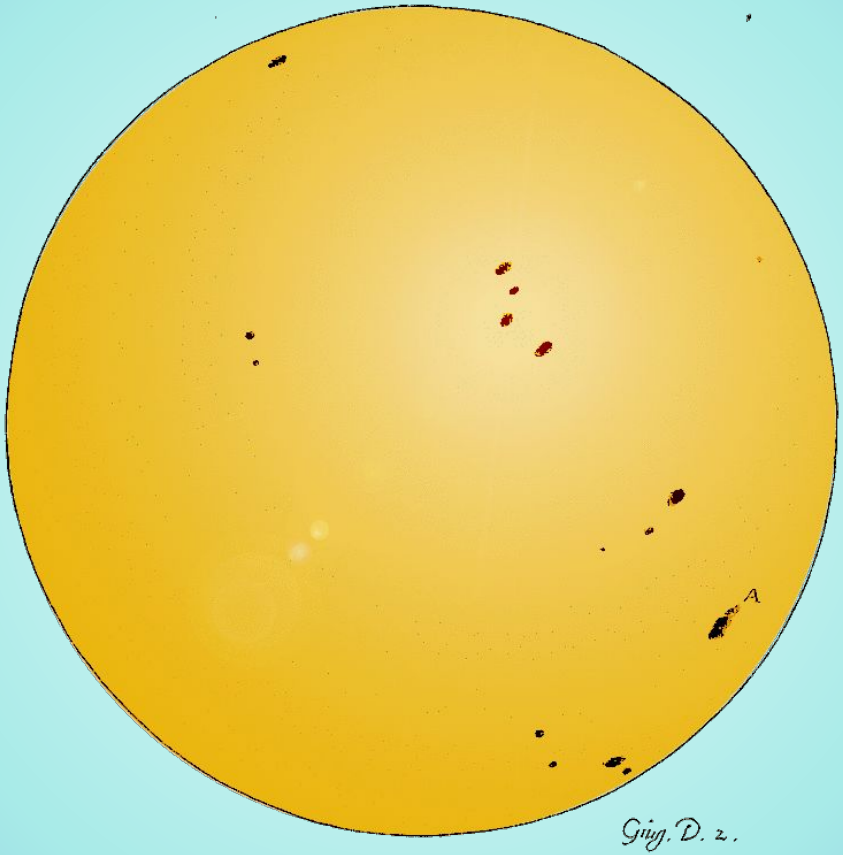
santiago
CENTER FOR DATA-DRIVEN DISCOVERY
Caltech
ArtCenter

galileo | 1612



IMAGES COURTESY OF GALILEO PROJECT: SUN SPOTS | ANIMATION AND COLORING BY SANTIAGO LOMBEYDA | GALILEO | 1612 | COURTESY OF GALILEO.RICE.EDU

DATA VISUALIZATION—

ART + TRUTH = INSIGHT

SCIENCE

ART + TRUTH = INSIGHT

SCIENCE

ART + TRUTH = INSIGHT

what is art?

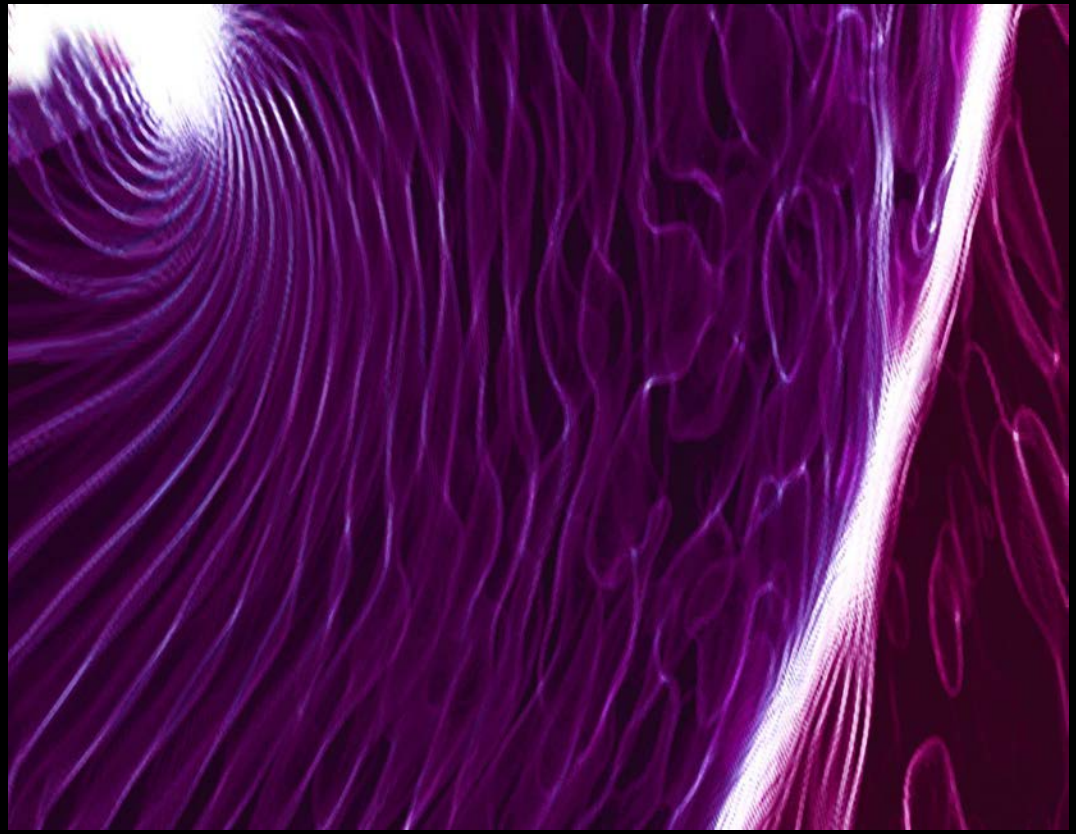
SCIENCE

ART + TRUTH = INSIGHT

~~what is art~~?

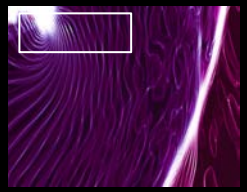
SANTIAGO LOMBEYDA **CALTECH+ARTCENTER**

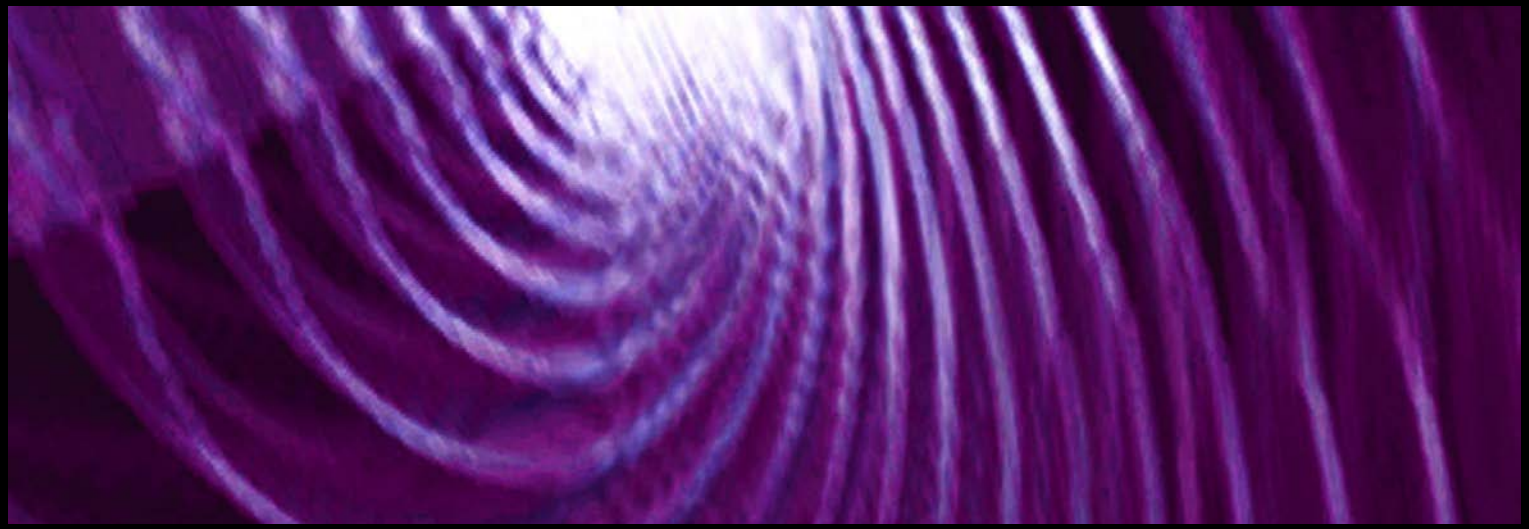
HORIZONTE | volume rendering of a time-step of a simulation of a shockwave propagating across a solid wedge | SIGGRAPH 2004 --

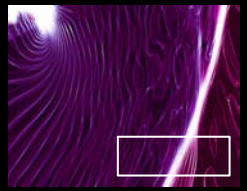


ART COURTESY OF SANTIAGO LOMBEYDA CALTECH+ARTCENTER

HORIZONTE | volume rendering of a time-step of a simulation of a shockwave propagating across a solid wedge | SIGGRAPH 2004 --







ART COURTESY OF SANTIAGO LOMBEYDA CALTECH+ARTCENTER

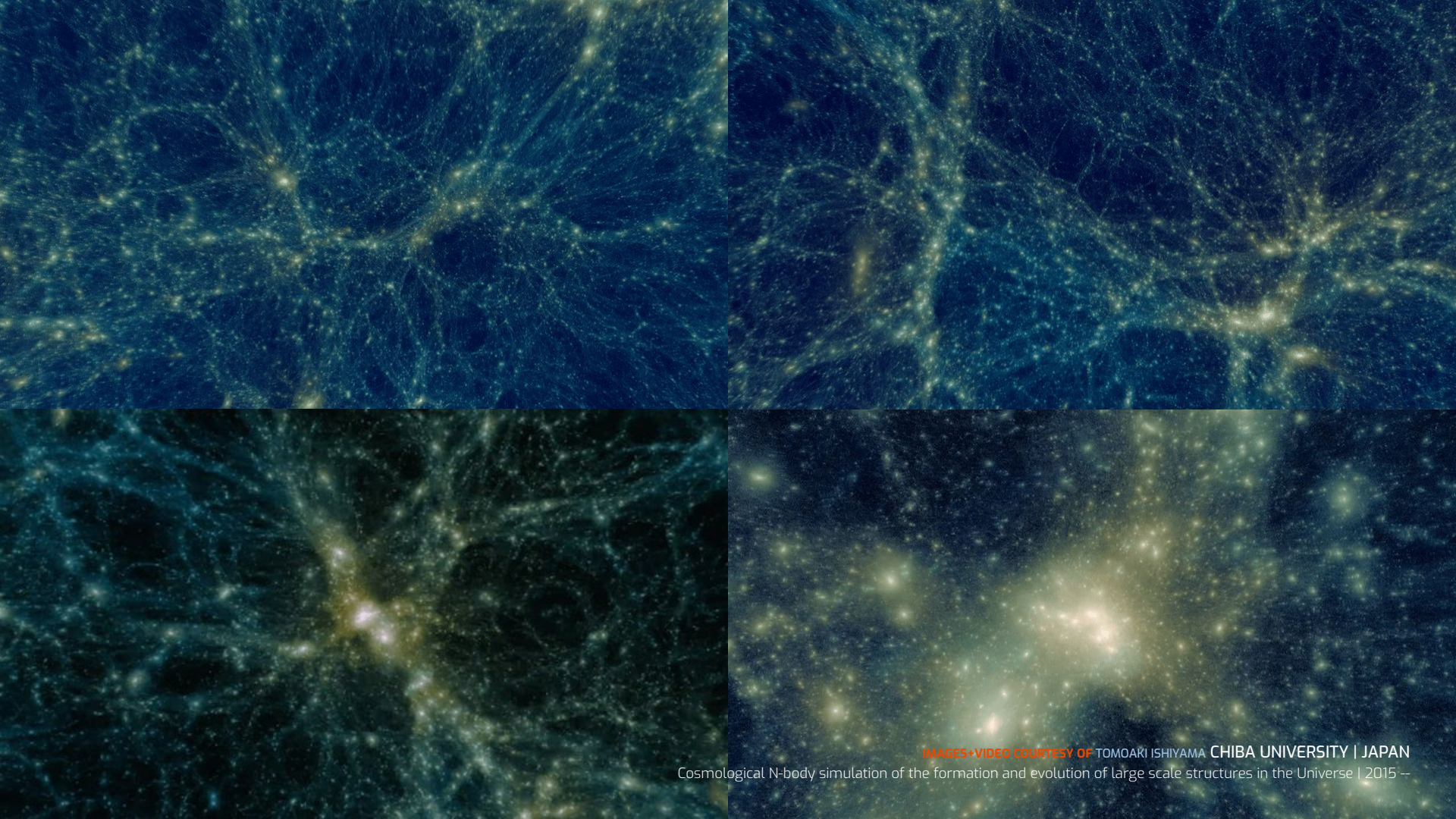
HORIZONTE | volume rendering of a time-step of a simulation of a shockwave propagating across a solid wedge | SIGGRAPH 2004 --

- ...but, is it good art?

Los Angeles Times

TOMOAKI ISHIYAMA CHIBA UNIVERSITY | JAPAN

Cosmological N-body simulation of the formation and evolution of large scale structures in the Universe | 2015 --



IMAGES+VIDEO COURTESY OF TOMOAKI ISHIYAMA CHIBA UNIVERSITY | JAPAN

Cosmological N-body simulation of the formation and evolution of large scale structures in the Universe | 2015 --

SCIENCE

ART + TRUTH = INSIGHT

~~what is art~~?

SCIENCE

ART + TRUTH = INSIGHT

ART PRACTICE

ART PRACTICE

art mastery
visual edification

ART PRACTICE

intentional

ART PRACTICE

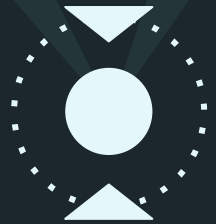
human centric

ART PRACTICE

target:
human cognitive system

contextual inquiry
↝ user centric design

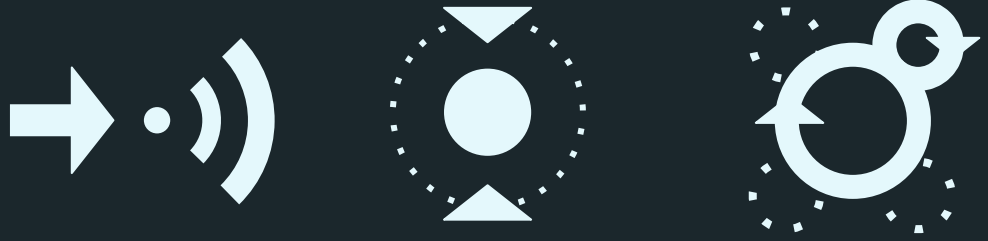
human centric



ART PRACTICE

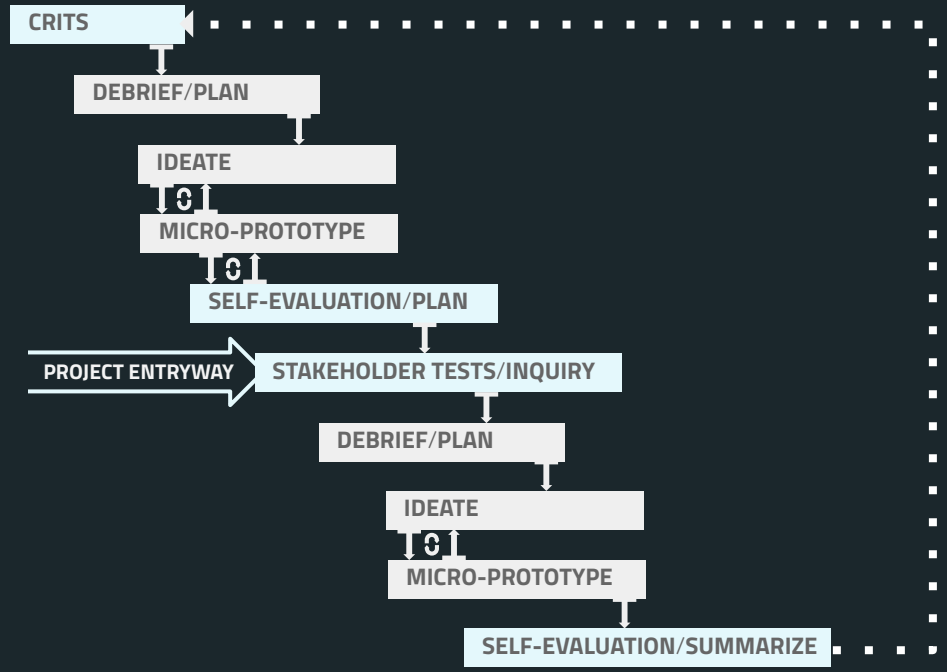
iterative

ART PRACTICE



ART PRACTICE

intentional **human centric** **iterative**



ART PRACTICE

intentional **human centric** **iterative**

FIGURE COURTESY OF SANTIAGO LOMBEYDA ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM | 2013 --

