daniel Acevedo Feliz, Tomer Moscovich, David H. Laidlaw, and Joseph J. LaViola Jr.
CavePainting: A fully immersive 3D artistic medium and interactive experience. In Proceedings of I3D 2001, pages 85–93, 2001.

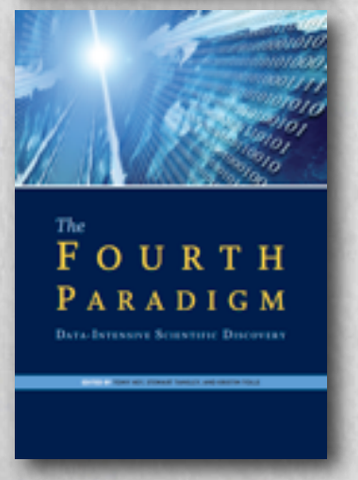
Surrounding Us:
Linked Virtual and Physical Worlds

Today: 3 Common Themes



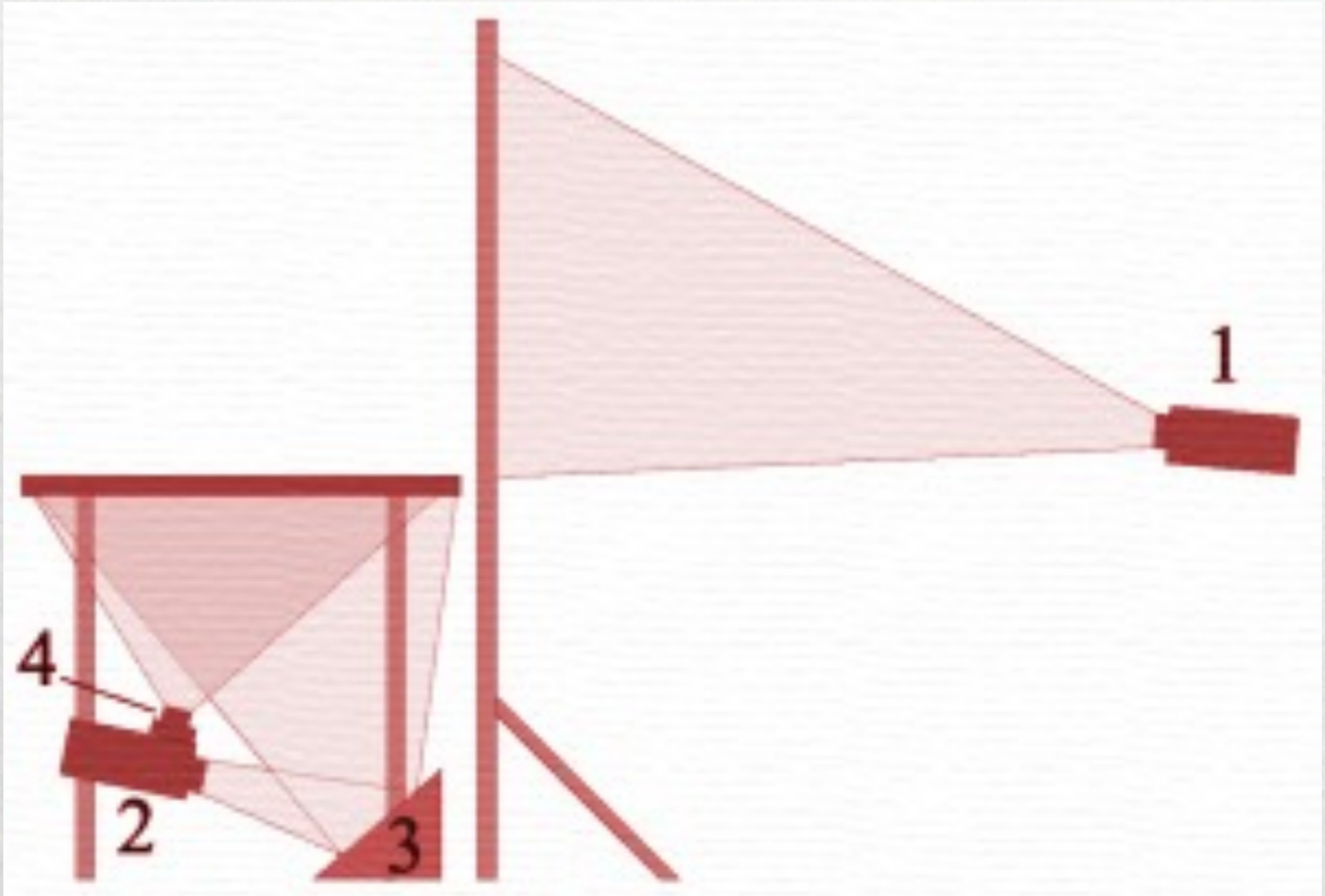
Linking the Virtual and the Physical

3D Vision, Illusion, and Multiple Scales



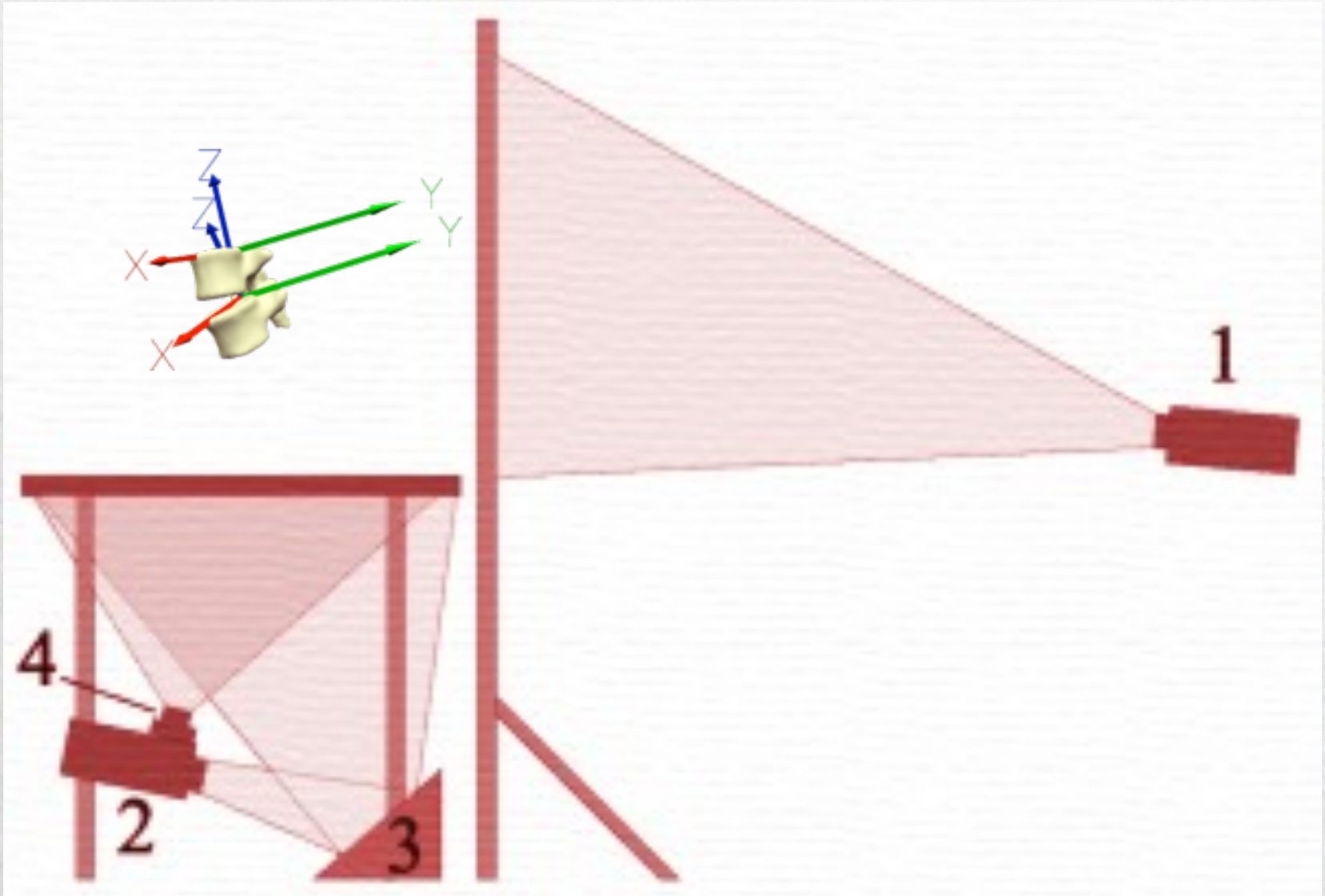
Art, Data, Information, and Aesthetics: Tension or Insight?

