

# CS 6900 – Seminar

# Research Introduction

Isaac Cho, Ph.D.

Isaac.cho@usu.edu

Assistant Professor, Computer Science, Utah State University

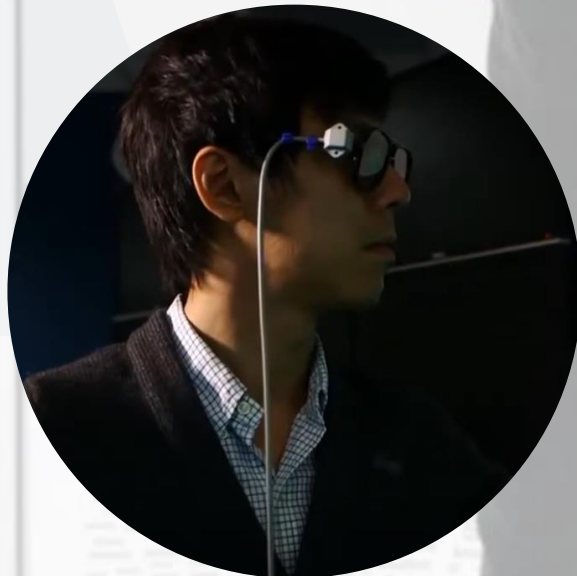
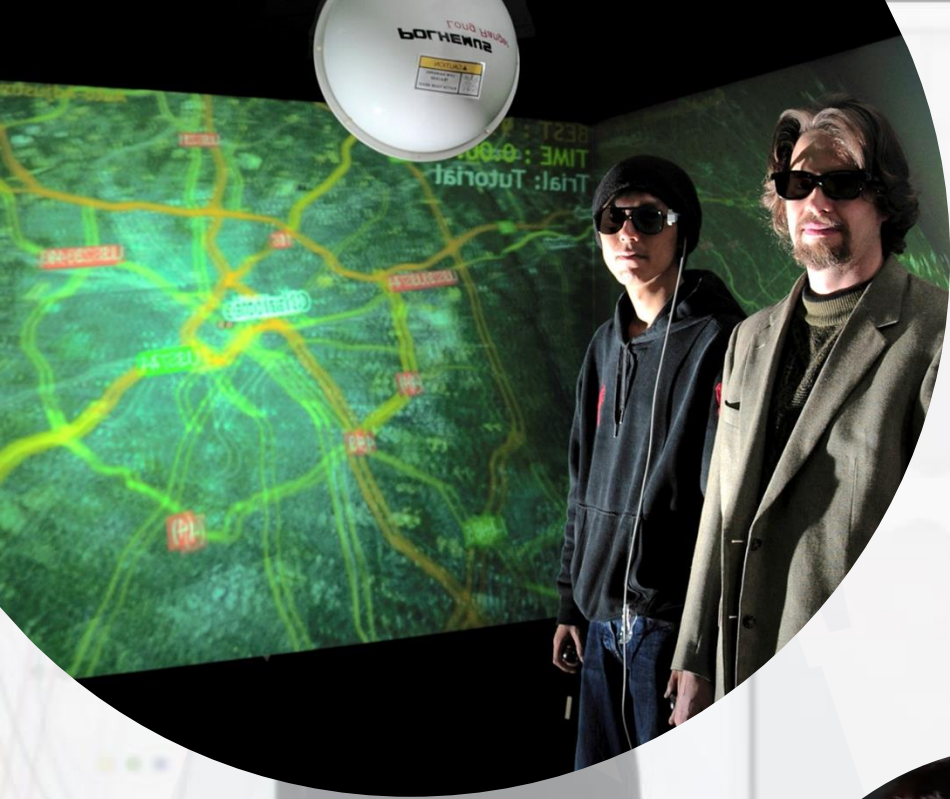
Adjunct Professor, Computer Science, University of North Carolina at Charlotte



# About me

- **Assistant Professor**, Computer Science Department, Utah State University
- **Adjunct Professor**, Computer Science Department, University of North Carolina at Charlotte
- **Director**, VizUS (Visualization lab at Utah State), Utah State University
- **Faculty Member:**
  - Ribarsky Center for Visual Analytics (Charlotte Visualization Center), Data Science Initiative, Cognitive Science Program at UNC Charlotte
- **Education:**
  - **Ph.D.**, University North Carolina at Charlotte, 2013
  - **B.S.** Hallym University, 2007





# Research Expertise & Activities

- Virtual and Augmented Reality
- Multimodal Interactions
- 3D User Interfaces
- Multi-Scale Virtual Environments
- Immersive Analytics
- Human factors in Immersive Environments