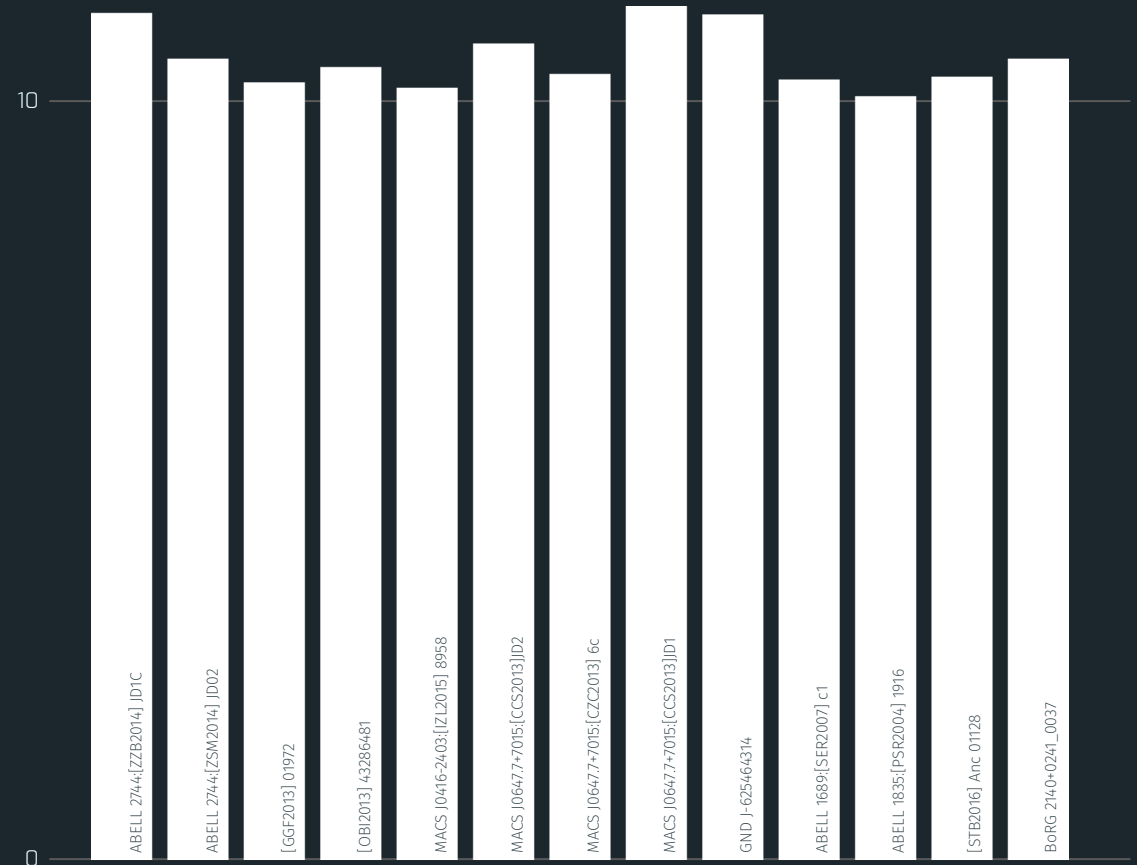
SCIENCE

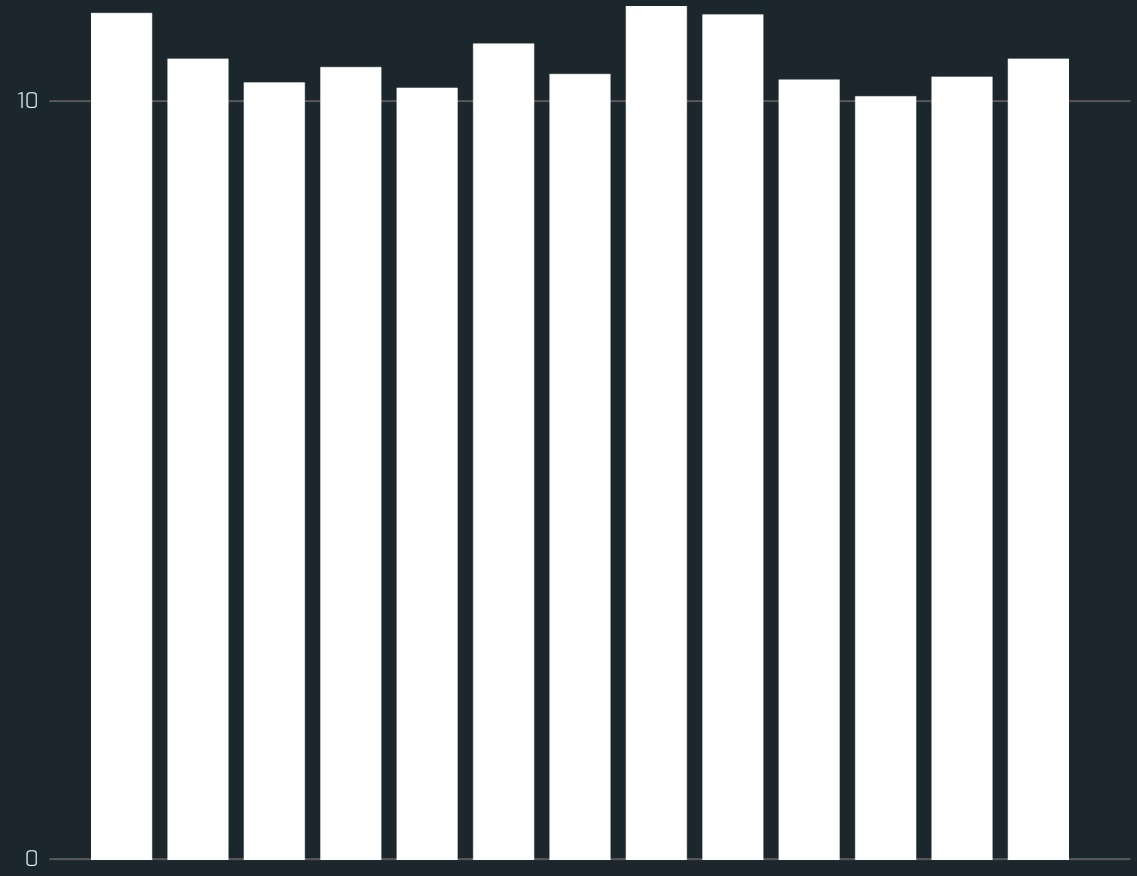
ART + TRUTH = INSIGHT

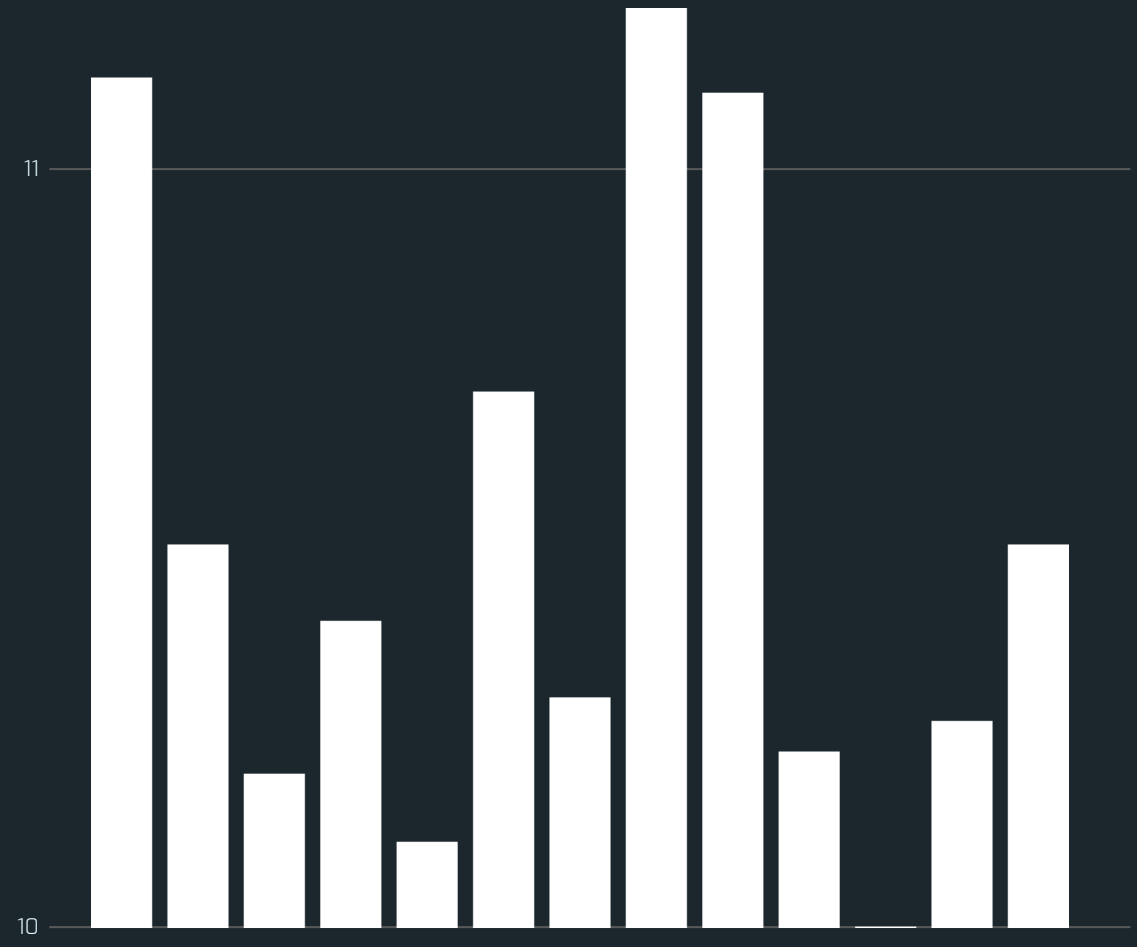
TRUTH

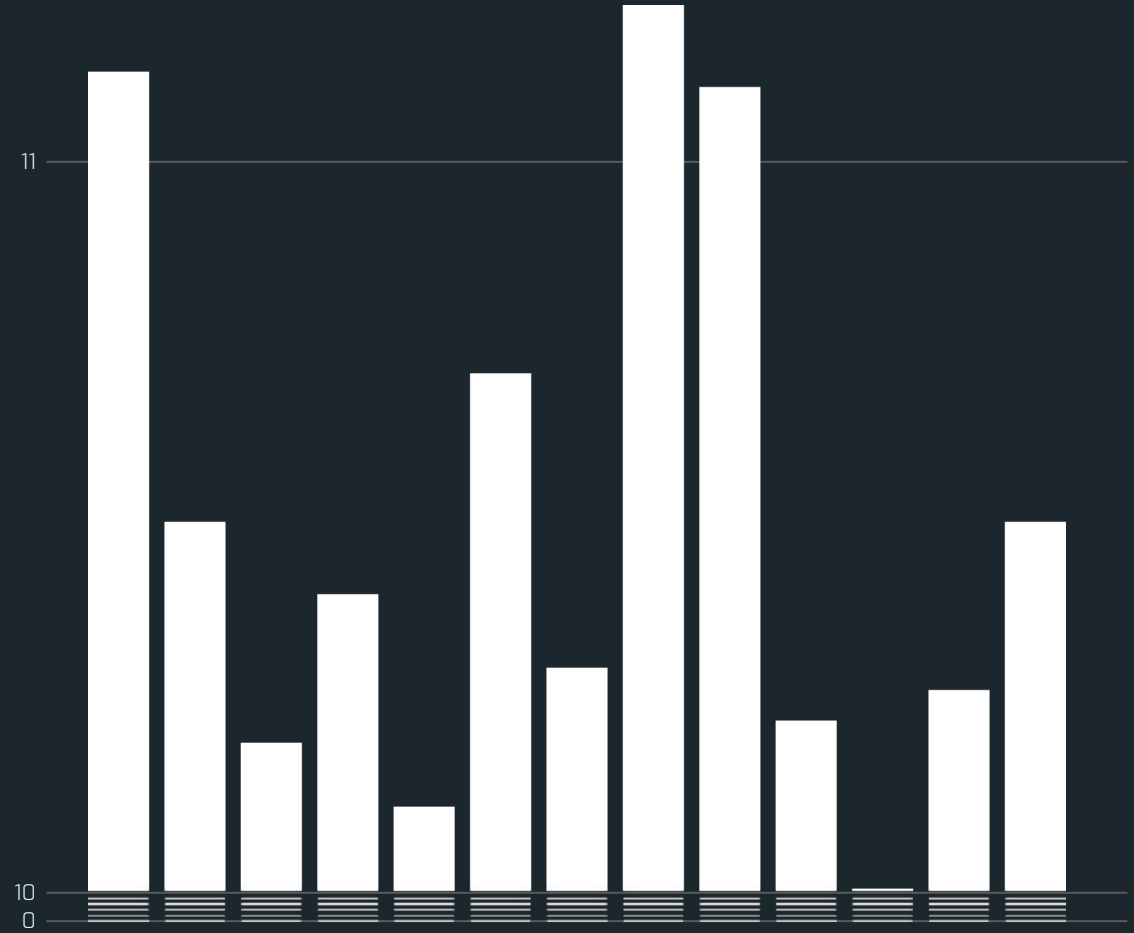
DATA *faithfulness*

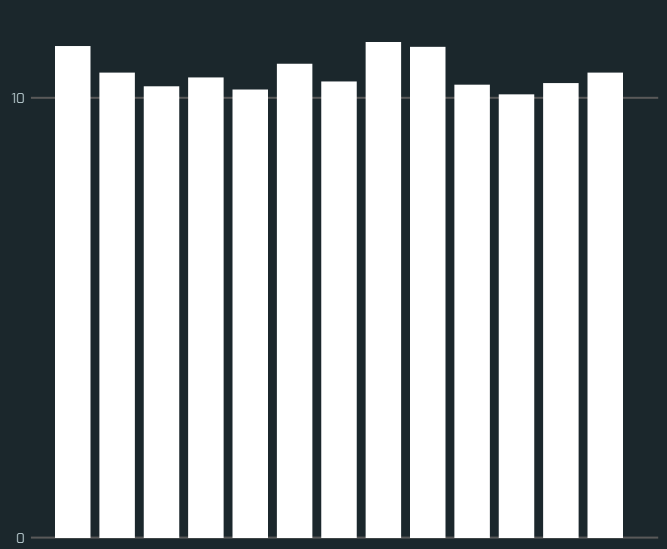
TRUTH

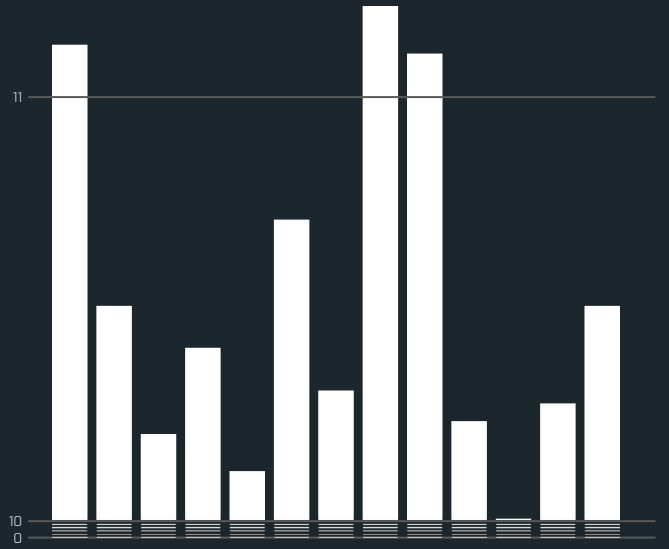

10
0
ABELL 2744:[ZZB2014] JD1C
ABELL 2744:[ZSM2014] JD02
[GGF2013] 01972
[OBI2013] 43286481
MACS J0416-2403:[IZL2015] 8958
MACS J0647.7+7015:[CCS2013]JD2
MACS J0647.7+7015:[CZC2013] 6c
MACS J0647.7+7015:[CCS2013]JD1
GND J-6254643 14
ABELL 1689:[SER2007] C1
ABELL 1835:[PSR2004] 1916
[STB2016] Anc 01128
BoRG 2140+0241_0037