Another 3D Computer Graphics Environment



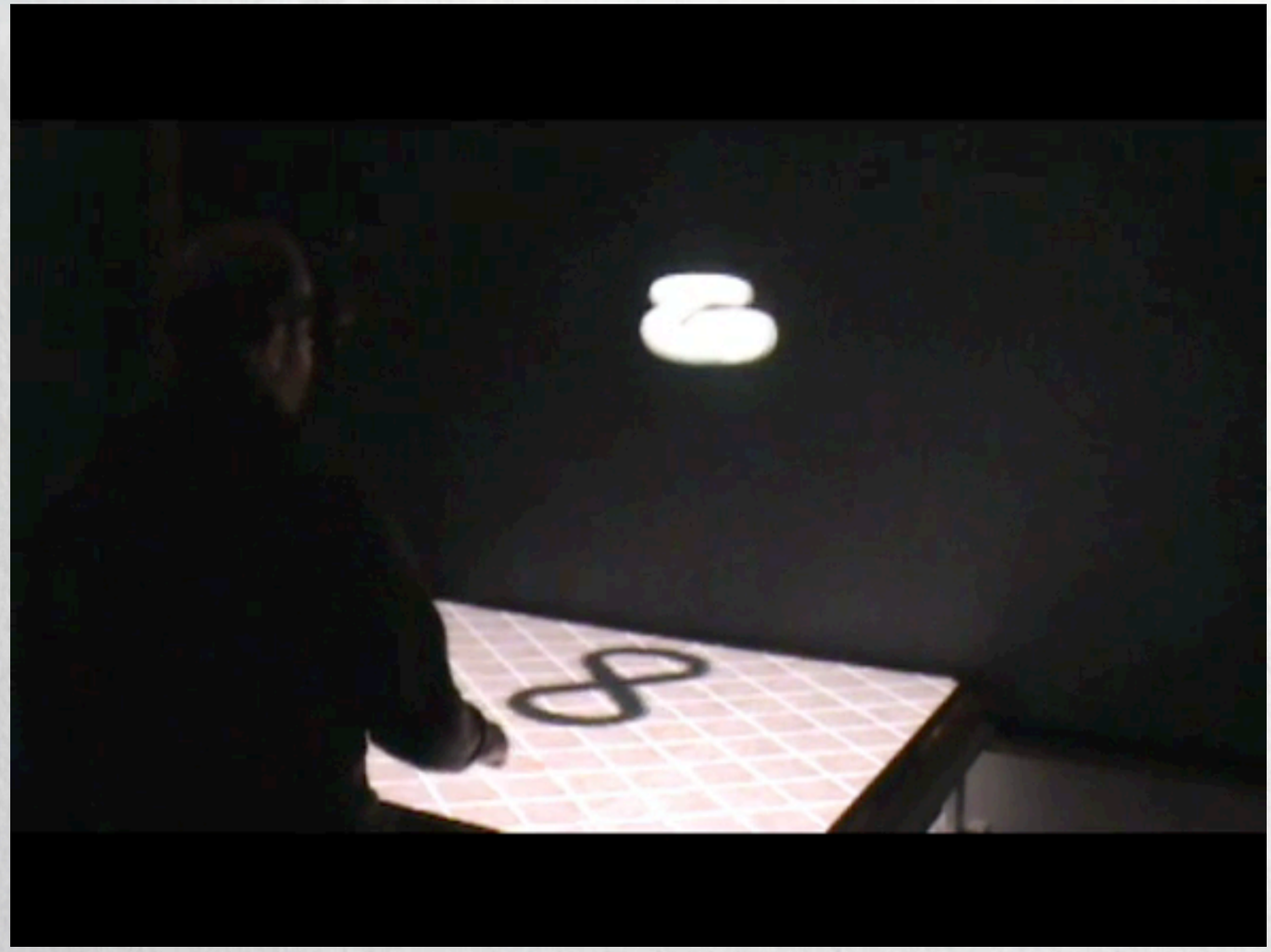
Coffey et al., Low Cost VR Meets Low Cost Multi-touch. In Proceedings of International Symposium on Visual Computing, Springer LNCS 6453, pages 351–360, 2010.

Another 3D Computer Graphics Environment



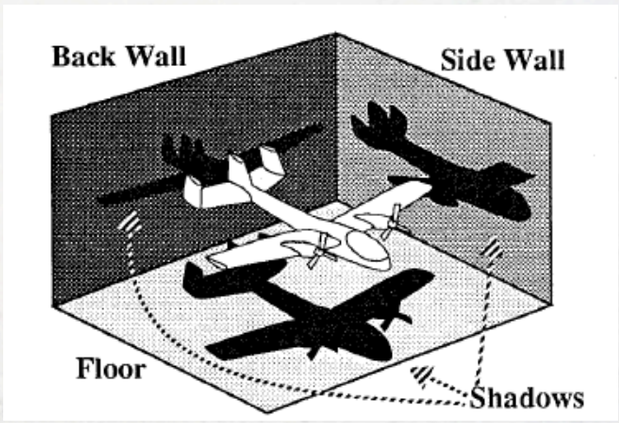
Coffey et al., Low Cost VR Meets Low Cost Multi-touch. In Proceedings of International Symposium on Visual Computing, Springer LNCS 6453, pages 351–360, 2010.