ACM SUI

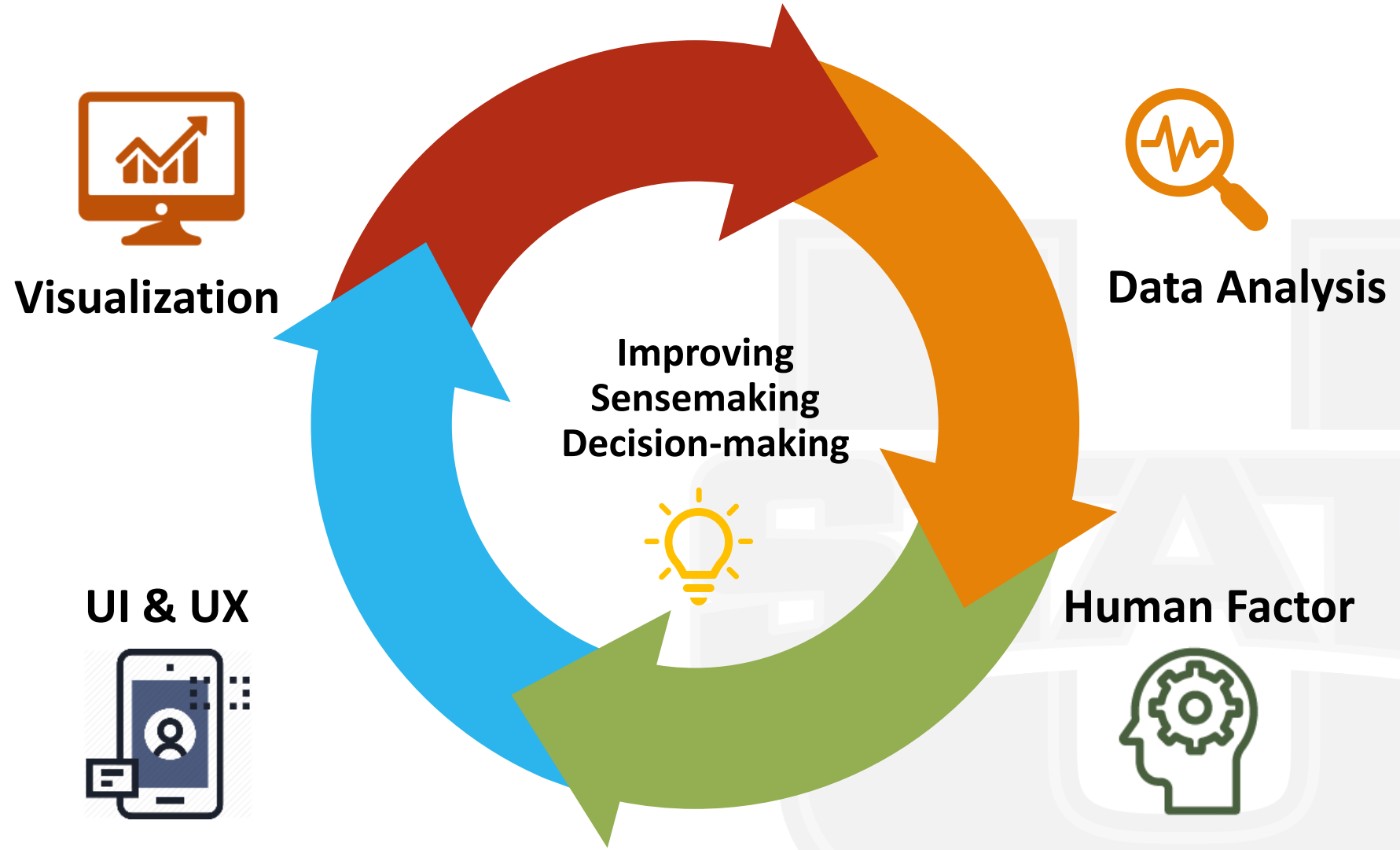
...

ACM CHI, IEEE ISMAR, IEEE TVCG, ACM TiiS ..

**DATA, DATA, DATA**



**DATA EVERYWHERE**



# Research Work

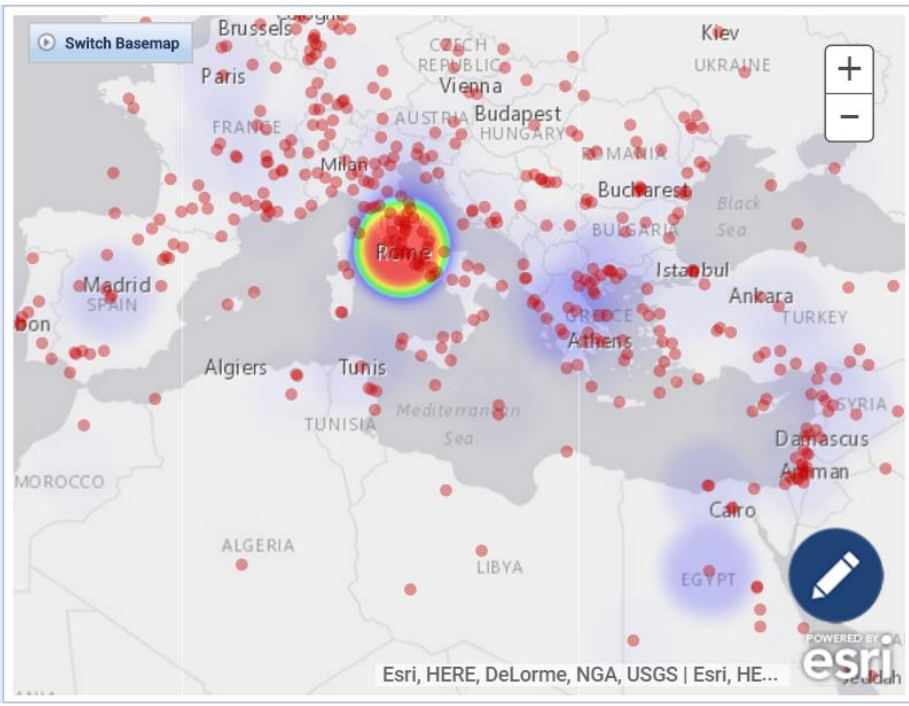
Google: "Isaac Cho Scholar"