10
0


11
10


11
10
0


10
0


11
10
0

DATA

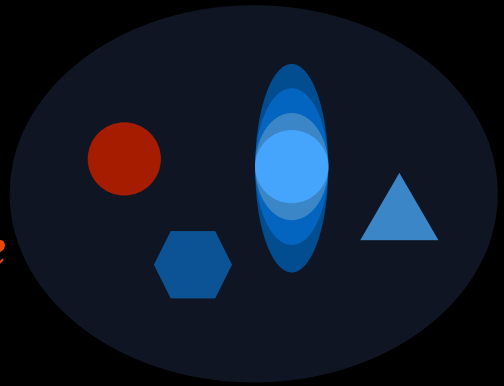
TRUTH

DATA

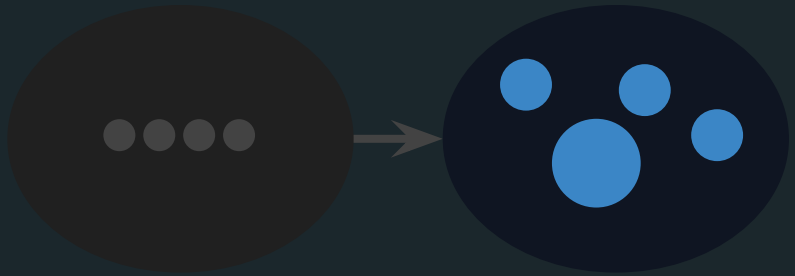
TRUTH

REPRESENTATION

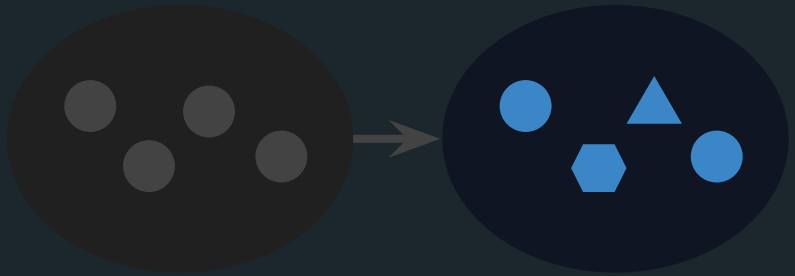
evident & objective



(VISUAL) DATA ENCODING CHANNELS

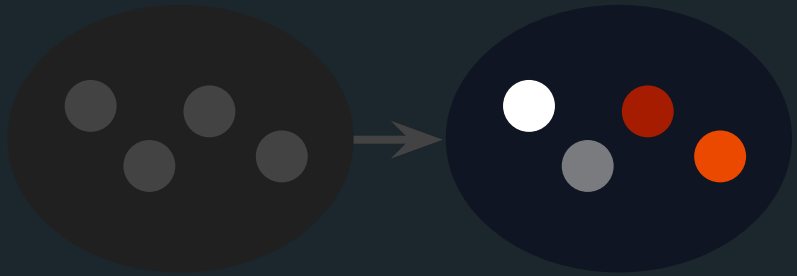


▪ SPATIAL ▪
position | scale | orientation

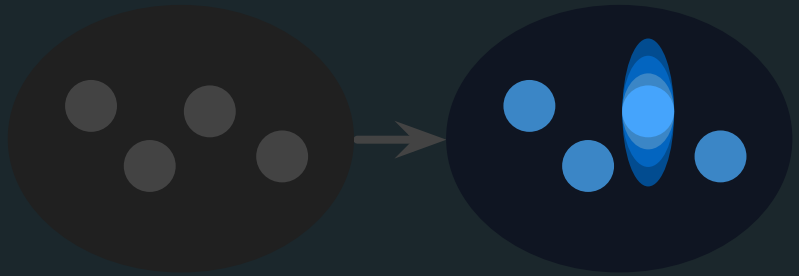


▪ SHAPE ▪
distinctive glyphs | bumps | points | whiskers

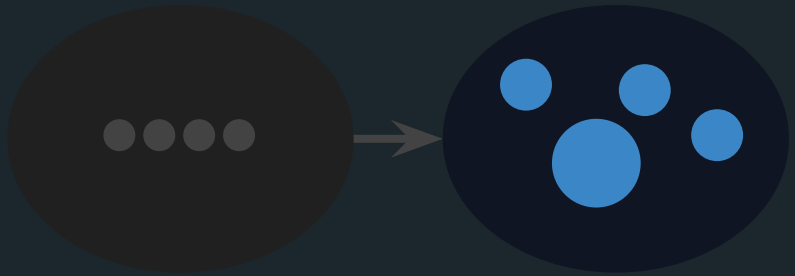
(VISUAL) DATA ENCODING CHANNELS



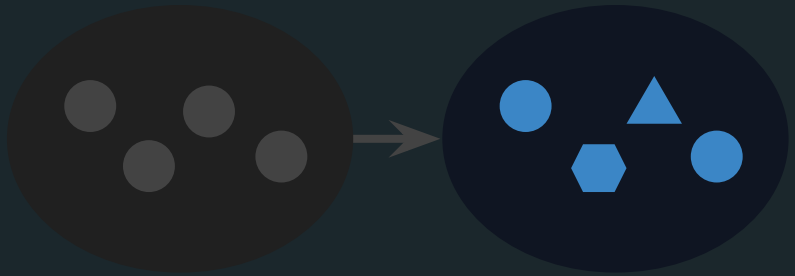
▪ COLOR ▪
luminosity | hue | saturation | texture



▪ MOTION ▪
vibration | rotation | deformation

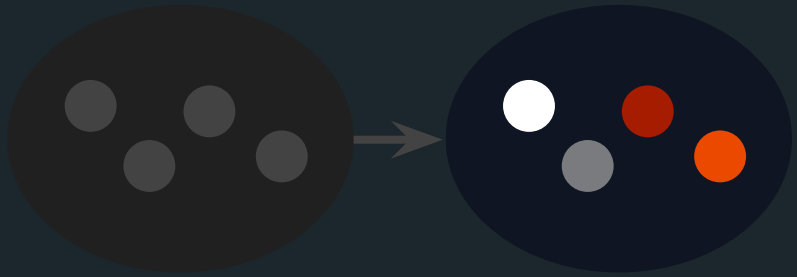


▪ SPATIAL ▪
position | scale | orientation

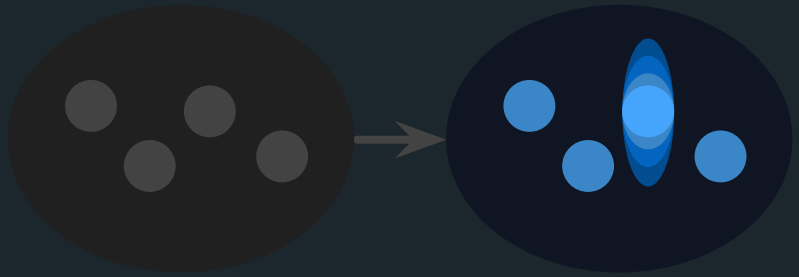


▪ SHAPE ▪
distinctive glyphs | bumps | points | whiskers

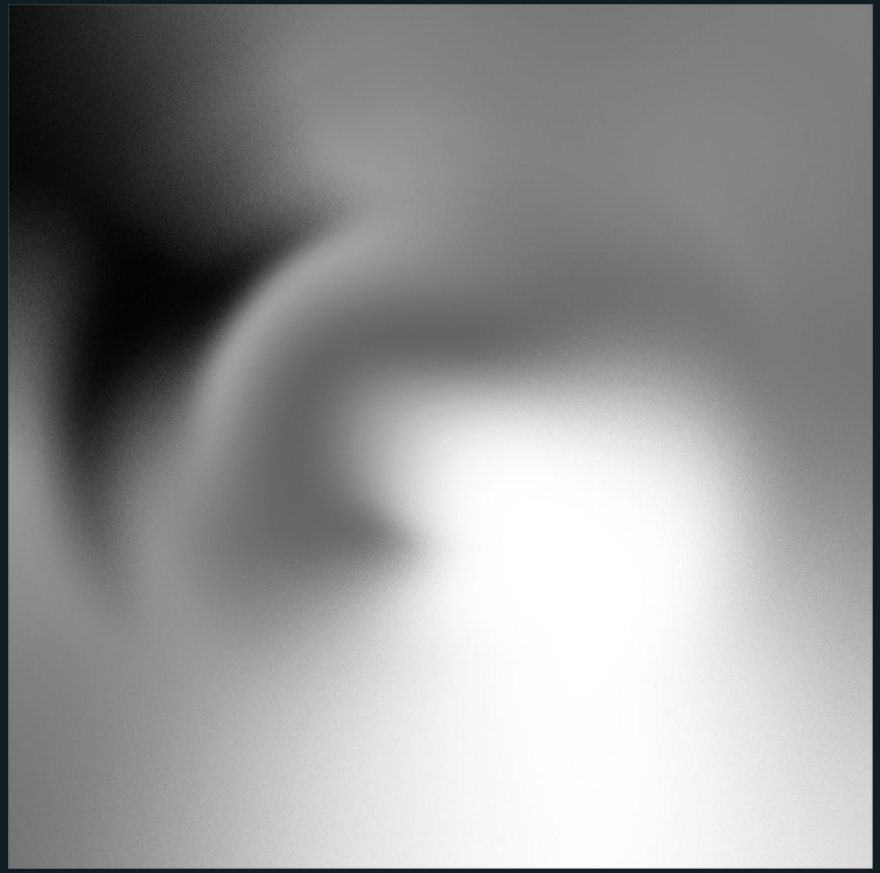
(VISUAL) DATA ENCODING CHANNELS

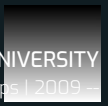


▪ COLOR ▪
luminosity | hue | saturation | texture

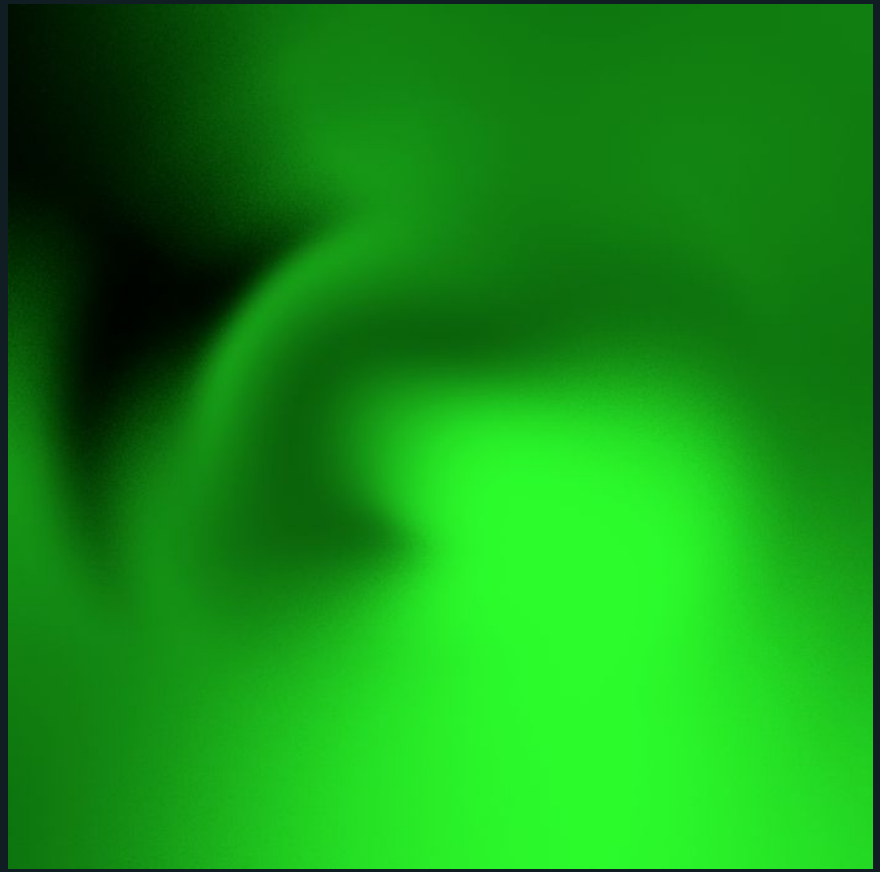


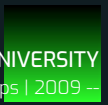
▪ MOTION ▪
vibration | rotation | deformation



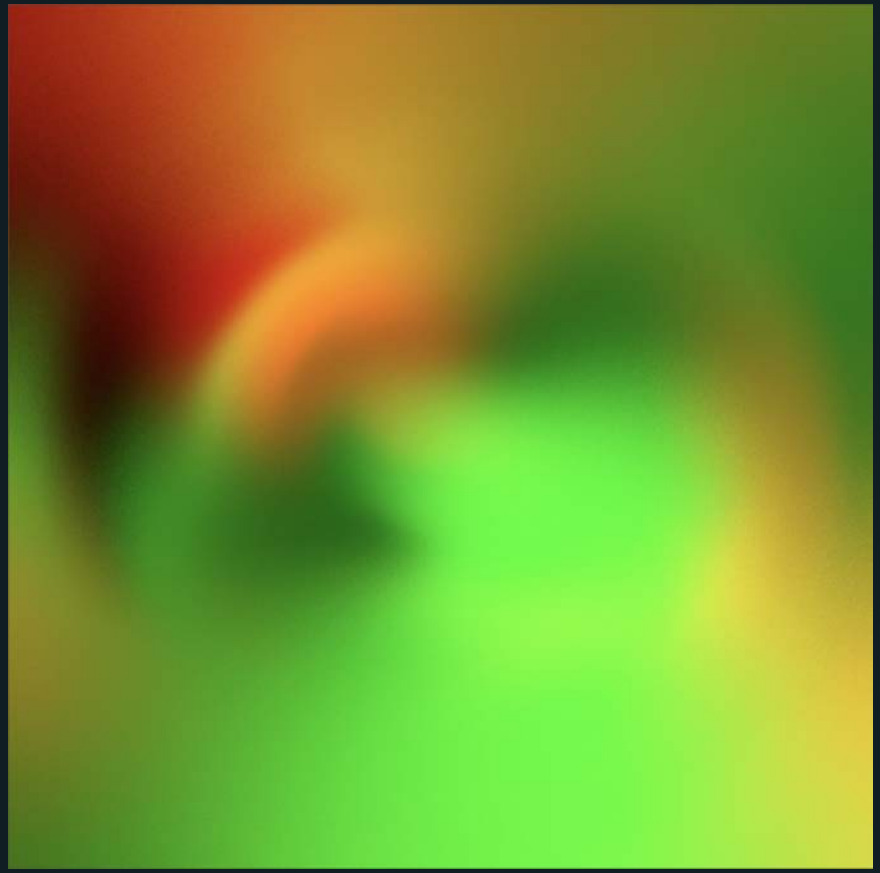


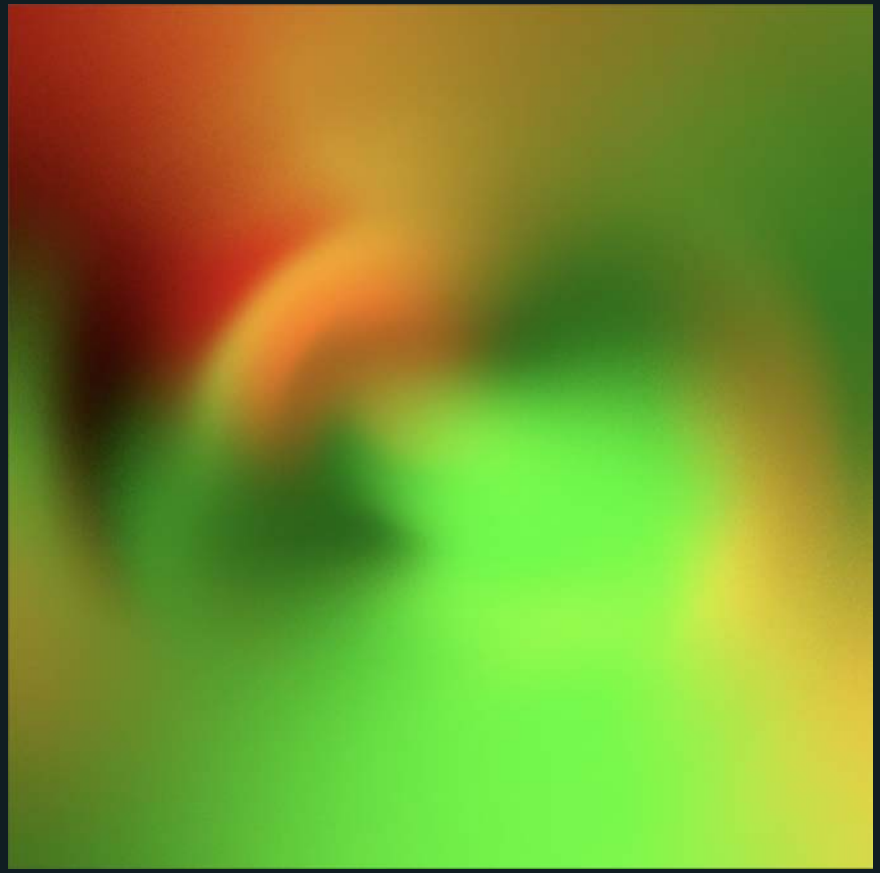
FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009