Useful Illusion: Touching Virtual Shadows

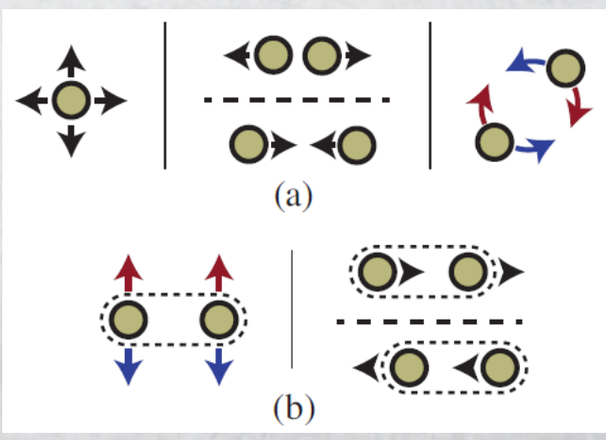


Inspiration:

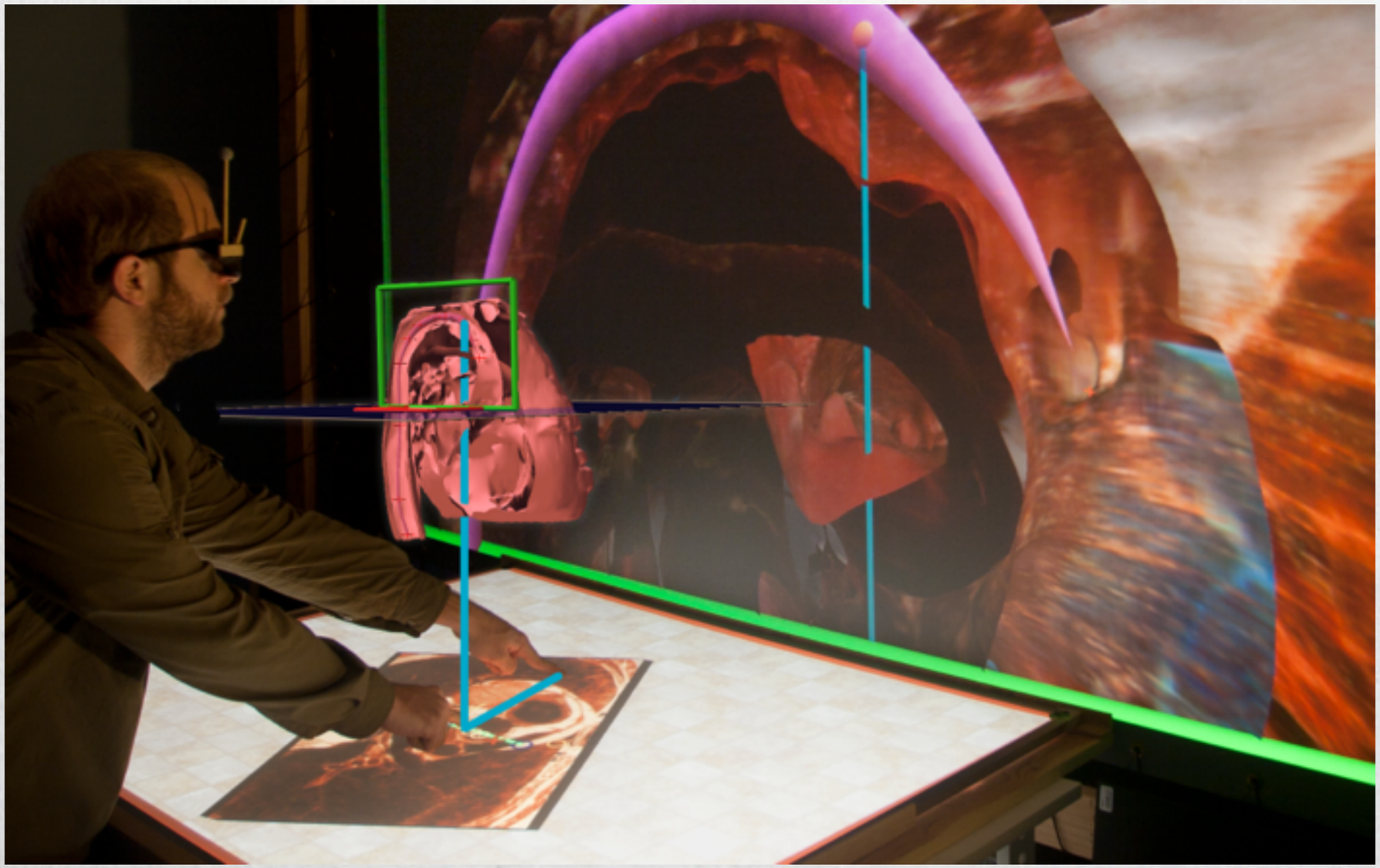
Interactive Shadows
Herndon et al. 1992



Multi-touch gestures
(a) trans, rot, scale parallel to table
(b) pitch, roll out of plane