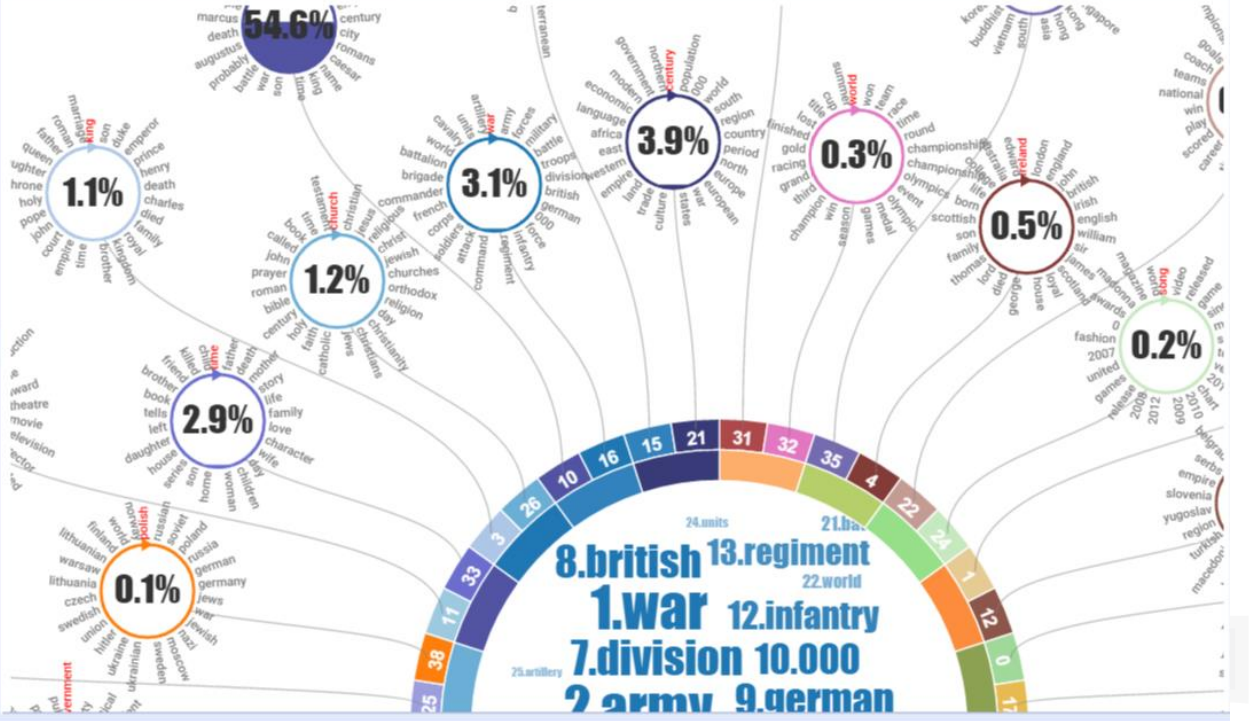
Map | Wiki

Location	Cnt	Certainty
rome	808	4
italy	213	6
egypt	190	6
roman republic	161	3
greece	116	6
philippi	112	3
alexandria	92	4
spain	80	6
gaul	66	3
syria	66	6
macedonia	54	6

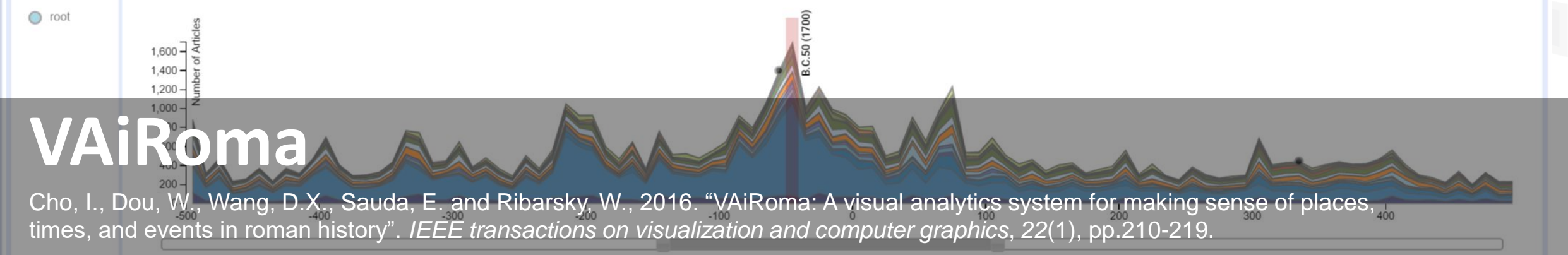


title	#loc
Dacian language	20
Veneto	18
Caesar's Civil War	17
Cleopatra	17
Roman Republic	16
Hasmonean dynasty	15
Hellenistic glass	15
Numidia	14
Abruzzo	14

Map | Wiki | Tree | Topic | Table | Annotation



german music hungarian king ireland album air israel city church roman film greek town building ship war law italian population company century team art song published church american language series species wine world time government india school french polish water