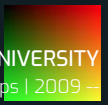




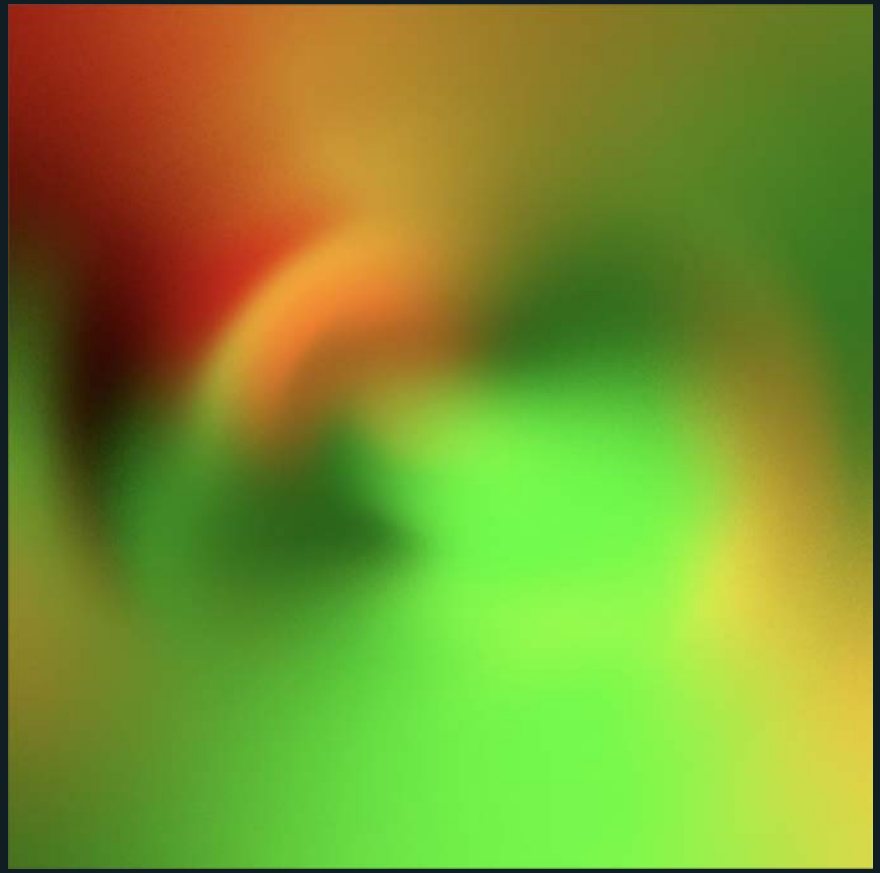
FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009 --

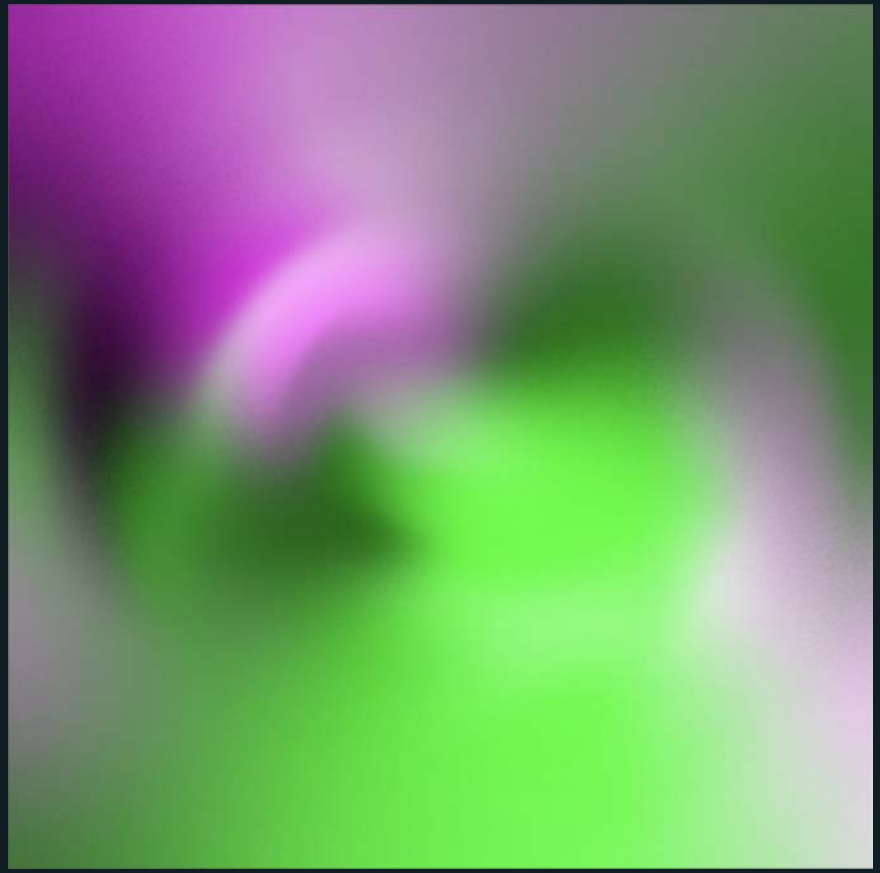


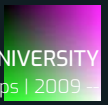




FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009 --

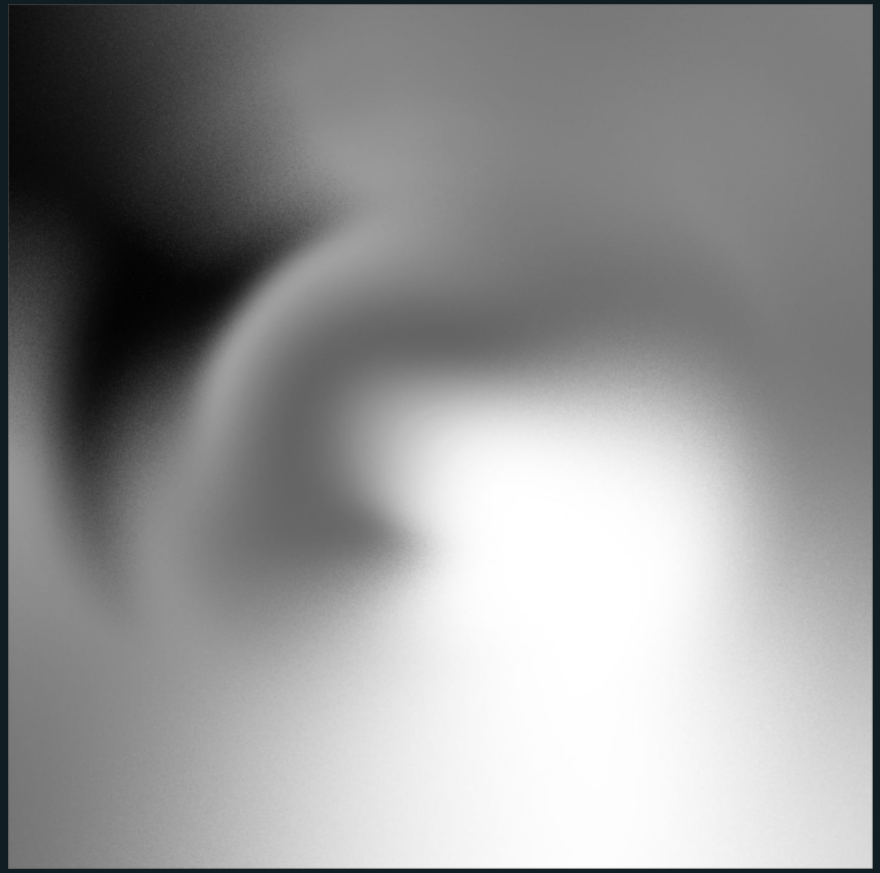


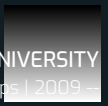




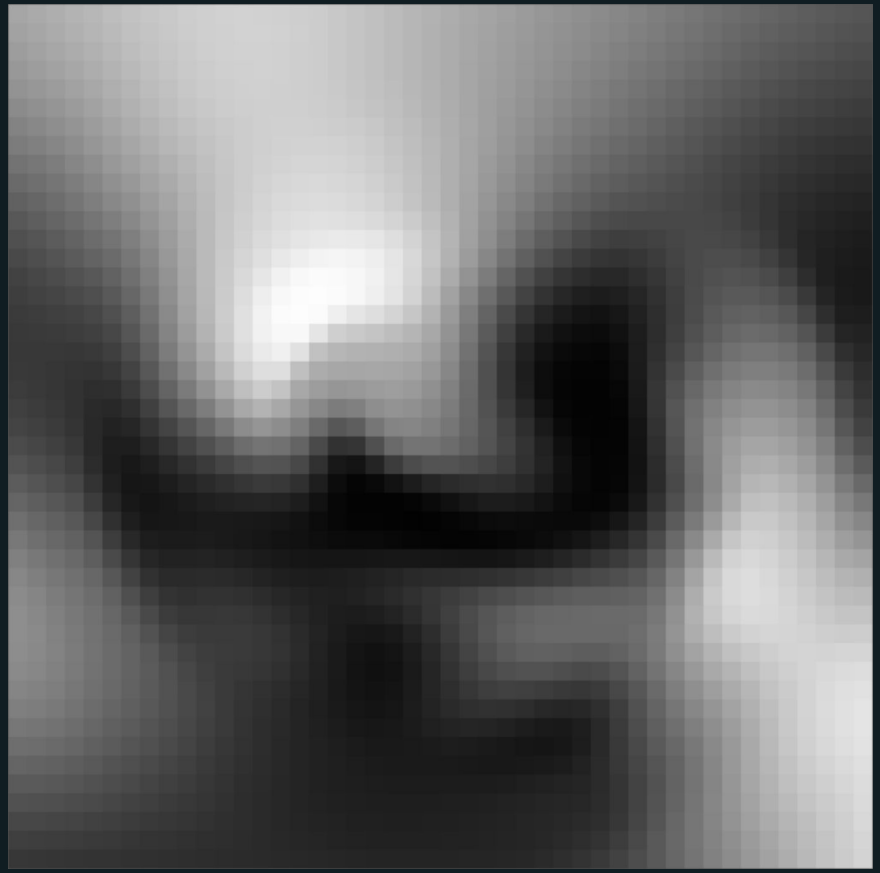
FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009

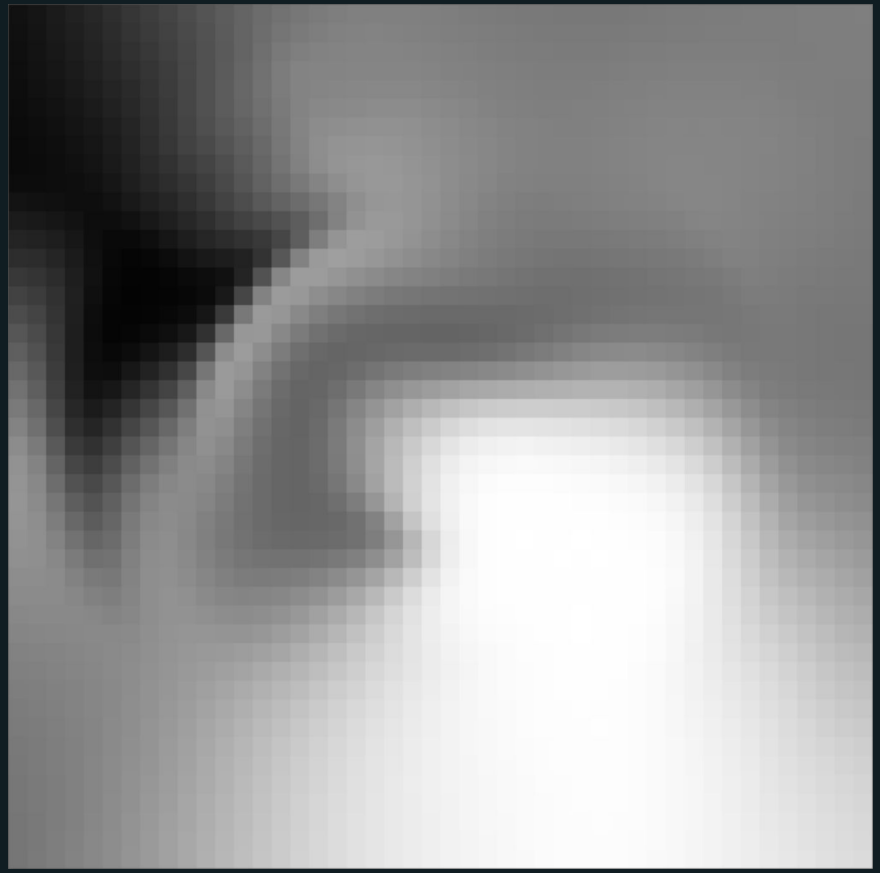
FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009 --





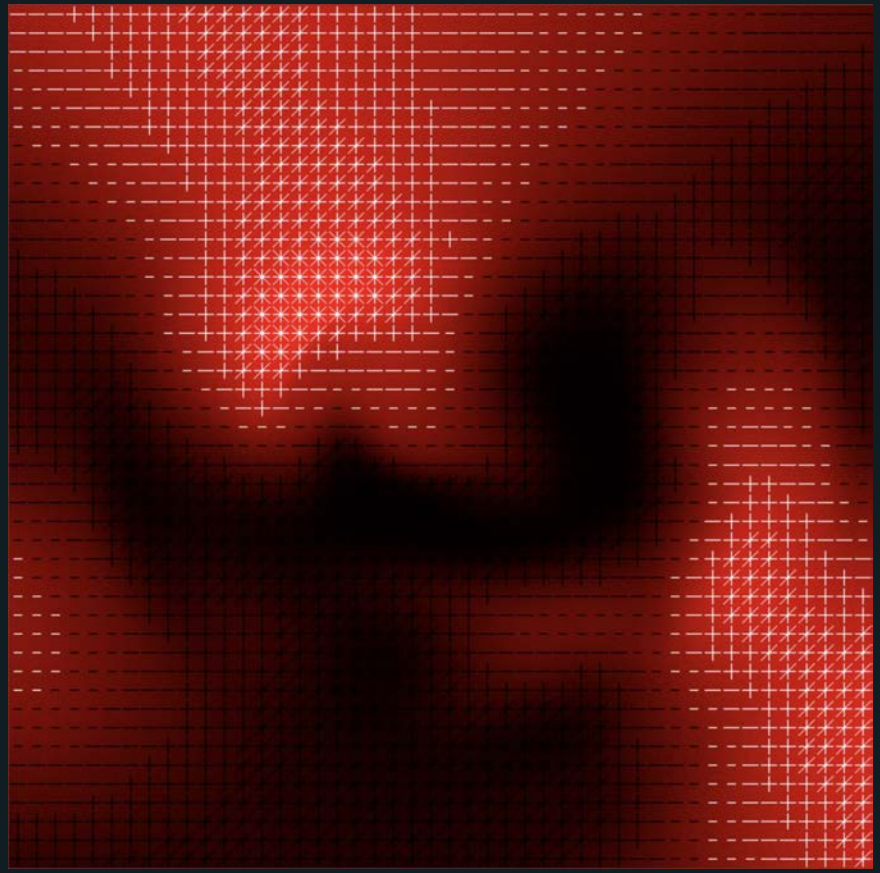
FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009