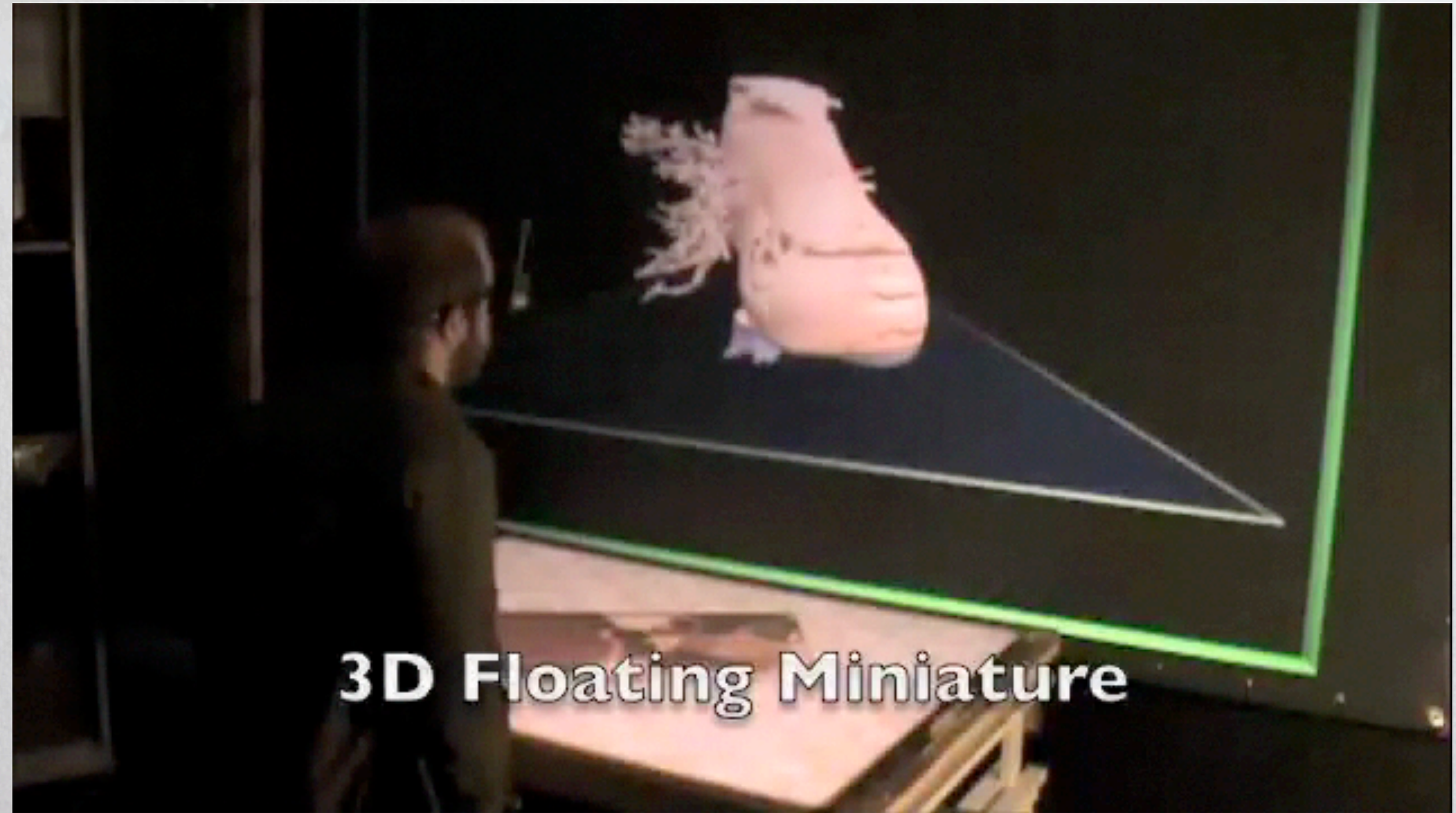


Exploring a 3D Virtual Heart at Multiple Scales



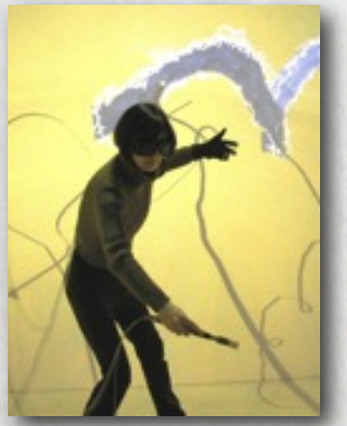
Coffey et al., Interactive SliceWIM: Navigating and Interrogating Volume Datasets Using a Multi-Surface, Multi-Touch VR interface. IEEE Transactions on Visualization and Computer Graphics, 2012.

Data: National Library of Medicine, Visible Human Project: http://www.nlm.nih.gov/research/visible/visible_human.html


3D Floating Miniature

Surrounding Us:
3D Vision, Useful Illusion, Multiple Scales and Patterns, Multiple Complementary Views of Data

Today: 3 Common Themes



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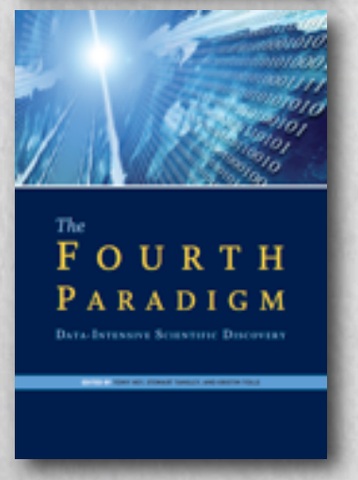
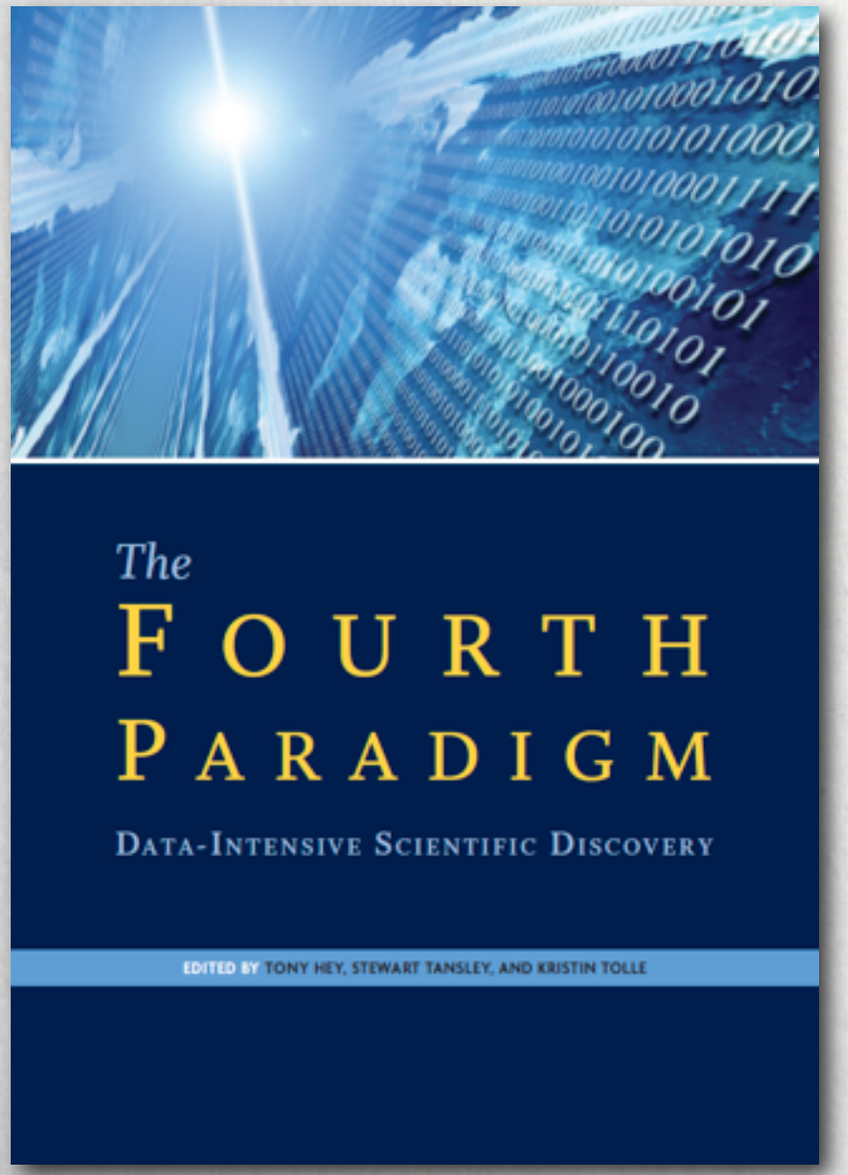
3D Vision, Illusion, and Multiple Scales



Art, Data, Information, and Aesthetics: Tension or Insight?