# VaiRoma

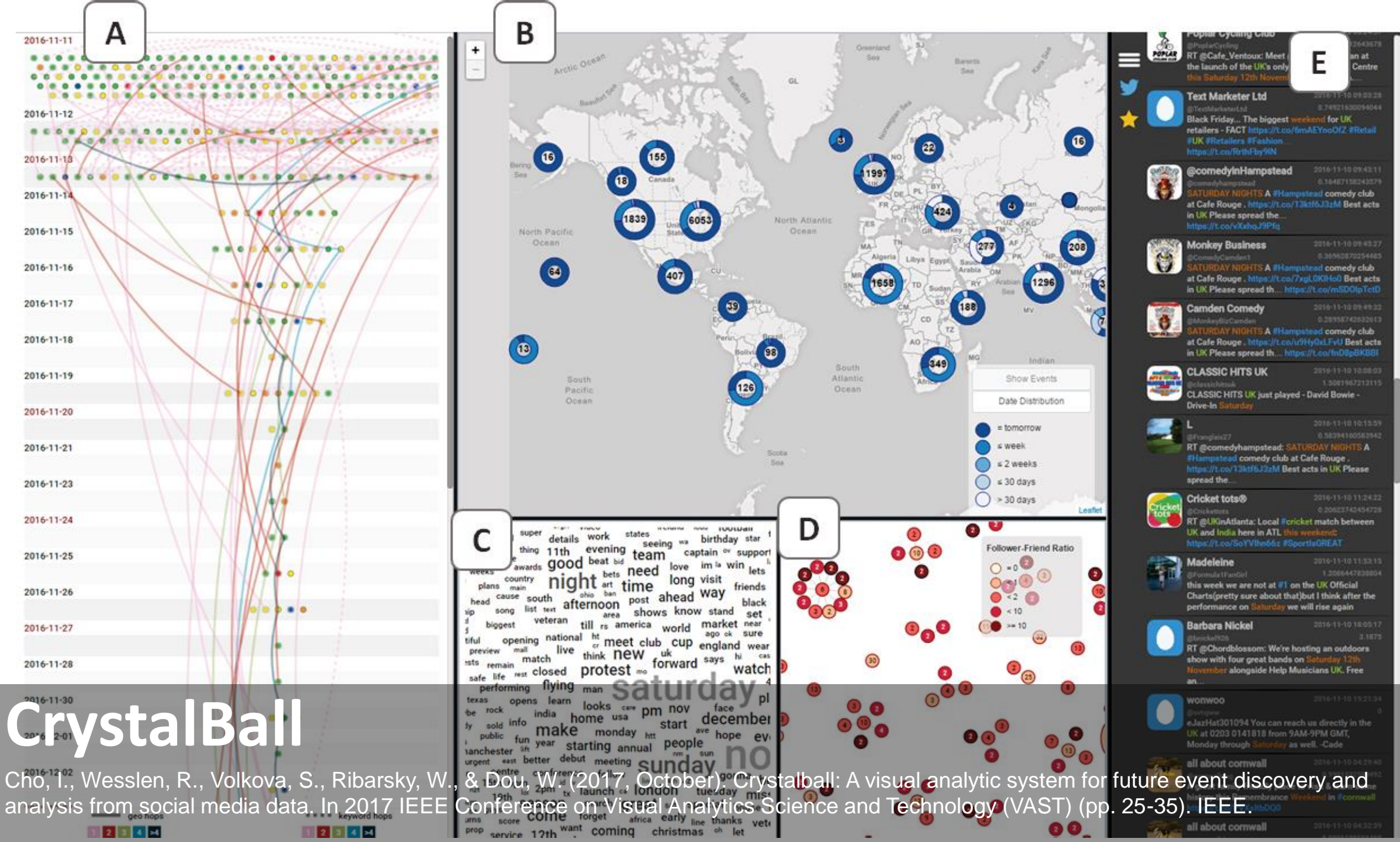
Cho, I., Dou, W., Wang, D.X., Sauda, E. and Ribarsky, W., 2016. "VAiRoma: A visual analytics system for making sense of places, times, and events in roman history". *IEEE transactions on visualization and computer graphics*, 22(1), pp.210-219.

# **VAiRoma: A Visual Analytics System for Making Sense of Places, Times, and Events in Roman History**

**Isaac Cho, Wenwen Dou, Derek Xiaoyu Wang, Eric Sauda and William Ribarsky**

**Charlotte Visualization Center  
UNC Charlotte**





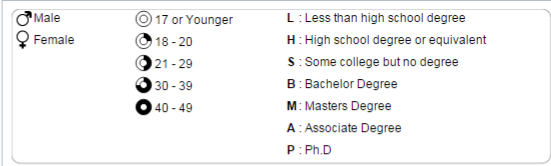
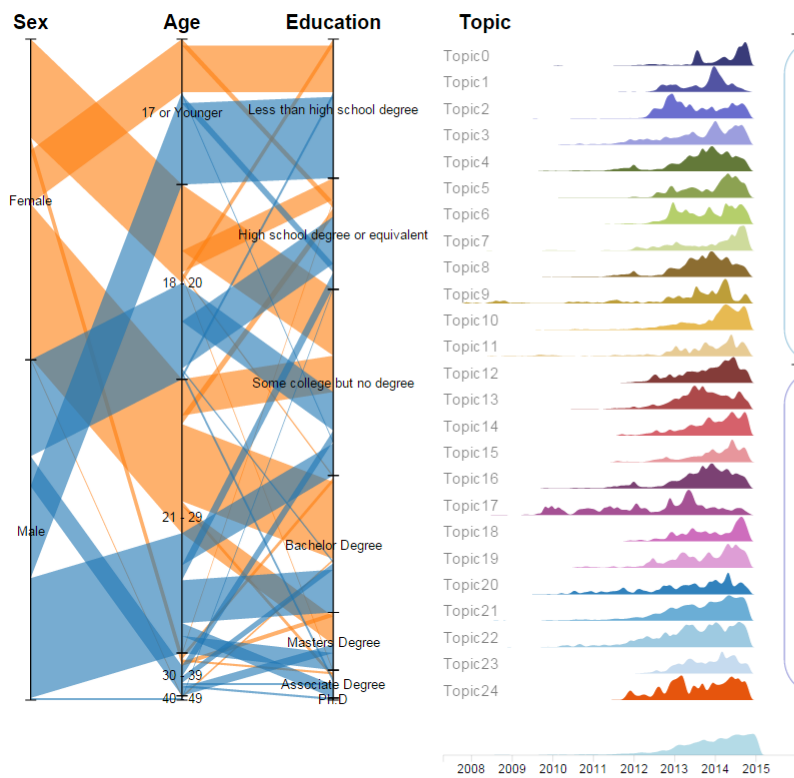
# CrystalBall

Cho, I., Wesslen, R., Volkova, S., Ribarsky, W., & Dou, W. (2017, October). Crystalball: A visual analytic system for future event discovery and analysis from social media data. In 2017 IEEE Conference on Visual Analytics Science and Technology (VAST) (pp. 25-35). IEEE.