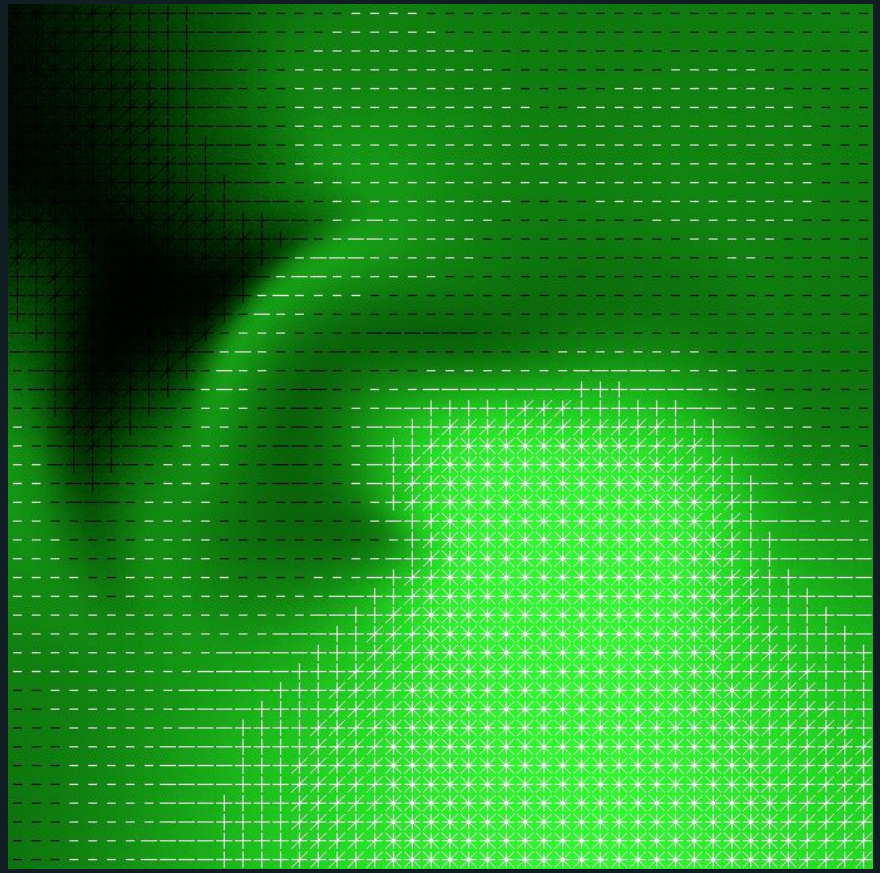


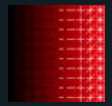


FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY

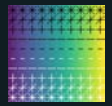
Quantitative Texton Sequences for Legible Bivariate Maps | 2009

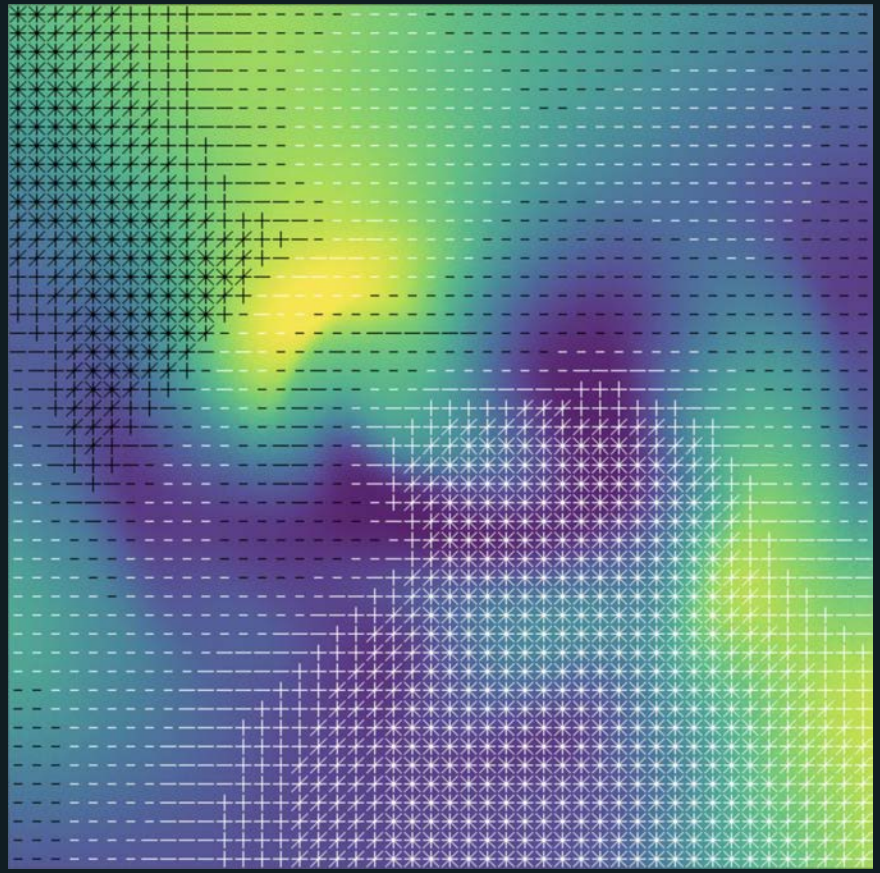


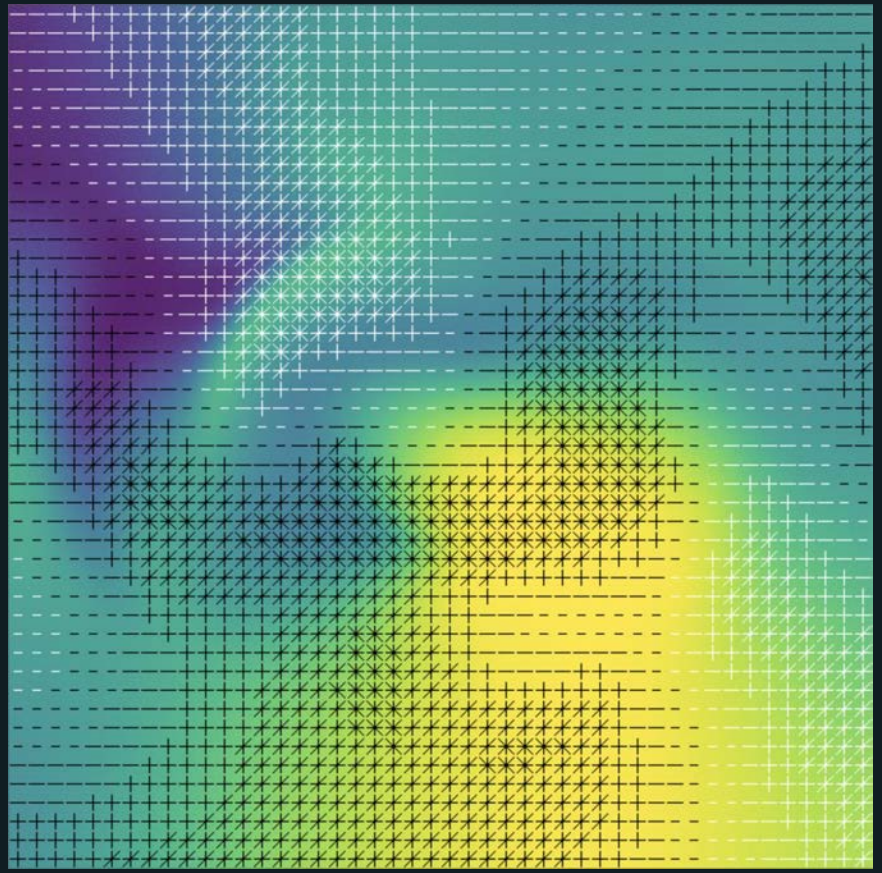


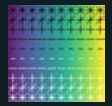


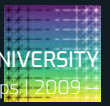
FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009











FIGURES BASED ON ORIGINAL RESEARCH BY COLIN WARE NEW HAMPSHIRE UNIVERSITY
Quantitative Texton Sequences for Legible Bivariate Maps | 2009

"WE KNOW **NEXT TO NOTHING** ABOUT

HOW COLLECTIVE COGNITION WORKS,

OR WHEN IT WORKS,

OR HOW TO MAKE IT WORK BETTER;

WE HAVE SOME IDEAS ABOUT IT,

BUT **AT BEST** THEY'VE THE STATUS OF

ARTISANAL RULES OF THUMB."

COLIN WARE VIS2009 KEYNOTE

quote from Bactra Review By Cosma Shalizi Of Edwin Hutchins's Book Cognition In The Wild | Atlantic City, New Jersey, 2009--

SCIENCE

ART + TRUTH = INSIGHT

VISUALIZATION PIPELINE

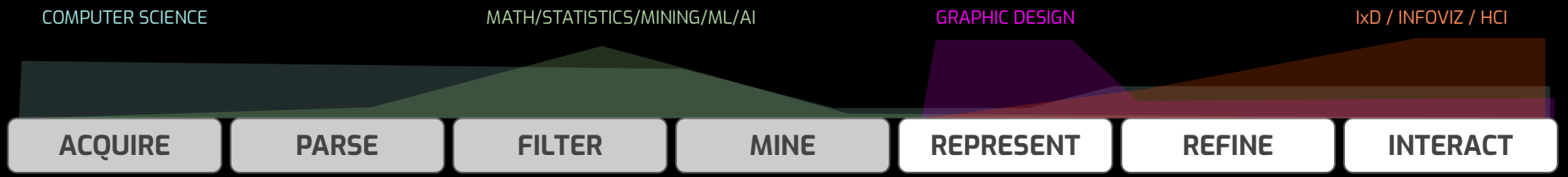
VISUALIZATION PIPELINE

BEN FRY **VISUALIZATION PIPELINE**

Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --

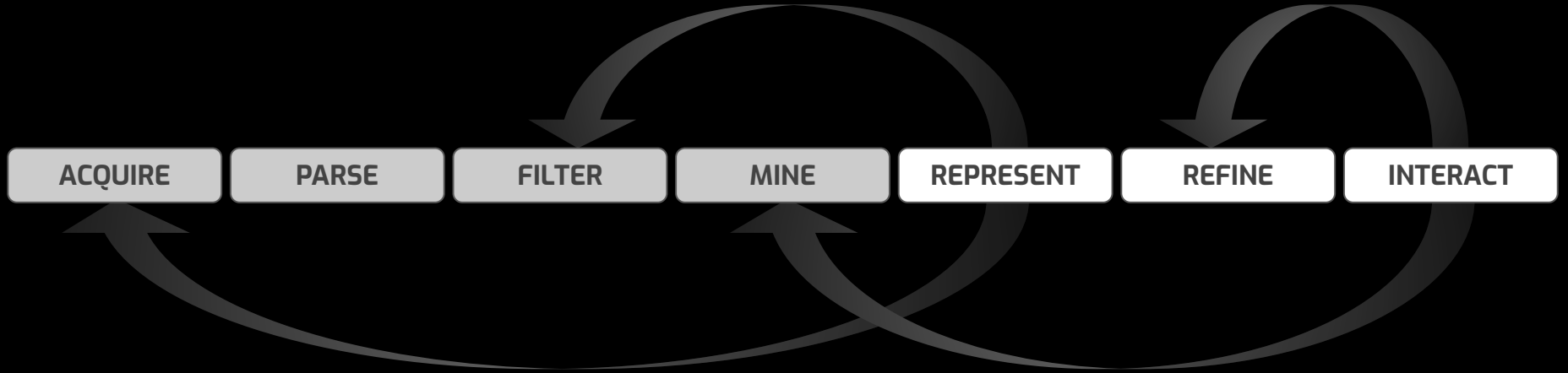
VISUALIZATION PIPELINE

FIGURES BASED ON ORIGINAL FIGURE BY BEN FRY VISUALIZATION PIPELINE
Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --



VISUALIZATION PIPELINE

FIGURES BASED ON ORIGINAL FIGURE BY BEN FRY VISUALIZATION PIPELINE
Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --



VISUALIZATION PIPELINE

FIGURES BASED ON ORIGINAL FIGURE BY BEN FRY VISUALIZATION PIPELINE
Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --

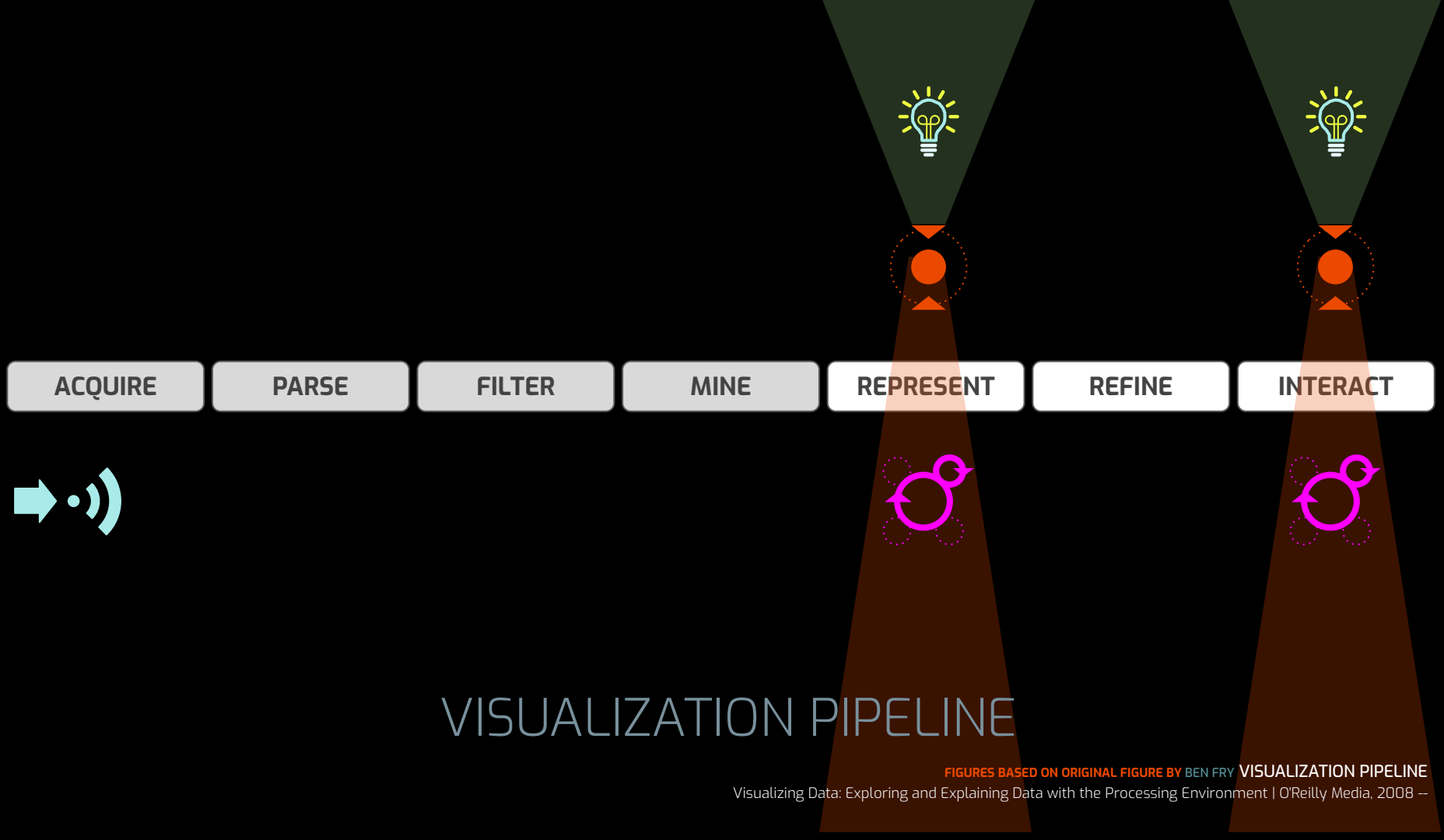
ACQUIRE | PARSE | FILTER | MINE | REPRESENT | REFINE | INTERACT

VISUALIZATION PIPELINE

FIGURES BASED ON ORIGINAL FIGURE BY BEN FRY VISUALIZATION PIPELINE
Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --

VISUALIZATION PIPELINE

FIGURES BASED ON ORIGINAL FIGURE BY BEN FRY VISUALIZATION PIPELINE
Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --



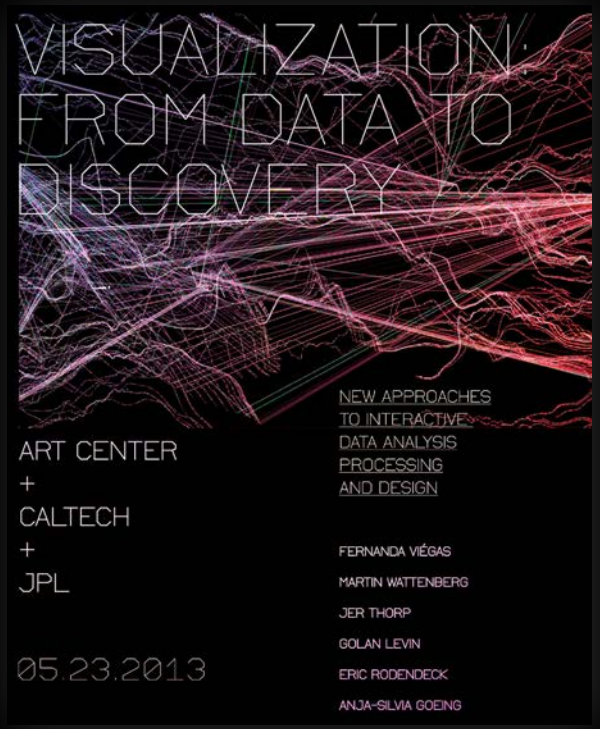
VISUALIZATION PIPELINE

FIGURES BASED ON ORIGINAL FIGURE BY BEN FRY VISUALIZATION PIPELINE
Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --

SCIENCE

ART + TRUTH = INSIGHT

DATA VISUALIZATION



POSTER COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM | 2013 --

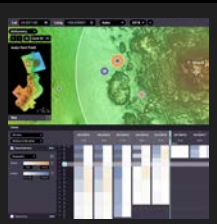
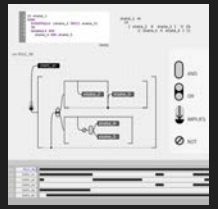
DATA2DISCOVERY

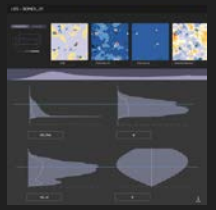
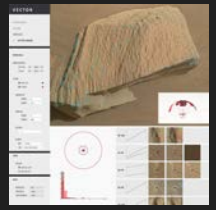
SCOTT DAVIDOFF JPL

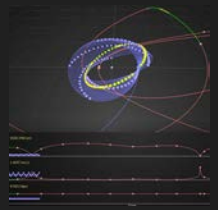
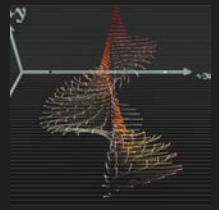
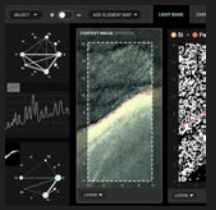
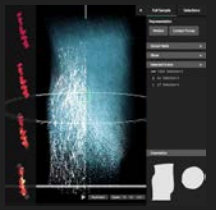
MAGGIE HENDRIE ART CENTER

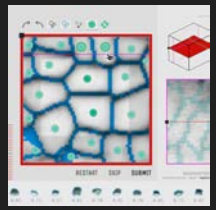
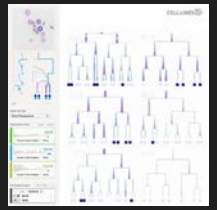
HILLARY MUSHKIN CALTECH

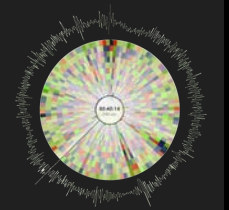
SANTIAGO LOMBEYDA CALTECH+ARTCENTER

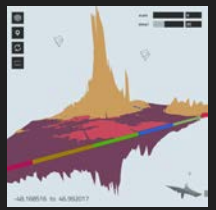



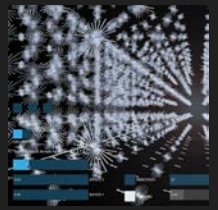



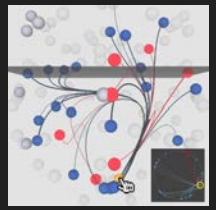
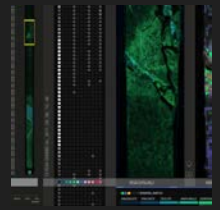
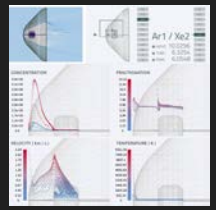
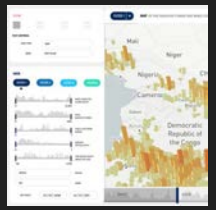











DATA2DISCOVERY|RSKETCH

FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM RSKETCH

Mars Rover path planning tool | DATA2DISCOVERY 2015

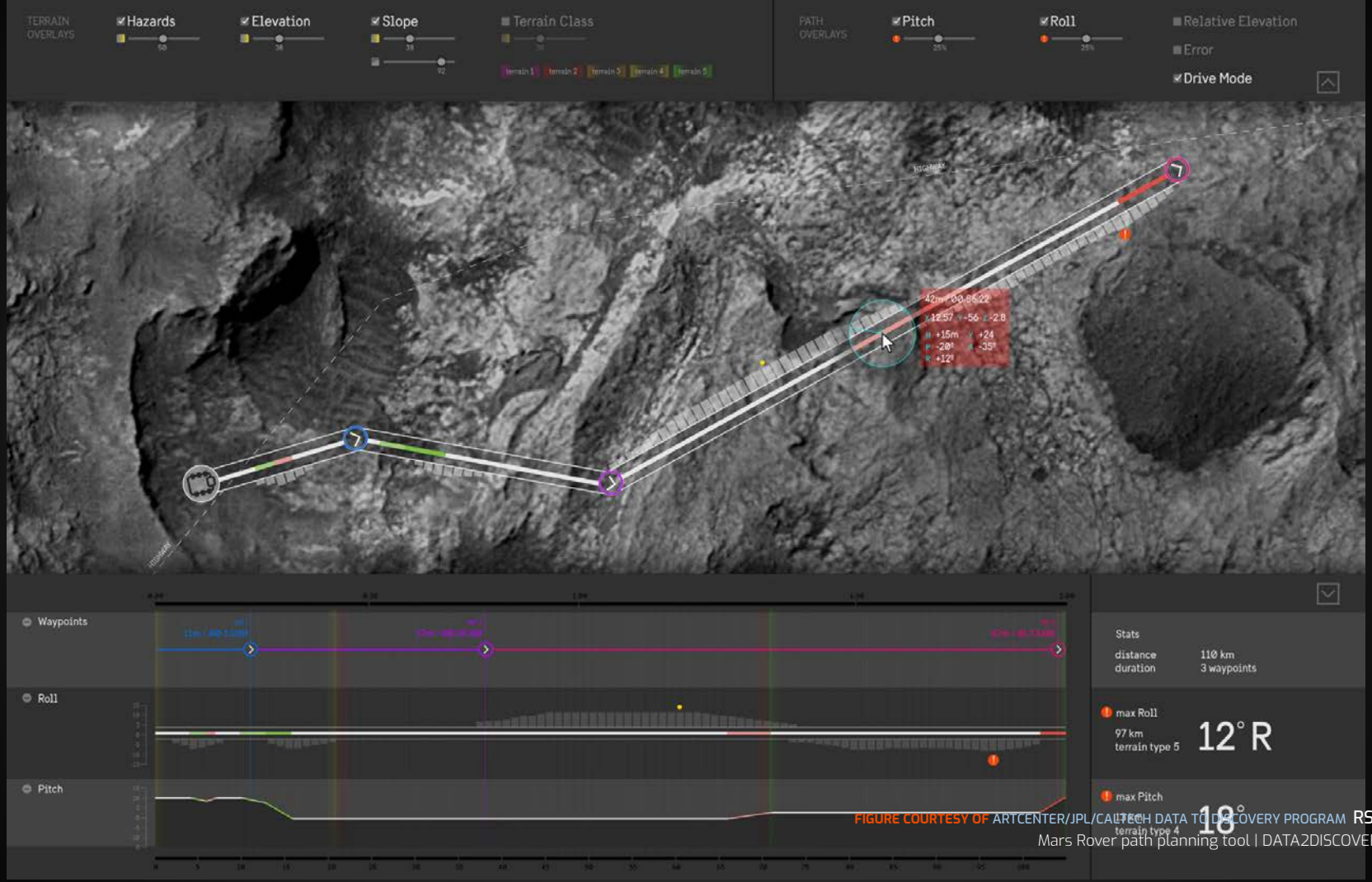
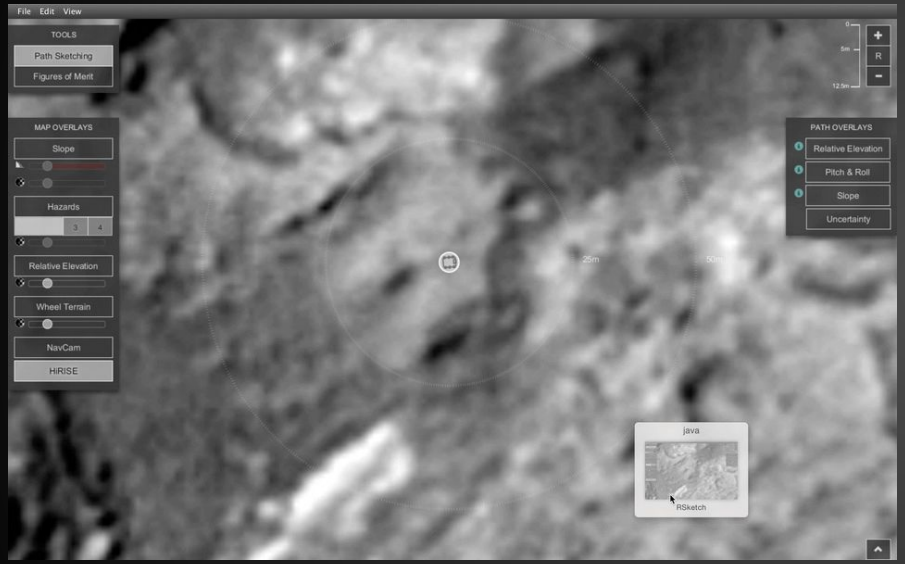


FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM RSKETCH

Mars Rover path planning tool | DATA2DISCOVERY 2015



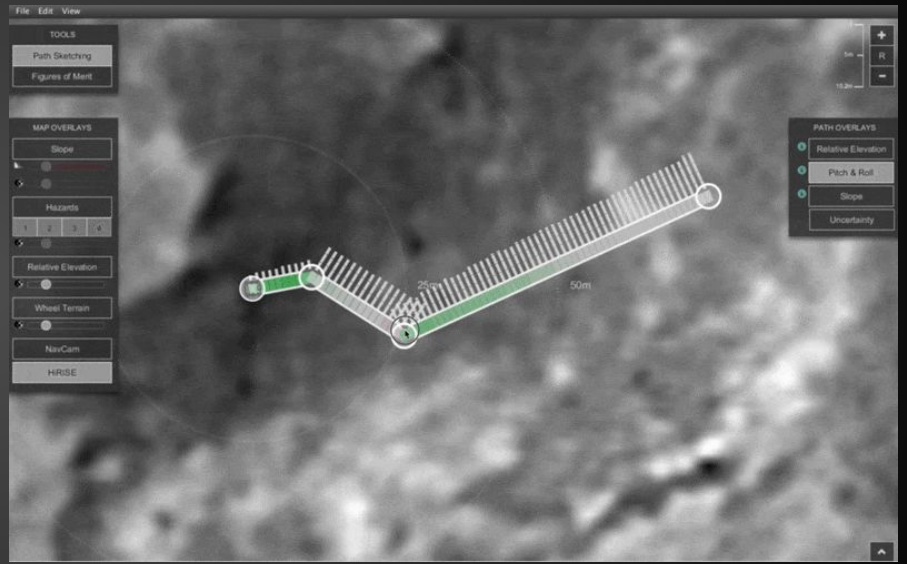


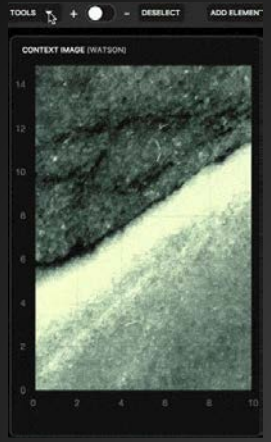
FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM **RSKETCH**

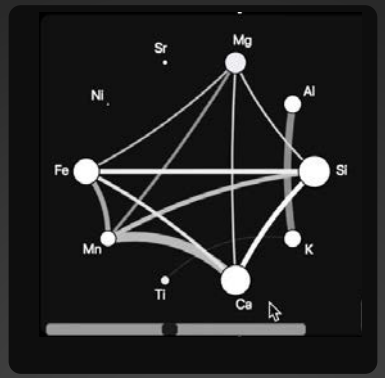
Mars Rover path planning tool | DATA2DISCOVERY 2015

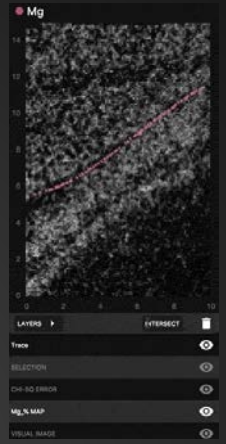
DATA2DISCOVERY|PIXLIZE

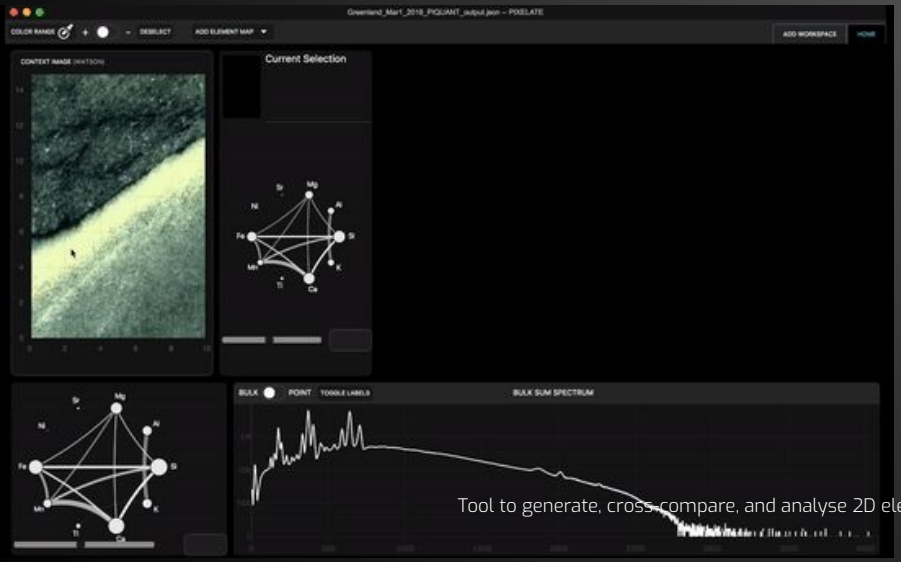
DAVID SCHURMAN, ADRIAN GALVIN, & POOJA NAIR (in collaboration with MARS 2020 PLANETARY INSTRUMENT FOR X-RAY LITHOCHEMISTRY TEAM) **PIXLIZE**

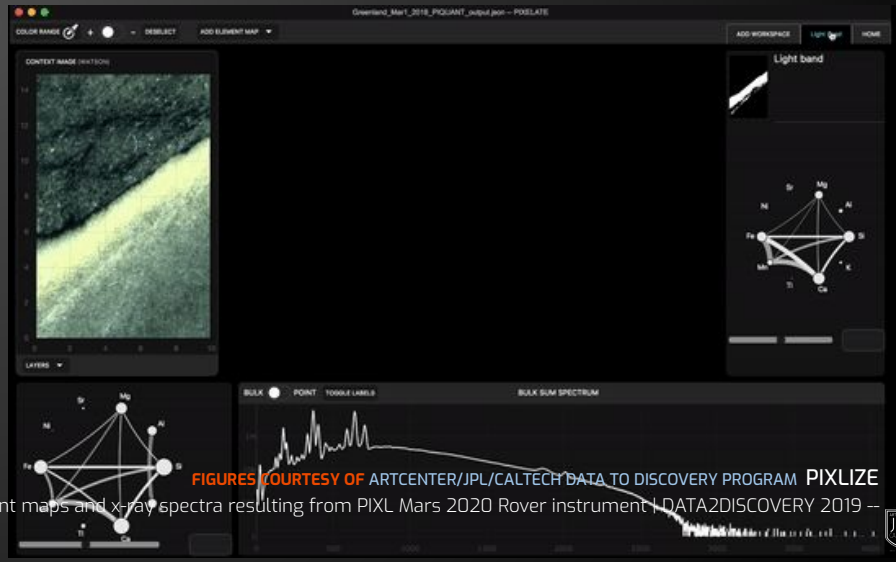
Tool to generate, cross-compare, and analyse 2D element maps and x-ray spectra resulting from PIXL Mars 2020 Rover instrument | DATA2DISCOVERY 2019 --











FIGURES COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM PIXLIZE

Tool to generate, cross-compare, and analyse 2D element maps and x-ray spectra resulting from PIXL Mars 2020 Rover instrument | DATA2DISCOVERY 2019 --

DATA2DISCOVERY|LIGO

WILLIAM LINDMEIER, STEPHEN BADER, & LUNA LIE (in collaboration with RANA ADHIKARI) LIGO INTERFEROMETER WATCH

Interface to visualize and analyzed hundred of data channels from LIGO Interferometer | DATA2DISCOVERY 2014 --