Data-Intensive Science and Engineering: A New Paradigm

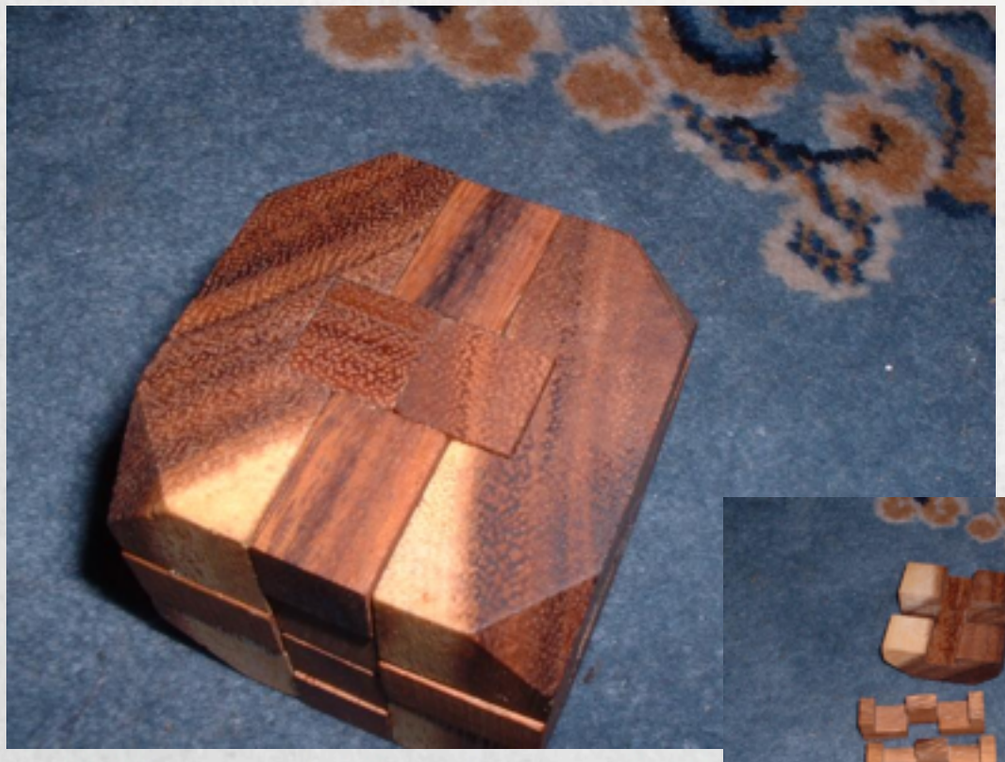


How do we move from data to insight?

- Rather than looking through telescopes, we are now looking through large-scale, complex simulations and instruments.
- Knowledge is stored in a computer in the form of massive, multidimensional datasets.
- Scientists/engineers analyze using data management, statistics, and visualization.
- Disciplines must adjust; new tools are needed to manage, organize, share, query, visualize, document, validate, and preserve data.

"From Data to Insight"

These images convey similar data… but my reaction to them is very different than what I feel in this gallery space.



Wikipedia 'burr puzzle'

One of about 81,600 results (0.25 seconds) from a Google Image search.

Surrounding Us:
Art, Data, Information, Aesthetics -
An Exciting (Insightful) Tension

Thanks to

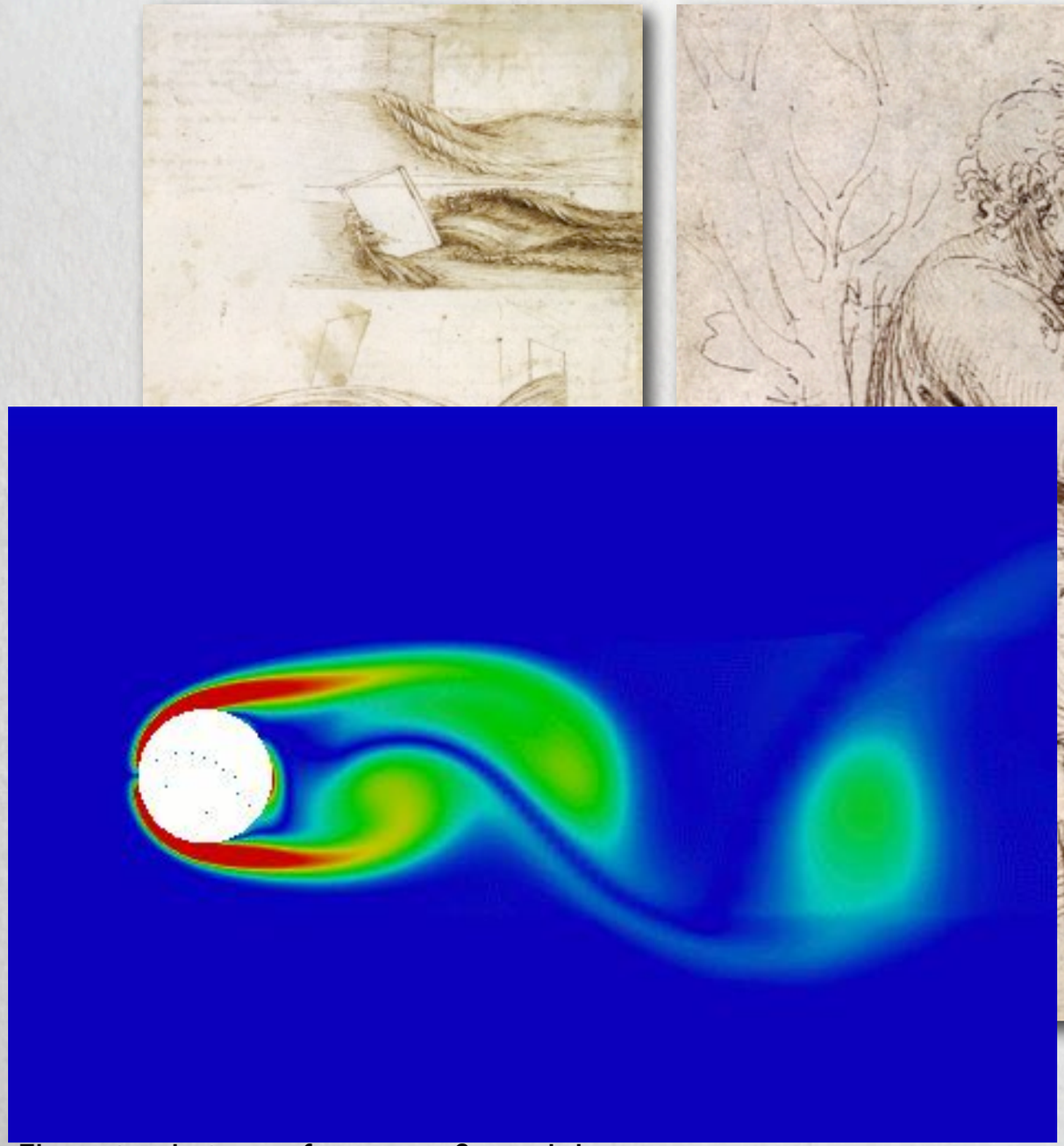
Dane Coffey, Bret Jackson, Fedor Korsakov, David Schroeder, Lauren Thorson, Art Erdman, and David Laidlaw.