VAST PAPER

# CrystalBall: A Visual Analytic System for Future Event Discovery and Analysis from Social Media Data

Isaac Cho, Ryan Wesslen, Svitlana Volkova, Bill Ribarsky, Wenwen Dou



choose primary axis: Sex  
 Graphs normalization: no

	Female	Male	17 or Younger	18-20	21-29	30-39	Less than high school degree	Bachelor Degree	Some college but no degree	High school degree or equivalent	Associate Degree
Linguistic	33.15%	33.55%	3.01%	6.84%	4.50%	0%	0%	5.35%	0%	4.75%	10.63%
anx	Dash	Comma	filler	filler	future	you	achieve	SemiC	quant	present	relativ
verb	Exclam	leisure	health	swear	filler	WC	adverb	posemo	negemo	time	
Dash	family	ingest	Dash	shehe	body	leisure	excl	AllPct	humans	filler	
Exclam	money	quant	work	work	they	see	time	assent	you	see	
cogmech	relig	WC	nonfl	SemiC	posemo	verb	i	money	leisure	affect	
Topic	9.54%	17.83%	13.46%	9.75%	9.83%	0%	13.68%	0%	0%	Leisure	37%
Subreddit	32.62%	32.49%	29.78%	13.94%	0%	21.63%	13.01%	0%	3.31%	ex) Cook, chat, movie	109%
OtherInfo	3.15%	3.15%	0%	1.47%	1.09%	12.28%	7.57%	0%	2.5%	3.53%	13.66%
Linguistic	80.3%	76.1%	55.7%	40.1%	27.2%	17.1%	13.6%	10.7%	19.7%	39.7%	66.27%
Topic	87.8%	85.1%	31.1%	57.0%	49.0%	57.0%	41.1%	50.78%	41.1%	65.34%	63.75%
Subreddit	32.94%	30.1%	33.85%	17.0%	57.0%	13.6%	6.37%	6.37%	57.0%	64.36%	61.61%
OtherInfo	83.57%	89.81%	65.08%	61.3%	56.13%	56.52%	68.32%	50.00%	53.54%	64.26%	66.70%

# DemographicVis

User	Title	Selftext	Topic	Ups	downs	Time
bl***	Anyone know what kind of dog this is?	Australian Cattle Dog aka blue or red heeler depending ...	dogpictures	43	0	9/3/2014
bl***	[Photo Friday] I got puppy fever!	[Service Dog puppy](http://i.imgur.com/VuCV31k.jpg). Sh...	dogs	20	0	6/5/2014
bl***	ACDRA took in 14 dogs from a neglect case in Mississippi...	[Australian Cattle Dog Rescue](http://www.acdra.org/) L...	AustralianCattleDog	15	0	9/3/2014
bl***	Anyone a member of Australian Cattle Dog Rescue Associa...	Ive been a member for about a year. They're having a C...	AustralianCattleDog	7	0	6/0/2013
bl***	I really want an ACD but I don't know if my home is fit...	Dog parks shouldnt be the only source of exercise and p...	AustralianCattleDog	5	0	7/4/2013
bl***	Gifts that help animals	A lady in my cattle dog rescue started [this](http://gl...	dogs	5	0	11/3/2013
bl***	What breed of dog is this? I want him.	Australian Cattle Dog (aka blue or red heeler). Not a d...	dogpictures	4	0	8/3/2014
bl***	I just adopted a new doggy! Any ideas on what breed	Definitely looks like a cattle dog mix	dogs	3	0	0/3/2014

Title: Anyone know what kind of dog this is?  
 Selftext: Australian *Cattle Dog* aka blue or red heeler depending on their coloring. He looks very young.

Dou, W., Cho, I., ElTayeb, O., Choo, J., Wang, X., & Ribarsky, W. (2015, October). DemographicVis: Analyzing demographic information based on user generated content. In 2015 IEEE Conference on Visual Analytics Science and Technology (VAST) (pp. 57-64). IEEE.

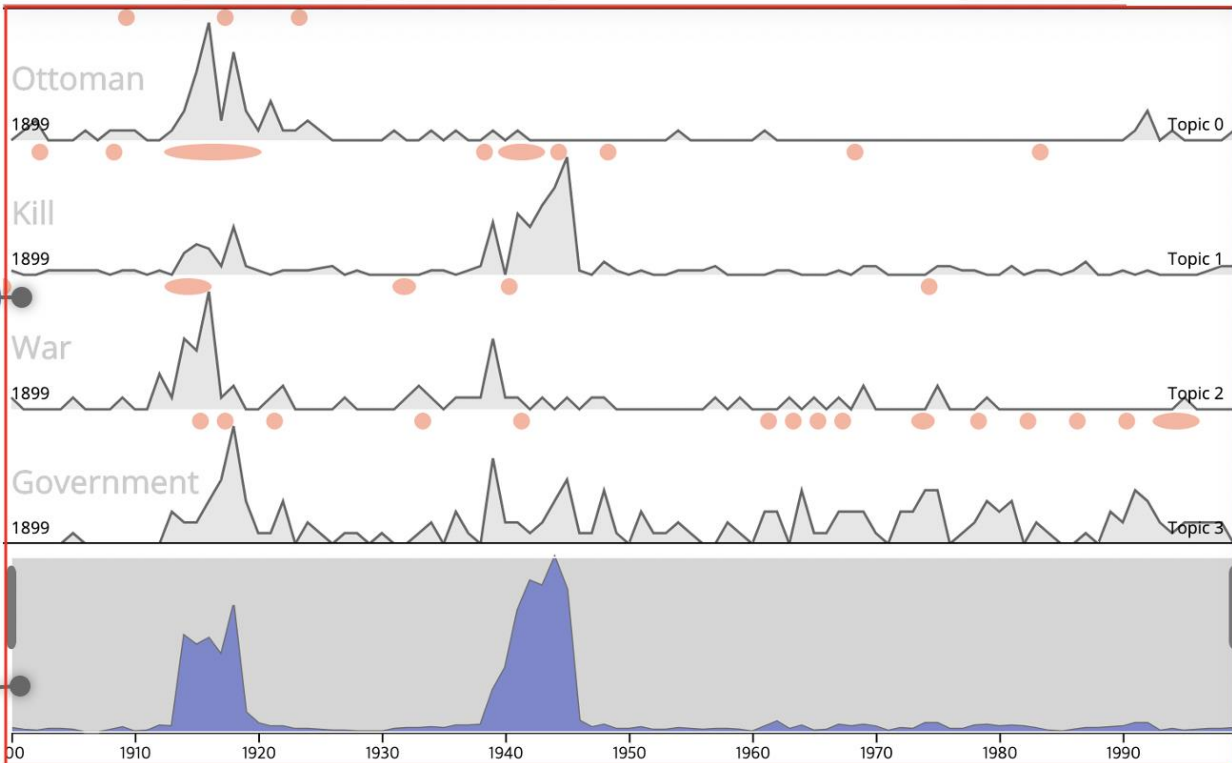
# **DemographicVis: Analyzing Demographic Information based on User Generated Content**