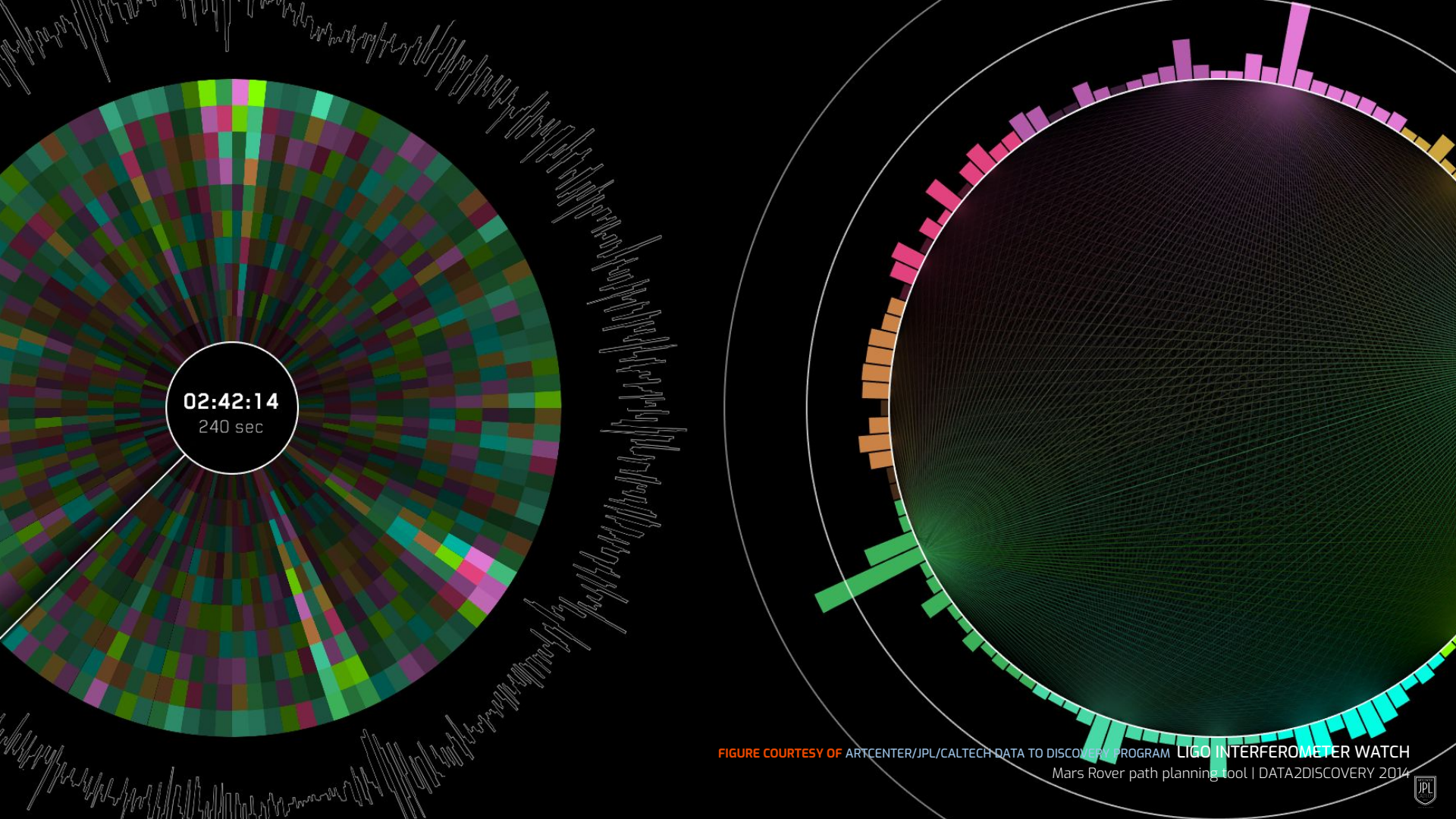
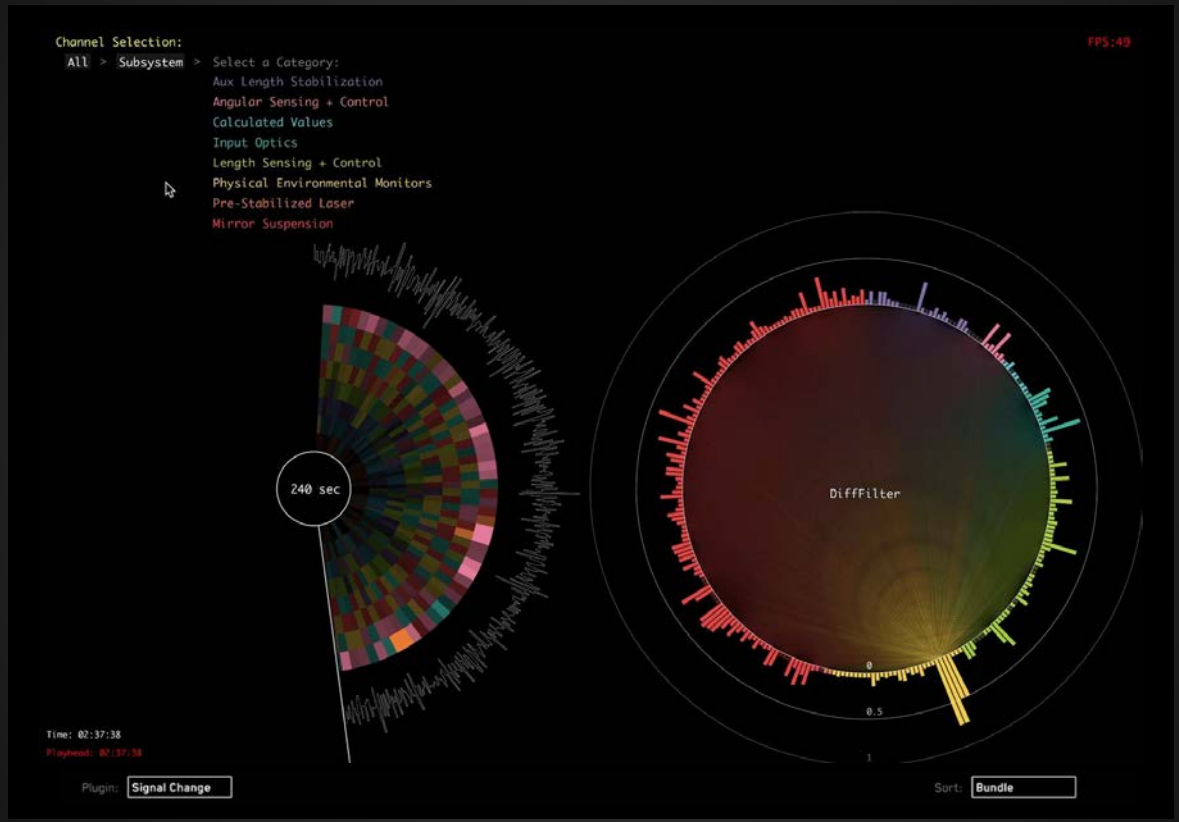
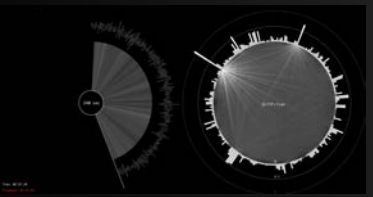


FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM LIGO INTERFEROMETER WATCH

Mars Rover path planning tool | DATA2DISCOVERY 2014





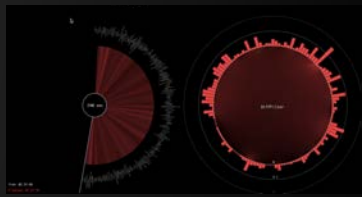
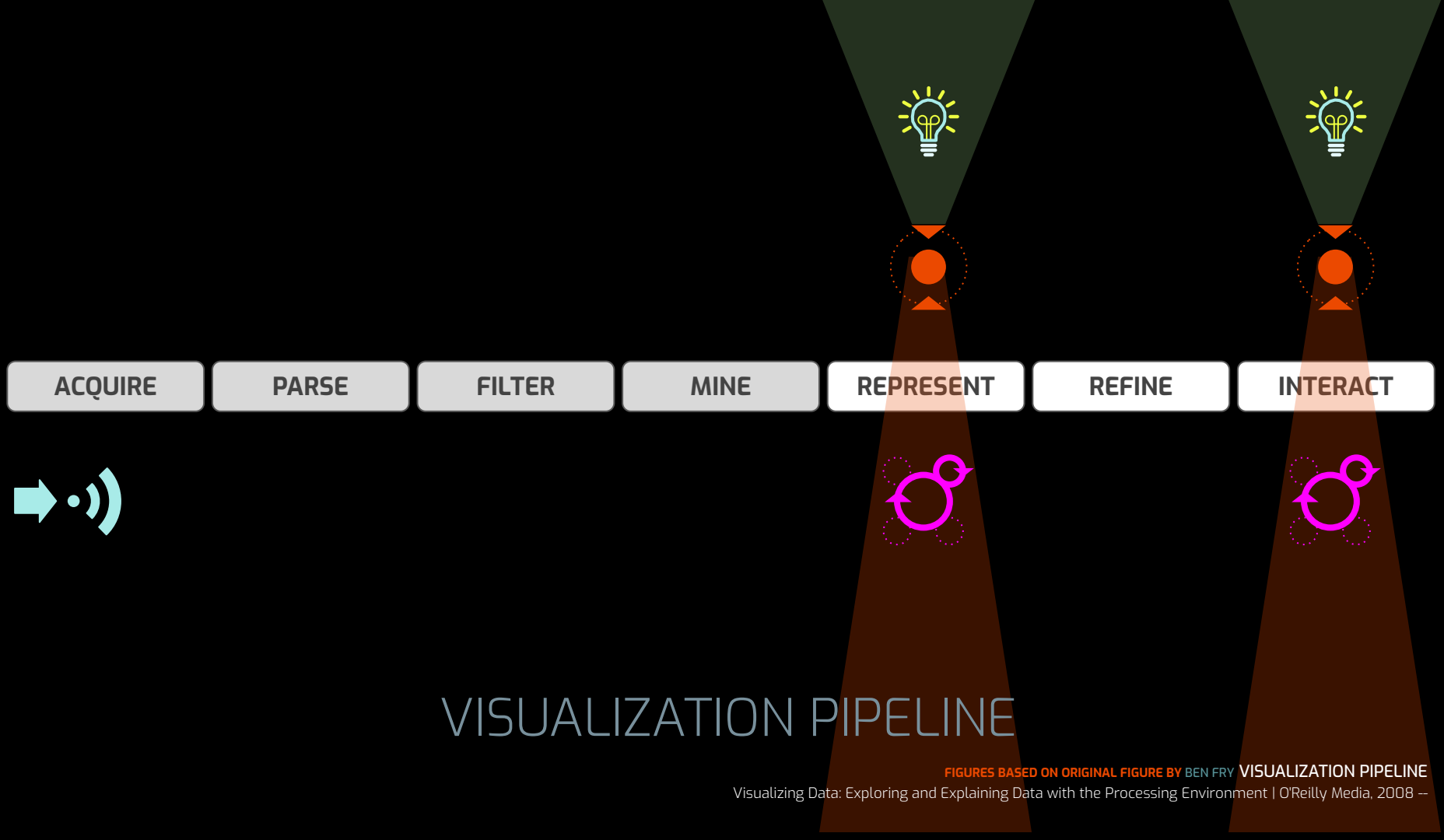


FIGURE COURTESY OF ARTCENTER/JPL/CALTECH DATA TO DISCOVERY PROGRAM **LIGO INTERFEROMETER WATCH**

Mars Rover path planning tool | DATA2DISCOVERY 2014



VISUALIZATION PIPELINE

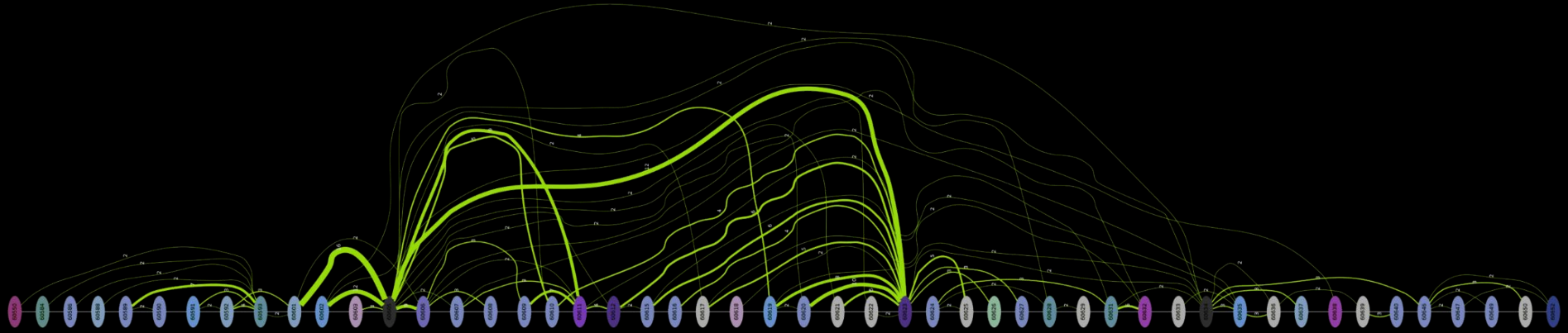
FIGURES BASED ON ORIGINAL FIGURE BY BEN FRY VISUALIZATION PIPELINE
Visualizing Data: Exploring and Explaining Data with the Processing Environment | O'Reilly Media, 2008 --

SCIENCE

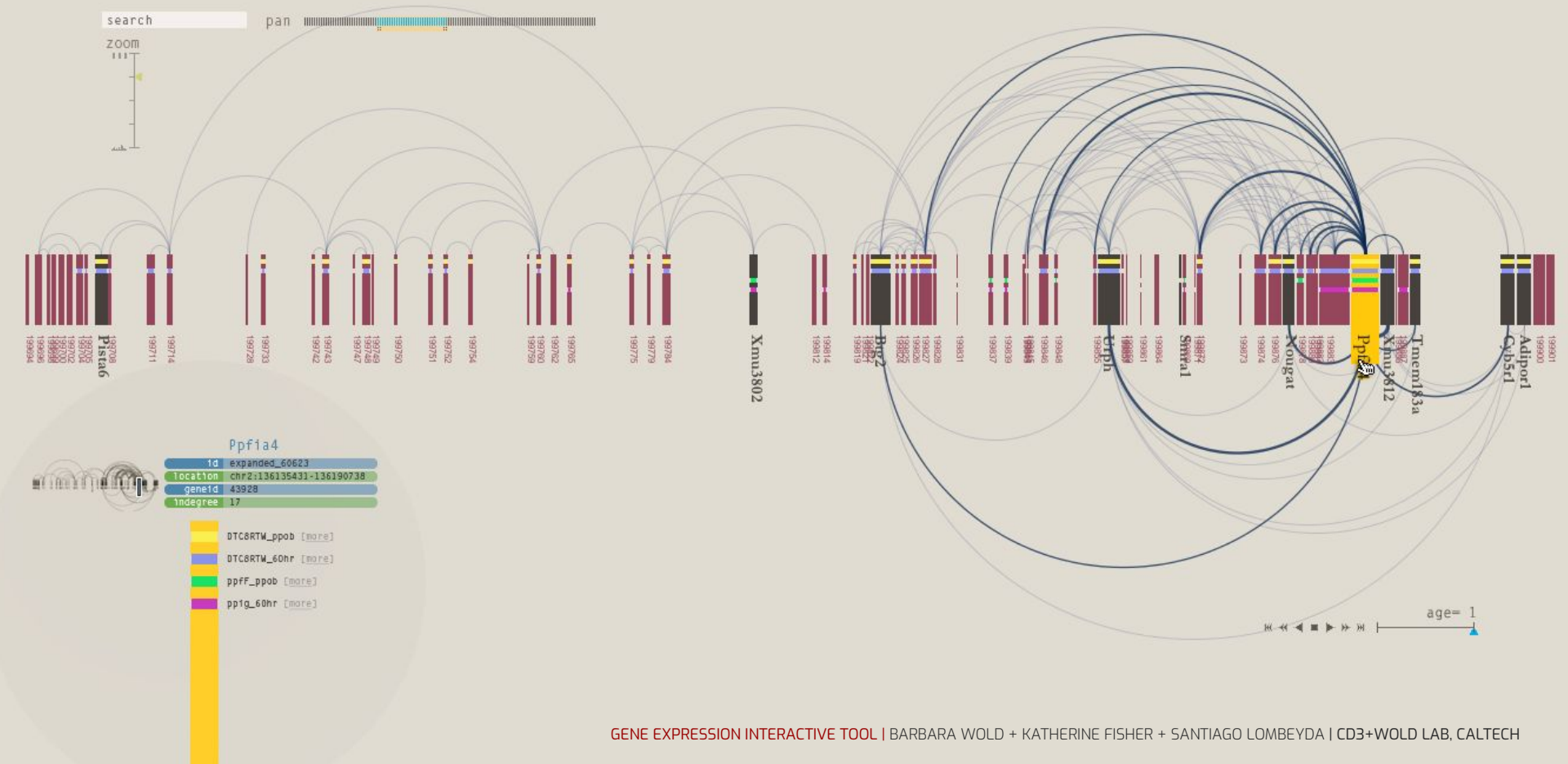
ART + TRUTH = INSIGHT

DATA VISUALIZATION

GENE EXPRESSION

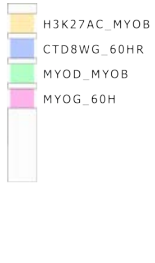


GENE EXPRESSION VISUALIZATION | BARBARA WOLD + KATHERINE FISHER | **WOLD LAB, CALTECH**



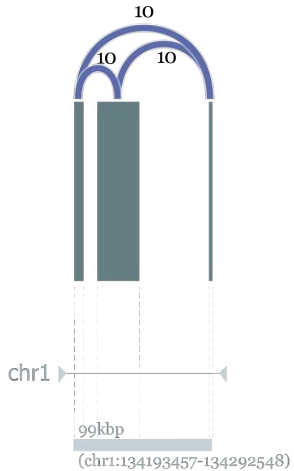
GENE EXPRESSION INTERACTIVE TOOL | BARBARA WOLD + KATHERINE FISHER + SANTIAGO LOMBEYDA | CD3+WOLD LAB, CALTECH