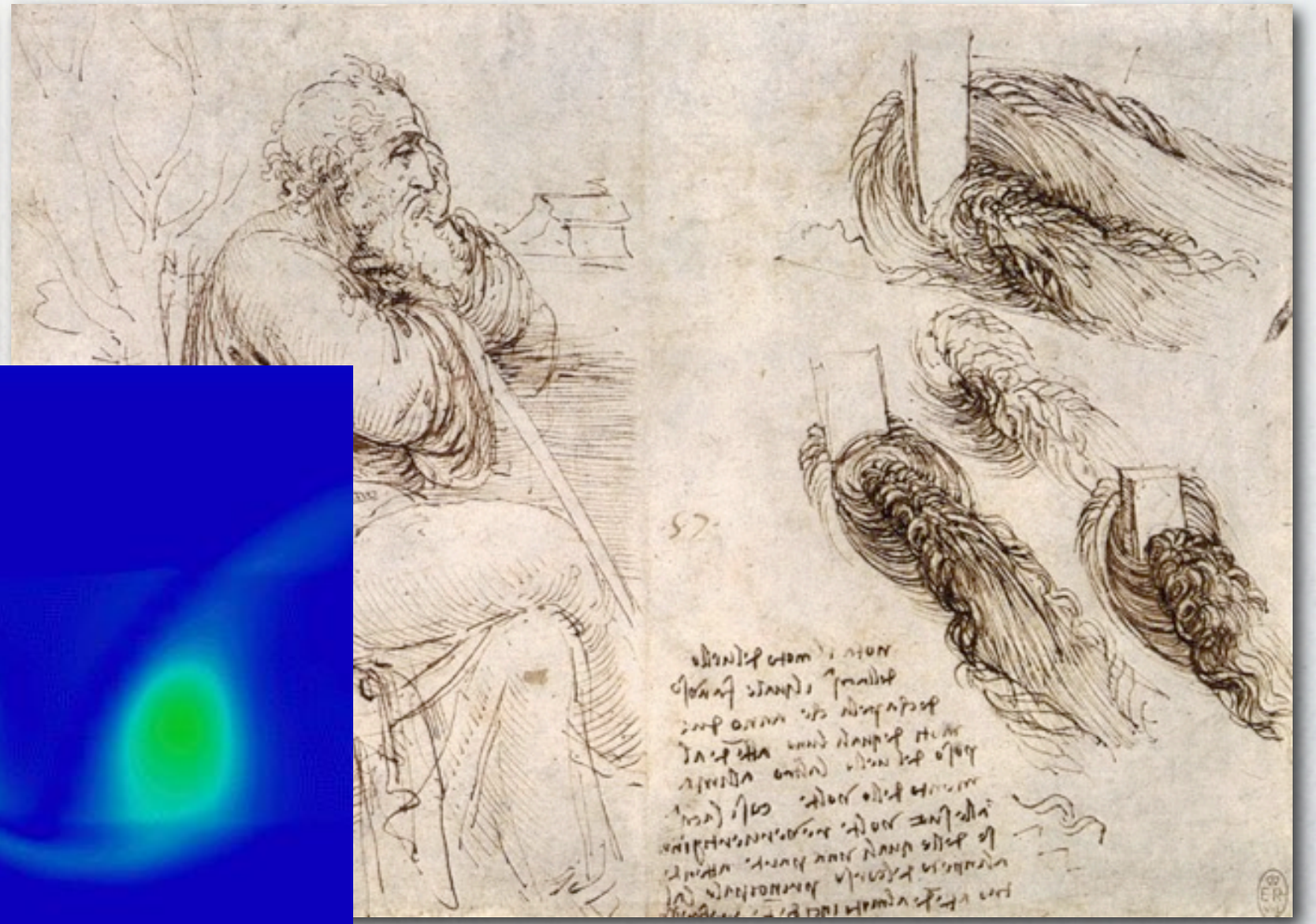
National Science Foundation (Award #1054783 and #1218058)
National Academies and W.M. Keck Foundation
University of Minnesota Digital Technology Center
University of Minnesota Office of VP for Research
Boston Scientific Corporation
NVidia Research
Autodesk Research

Other Examples

Example: Picturing Fluids

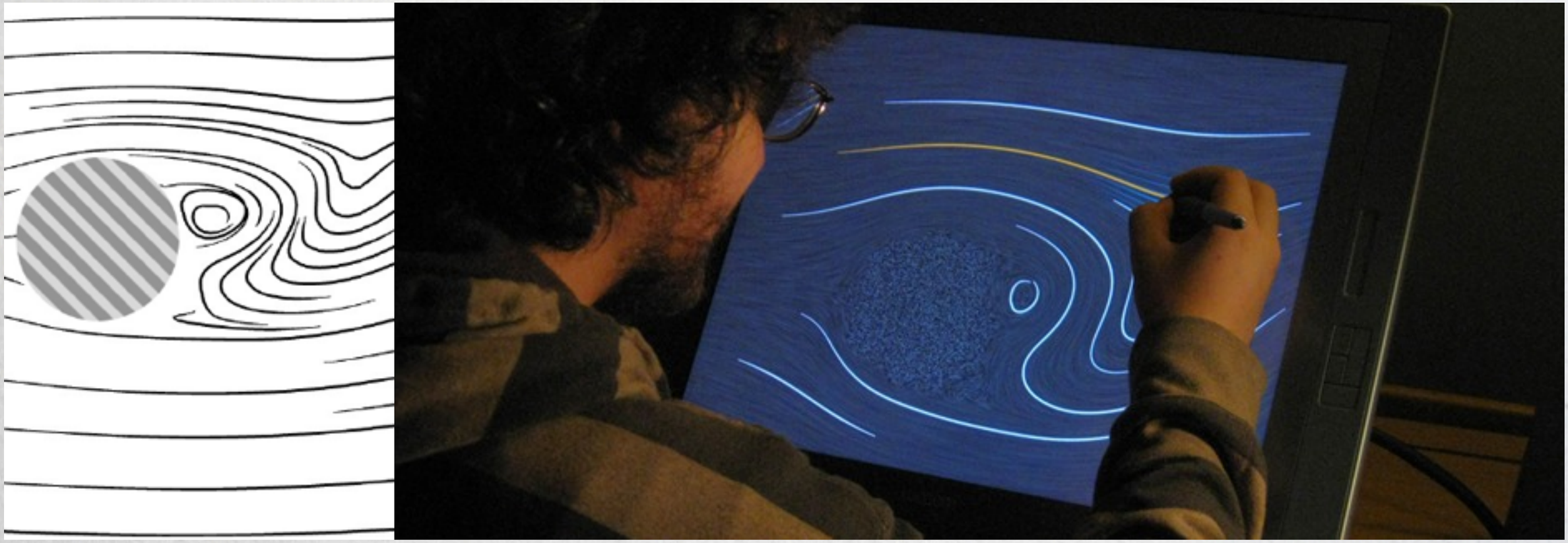
Example: Picturing Fluids





Flow simulation software: mfix.netl.doe.gov

“Drawing with the Flow”