**Wenwen Dou, Isaac Cho, Omar ElTayeby, Jaegul Choo,  
Derek Xiaoyu Wang and William Ribarsky**

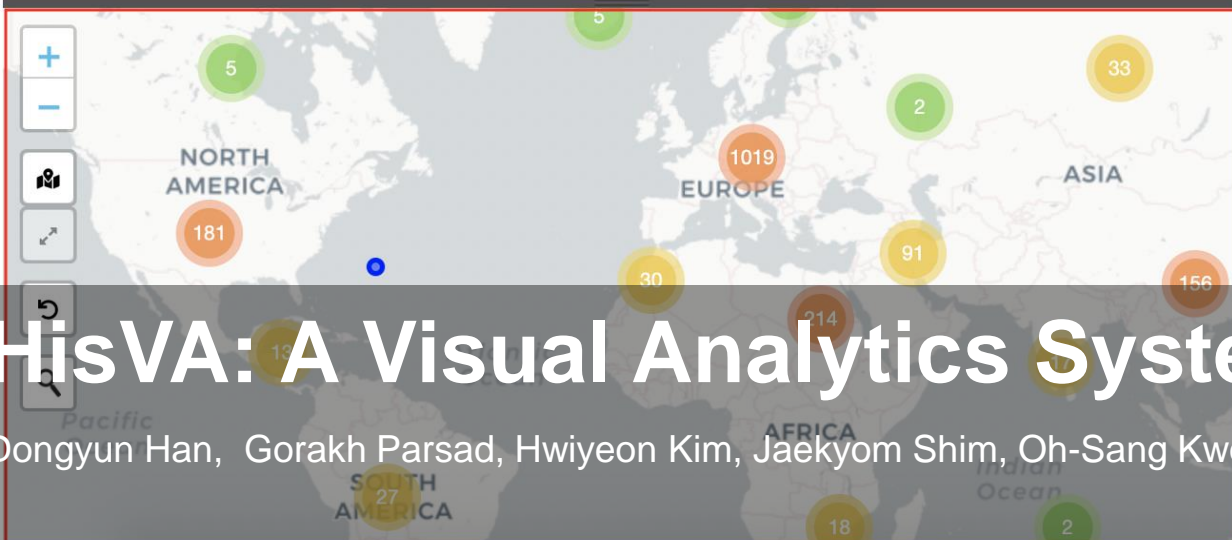
**Charlotte Visualization Center  
UNC Charlotte**



A



B



C

list result article annotation

Clear Timeline

Time Order



**Balkan League**  
1912-10-01  
Topic 9 (0.353), 5 (0.327)  
PageRank 0.02346



**First Balkan War**  
1912-10-15  
Topic 9 (0.337)  
PageRank 0.09618



**Balkan Wars**  
1913-06-16  
Topic 9 (0.412), 5 (0.23)  
PageRank 0.09817



**Second Balkan War**  
1913-07-20  
Topic 9 (0.453)  
PageRank 0.09474



**Assassination of Archduke Franz Ferdinand**  
1914-06-28  
Topic 9 (0.411), 1 (0.342)  
PageRank 0.16299



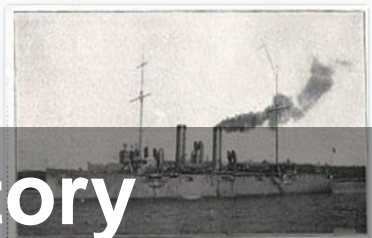
**Anti-Serb riots in Sarajevo**  
1914-06-29  
Topic 9 (0.372), 1 (0.259), 3 (0.218)  
PageRank 0.00656