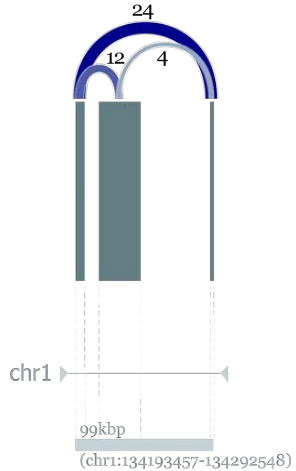
Mybph
Adora1
Myog
chr1
99kbp
(chr1:134193457-134292548)

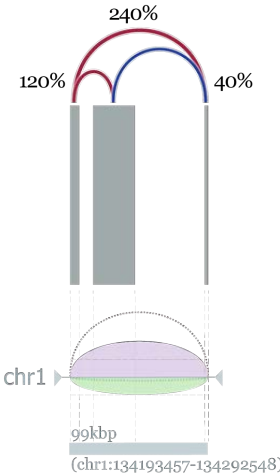

H3K27AC_MYOB
CTD8WG_60HR
MYOD_MYOB
MYOG_60H

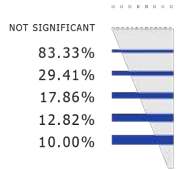
Mybph
Adora1
Myog
chr1
99kbp
(chr1:134193457-134292548)

NOT SIGNIFICANT
120.00%
340.00%
560.00%
780.00%
1000.00%


10
10
10
chr1
99kbp
(chr1:134193457-134292548)

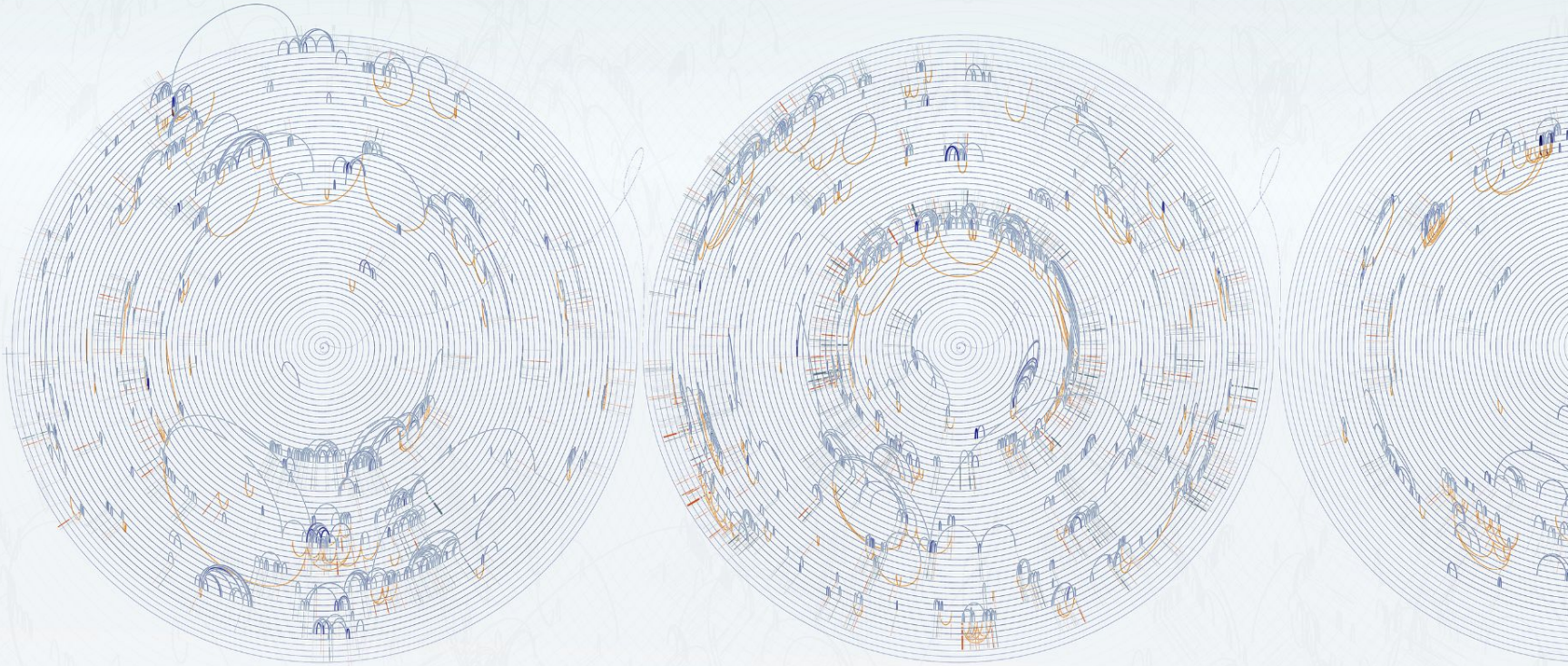

24
12
4
chr1
99kbp
(chr1:134193457-134292548)


240%
120%
40%
chr1
99kbp
(chr1:134193457-134292548)


NOT SIGNIFICANT
83.33%
29.41%
17.86%
12.82%
10.00%

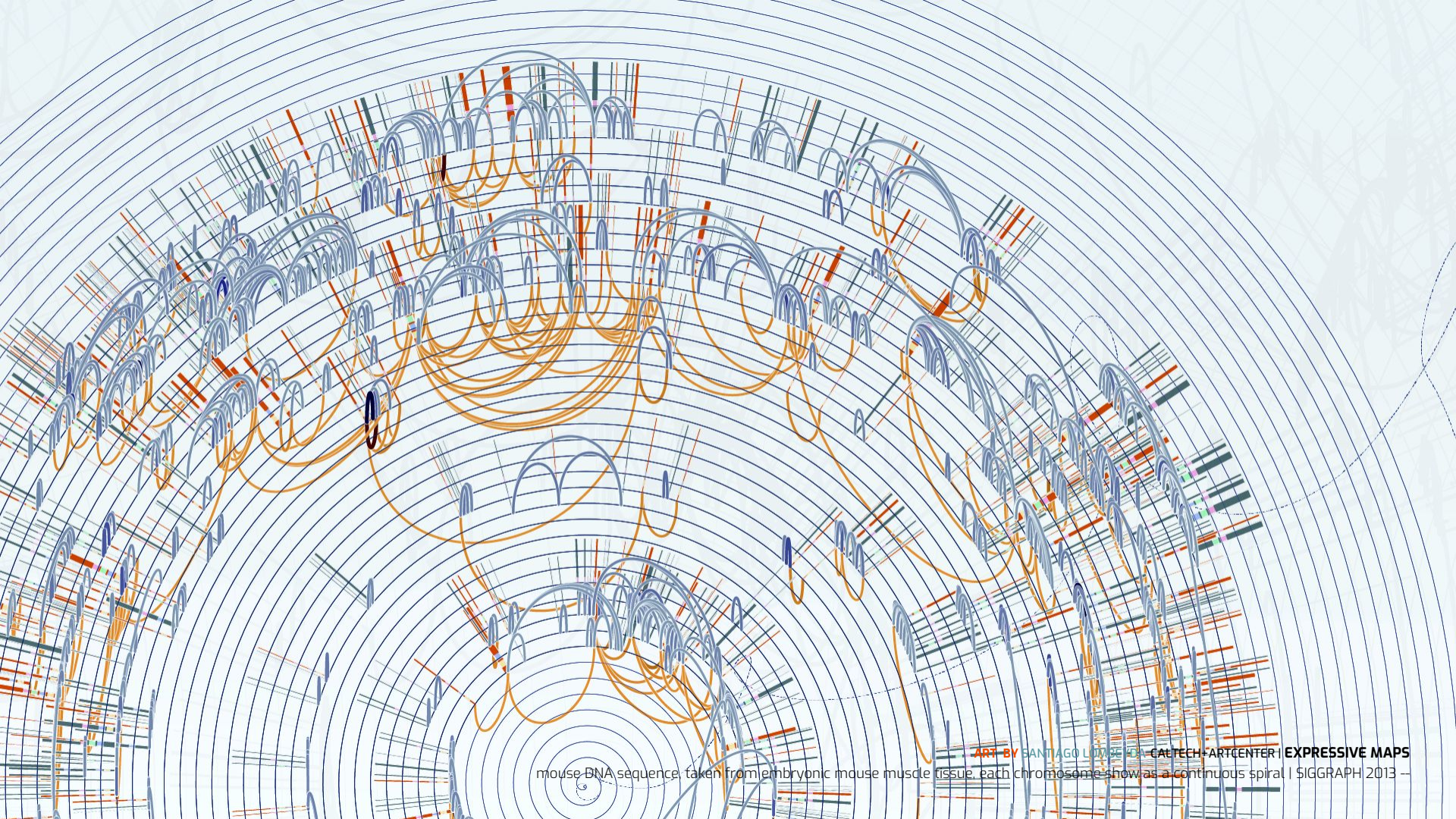
SANTIAGO LOMBEYDA CALTECH+ARTCENTER

EXPRESSIVE MAPS | mouse DNA sequence, taken from embryonic mouse muscle tissue, each chromosome show as a continuous spiral | SIGGRAPH 2013 --



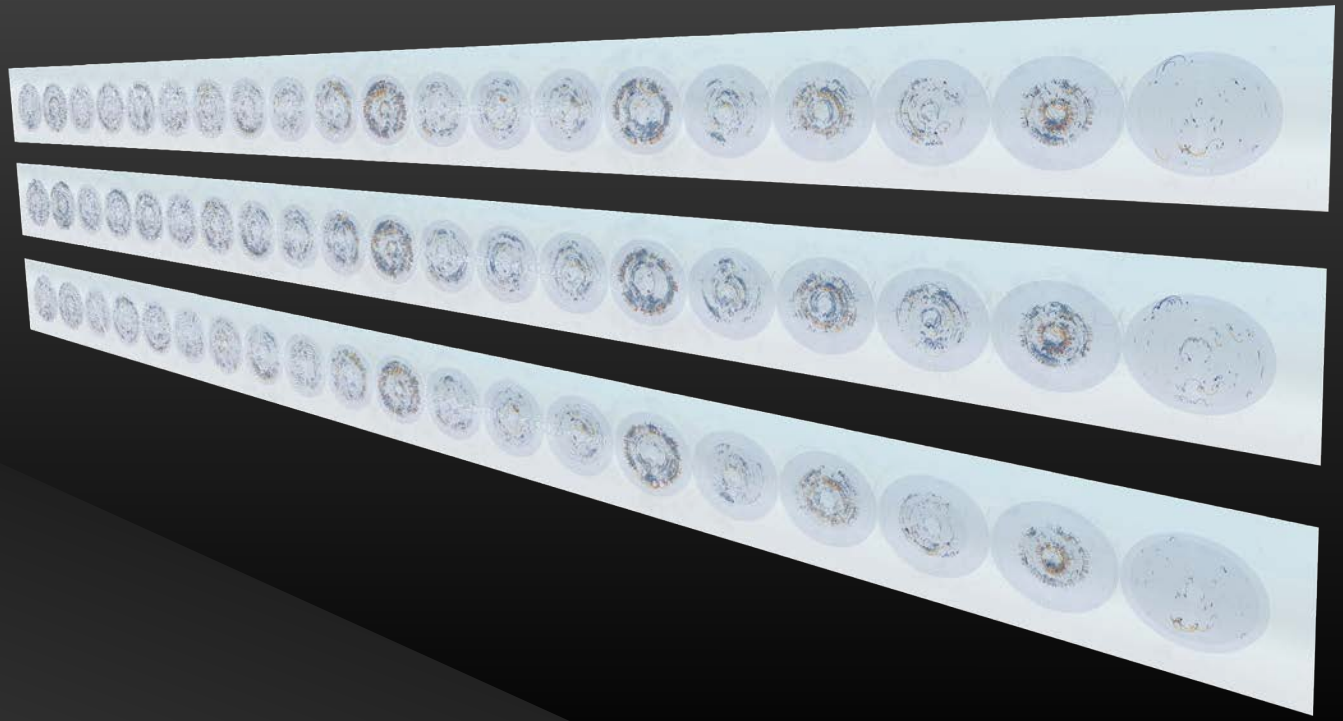
ART BY SANTIAGO LOMBEYDA CALTECH+ARTCENTER | **EXPRESSIVE MAPS**

mouse DNA sequence, taken from embryonic mouse muscle tissue, each chromosome show as a continuous spiral | SIGGRAPH 2013 --



ART BY SANTIAGO URIBE-ZEA | CALTECH-ARTCENTER | **EXPRESSIVE MAPS**

mouse DNA sequence, taken from embryonic mouse muscle tissue, each chromosome show as a continuous spiral | SIGGRAPH 2013 —



ART BY SANTIAGO LOMBEYDA CALTECH+ARTCENTER | **EXPRESSIVE MAPS**

mouse DNA sequence, taken from embryonic mouse muscle tissue, each chromosome show as a continuous spiral | SIGGRAPH 2013 --

ART BY SANTIAGO LOMBEYDA CALTECH+ARTCENTER ON DISPLAY AT THE ALYCE DE ROULET WILLIAMSON GALLERY AT ARTCENTER COLLEGE OF DESIGN | **EXPRESSIVE MAPS**
mouse DNA sequence, taken from embryonic mouse muscle tissue, each chromosome show as a continuous spiral | REALSPACE 2015 --

DIRECT DATA INSPECTION

data faithfulness

self evident & objective representations

CONTEXTUAL INQUIRY PROCESS

ITERATIVE DESIGN & VALIDATION

USE OF RESULTING EFFICIENT TOOL

art mastery
~ visual edification

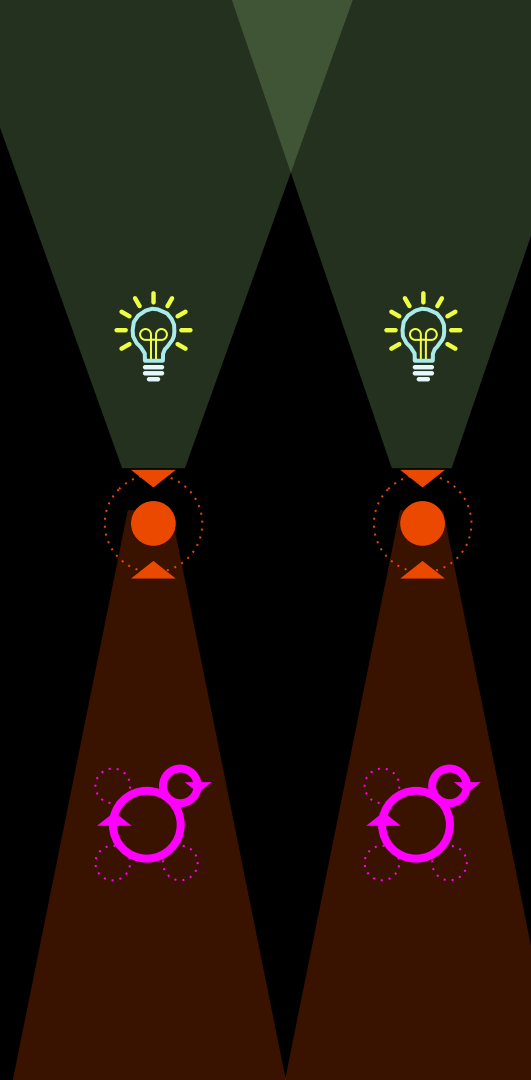
ART PRACTICES + TRUTH = INSIGHT

ART PRACTICES + TRUTH = INSIGHT

thanks!

DATA VISUALIZATION –
SCIENCE

ART + TRUTH = INSIGHT



DATA VISUALIZATION—

ART + TRUTH = INSIGHT

santiago LOMBEYDA

Caltech

CENTER FOR DATA-DRIVEN DISCOVERY

ArtCenter

santiago

santiago
CENTER FOR DATA-DRIVEN DISCOVERY
Caltech
ArtCenter