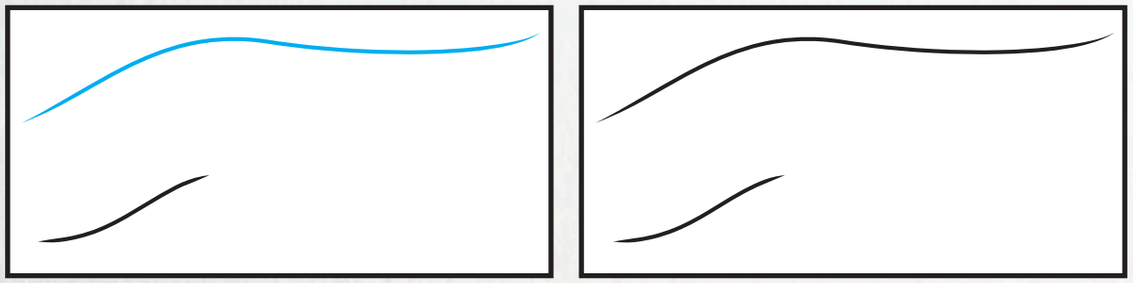
David Schroeder, Dane Coffey, Daniel F. Keefe. Drawing with the Flow: A Sketch-Based Interface for Illustrative Visualization of 2D Vector Fields In Proceedings of ACM SIGGRAPH/Eurographics Sketch-Based Interfaces and Modeling 2010, 2010.

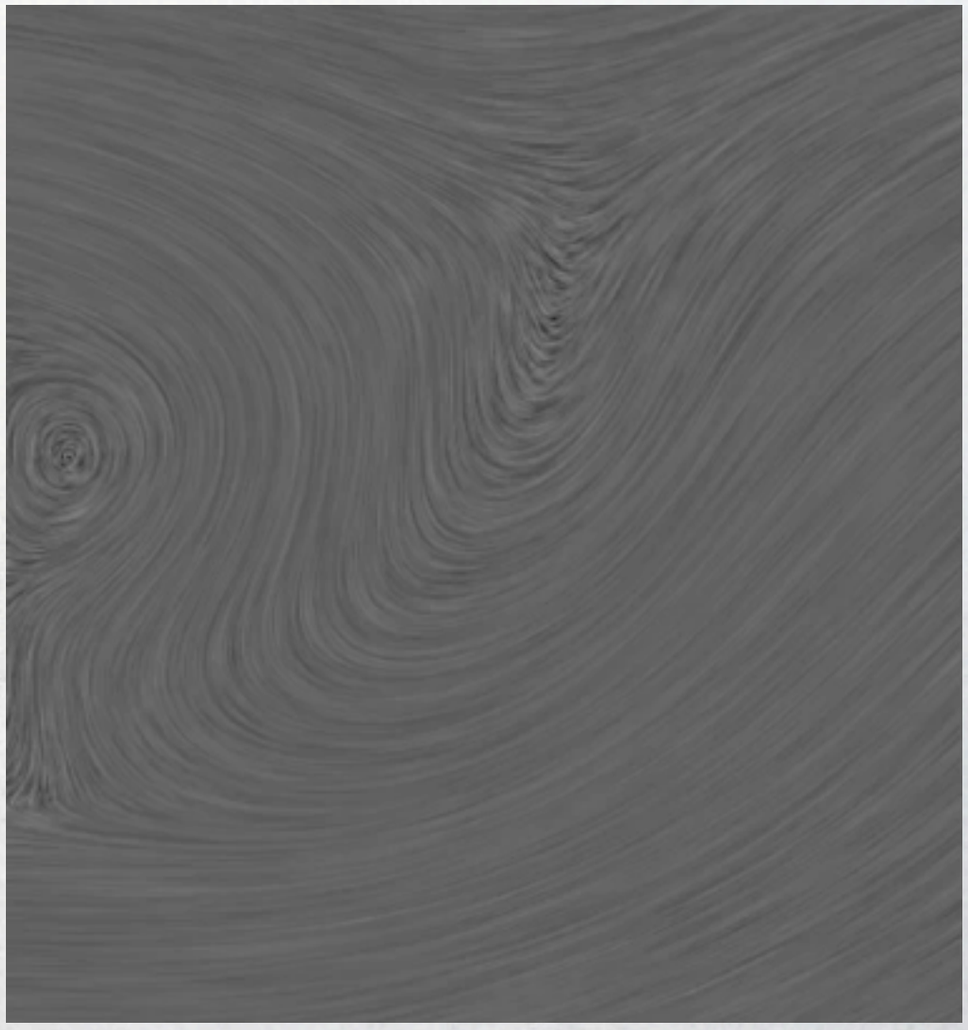
Data thanks to Mike Kirby and David Laidlaw