**Hungary in World War I**  
1914-07-01  
Topic 5 (0.221), 9 (0.239), 4 (0.22)  
PageRank 0.00062



**Battle of Cer**  
1914-08-01  
Topic 9 (0.462)  
PageRank 0.00879



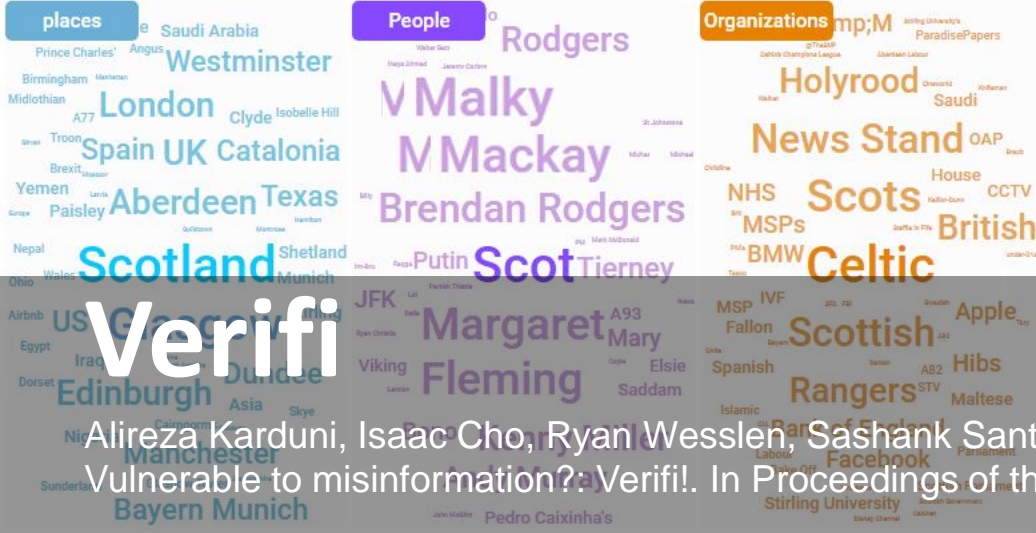
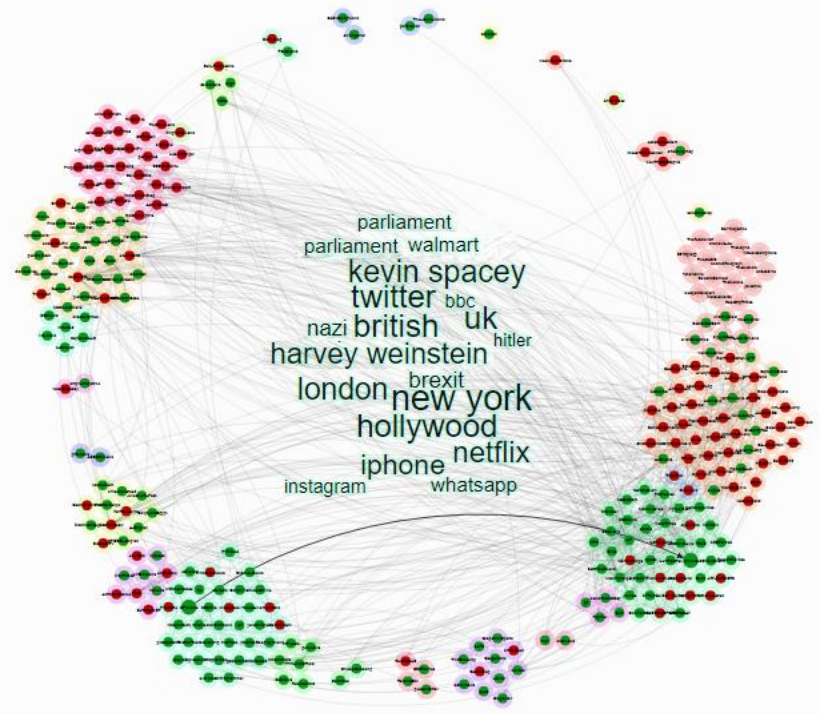
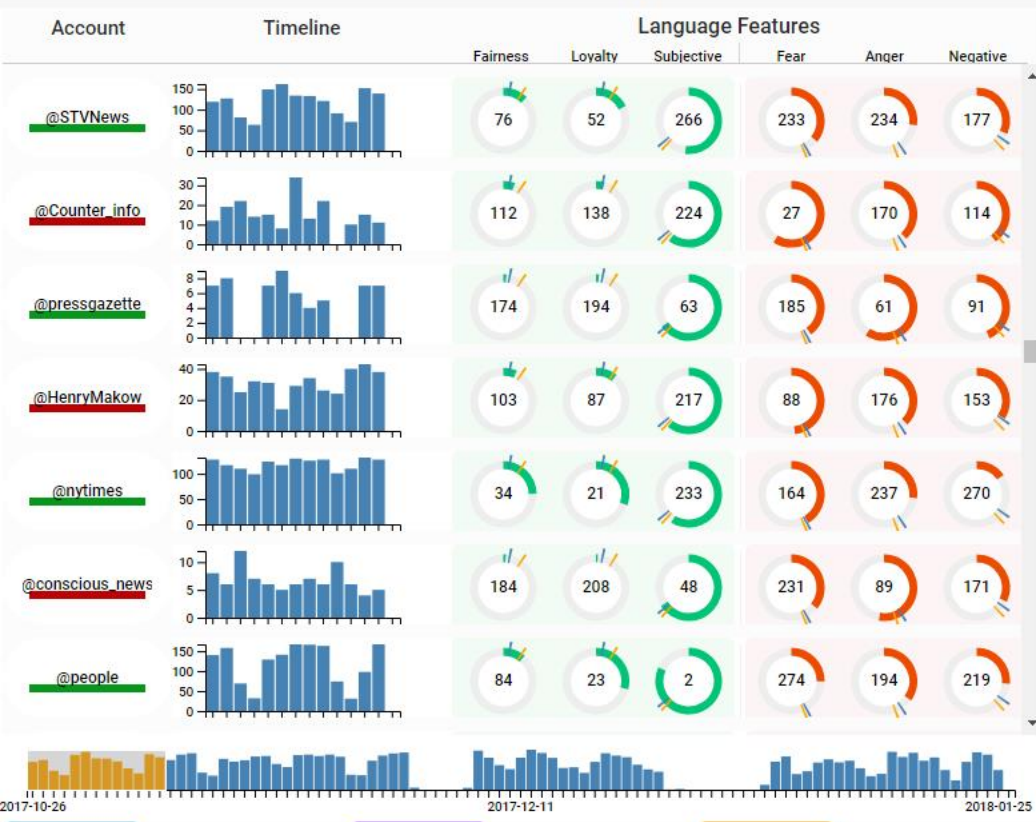
**Battle of Antivari**  
1914-08-16  
Topic 5 (0.347), 9 (0.218)  
PageRank 0.00411

# HisVA: A Visual Analytics System for Learning History

Dongyun Han, Gorakh Parsad, Hwiyeon Kim, Jaekyom Shim, Oh-Sang Kwon, Kyung A Son, Jooyoung Lee, Isaac Cho, and Sungahn Ko







close

- STVNews **Wednesday, Mar-28-2018, 11:17 am**

News Stand: Catch up on this morning's headline news. #scotpapers <https://t.co/tVvB67rzBy> <https://t.co/78B7QRJmW9>
- STVNews **Wednesday, Mar-28-2018, 11:17 am**