Streamline Gesture Set

Streamline Gesture Set

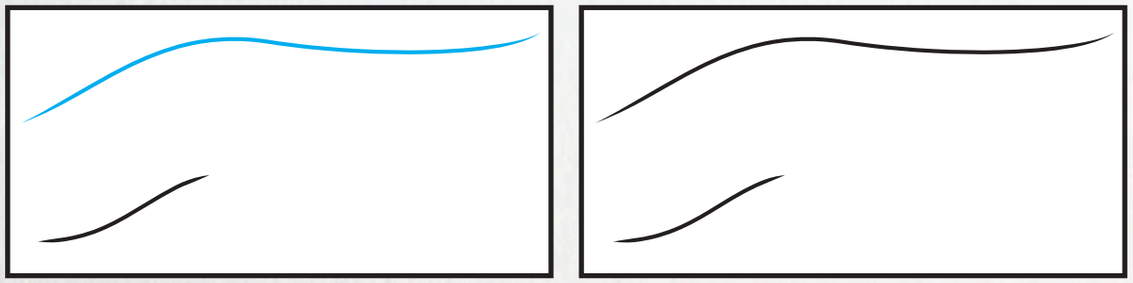
New



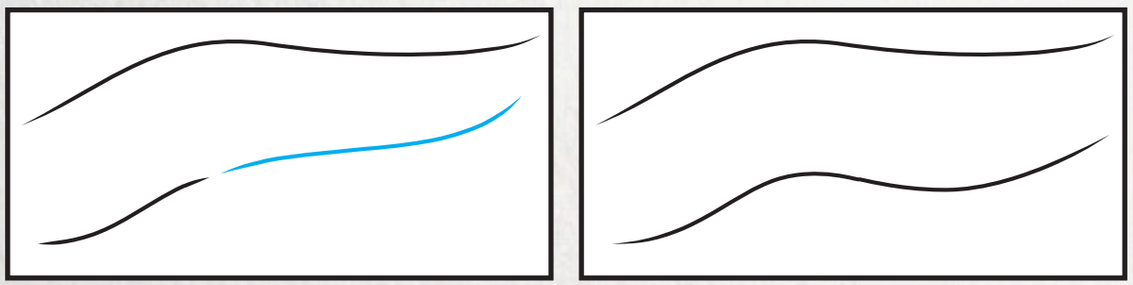


Streamline Gesture Set

New



Extend

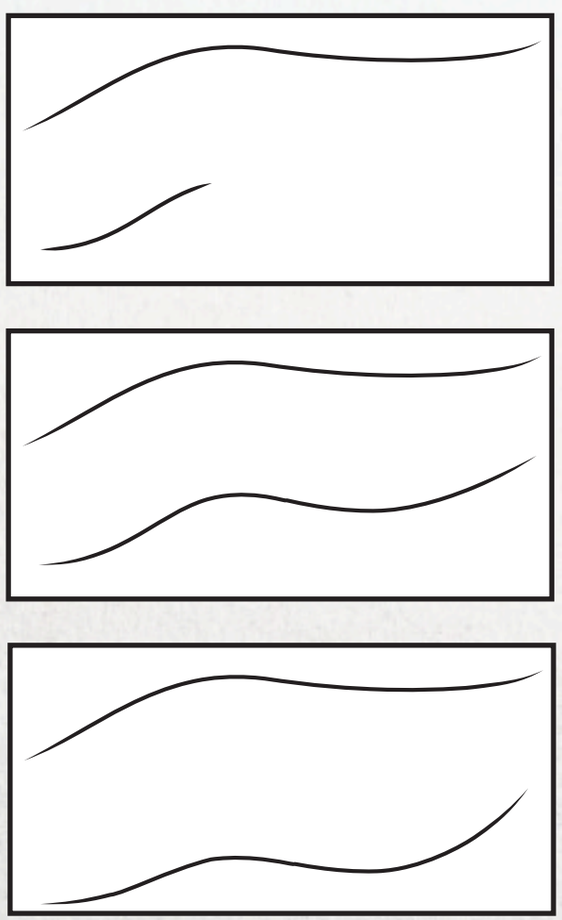


Streamline Gesture Set

New

Extend

Refine



Streamline Gesture Set

New

Extend

Refine

Crop

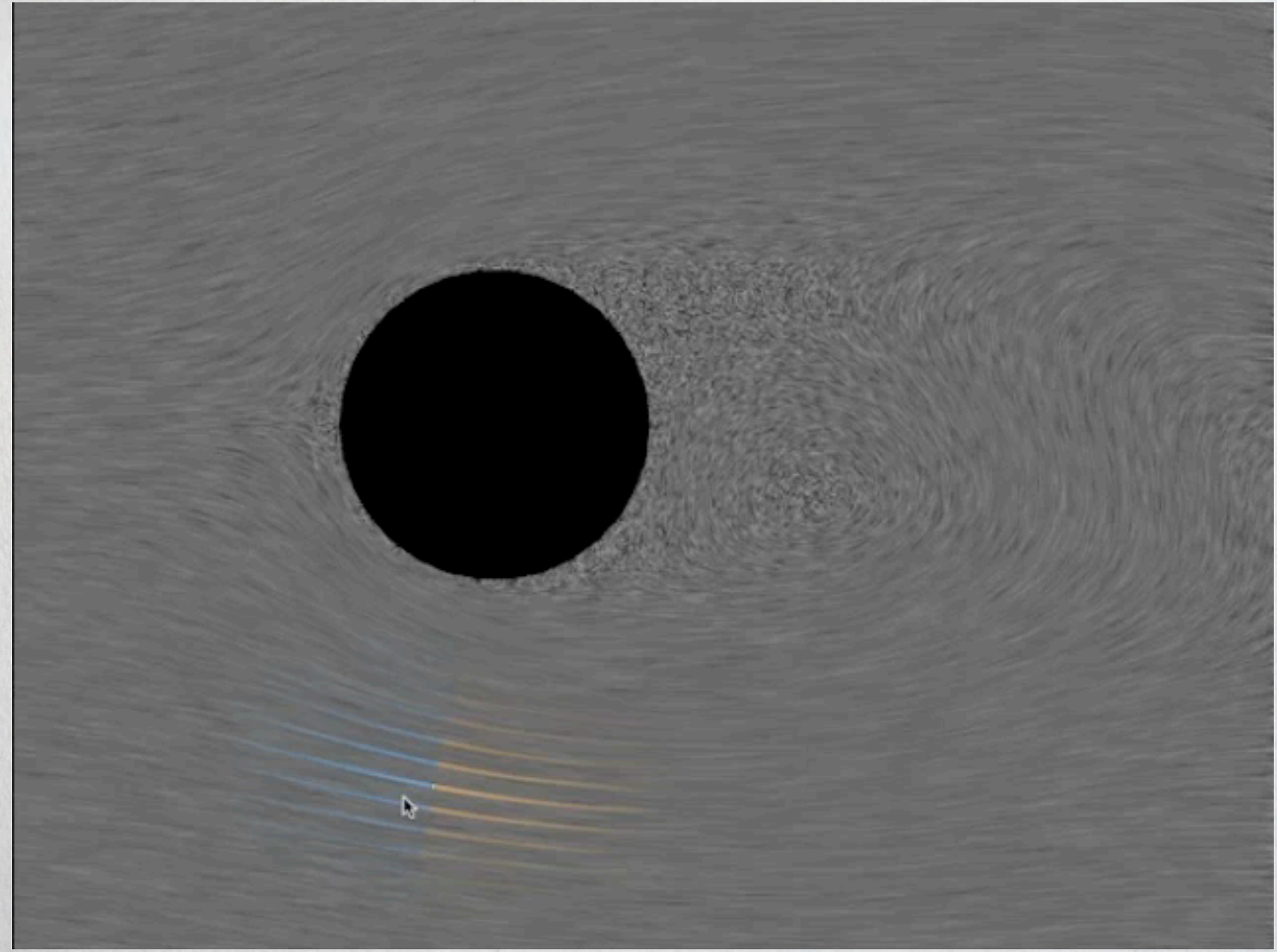
Streamline Gesture Set

New

Extend

Refine

Crop

Delete

IV/LAB