Scotland's health 'is not improving', warns @AuditScotland <https://t.co/8Yz5wMnMt1> <https://t.co/7w6xVHGqPe>
- STVNews **Wednesday, Mar-28-2018, 11:17 am**

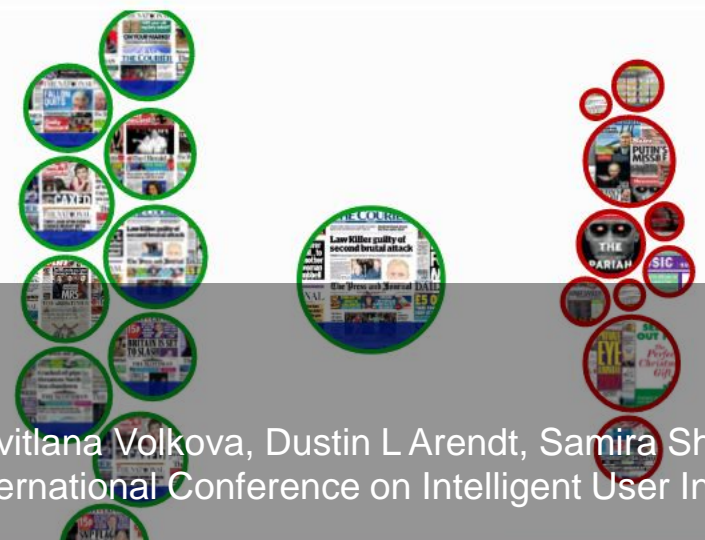
Kenyan opposition calls for boycott at repeat presidential election <https://t.co/gRanBZsPcX> <https://t.co/wELNwvQUDs>
- STVNews **Wednesday, Mar-28-2018, 11:17 am**

News Stand: Freed killer attacks again, Neglect scandal <https://t.co/4d5S7EMmQL> <https://t.co/rWmbhMoM9r>
- STVNews **Wednesday, Mar-28-2018, 11:17 am**

Scotland's health 'is not improving', warns watchdog <https://t.co/tKwQ3FUtg> <https://t.co/gOpWEpdVQC>
- STVNews **Wednesday, Mar-28-2018, 11:17 am**

Kenyan opposition calls for boycott at repeat election <https://t.co/lqskqHkdvY> <https://t.co/fnrQJdm4Xu>
- STVNews **Wednesday, Mar-28-2018, 11:17 am**

Science centres in #Glasgow, #Edinburgh, #Dundee and #Aberdeen to share £2.6m funding boost <https://t.co/CdxkkvZLOh>



ES VA

Expand

W

NW

SW

MW

SE

NE

MA

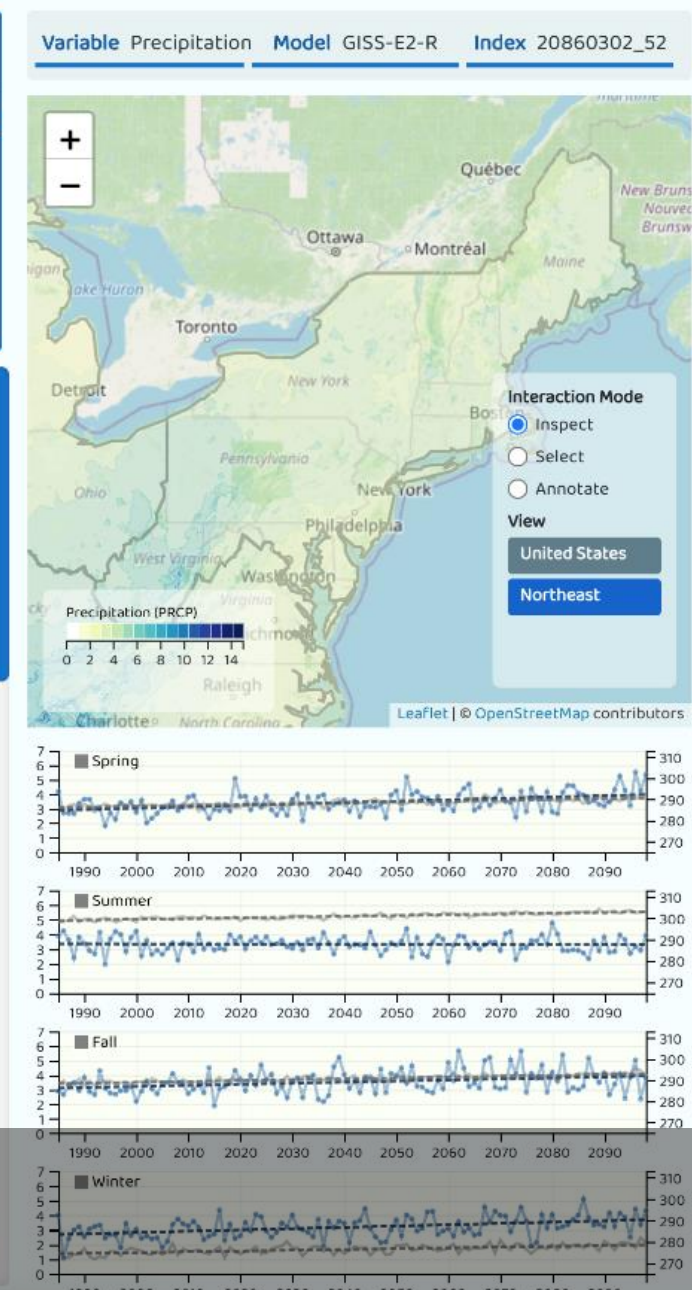
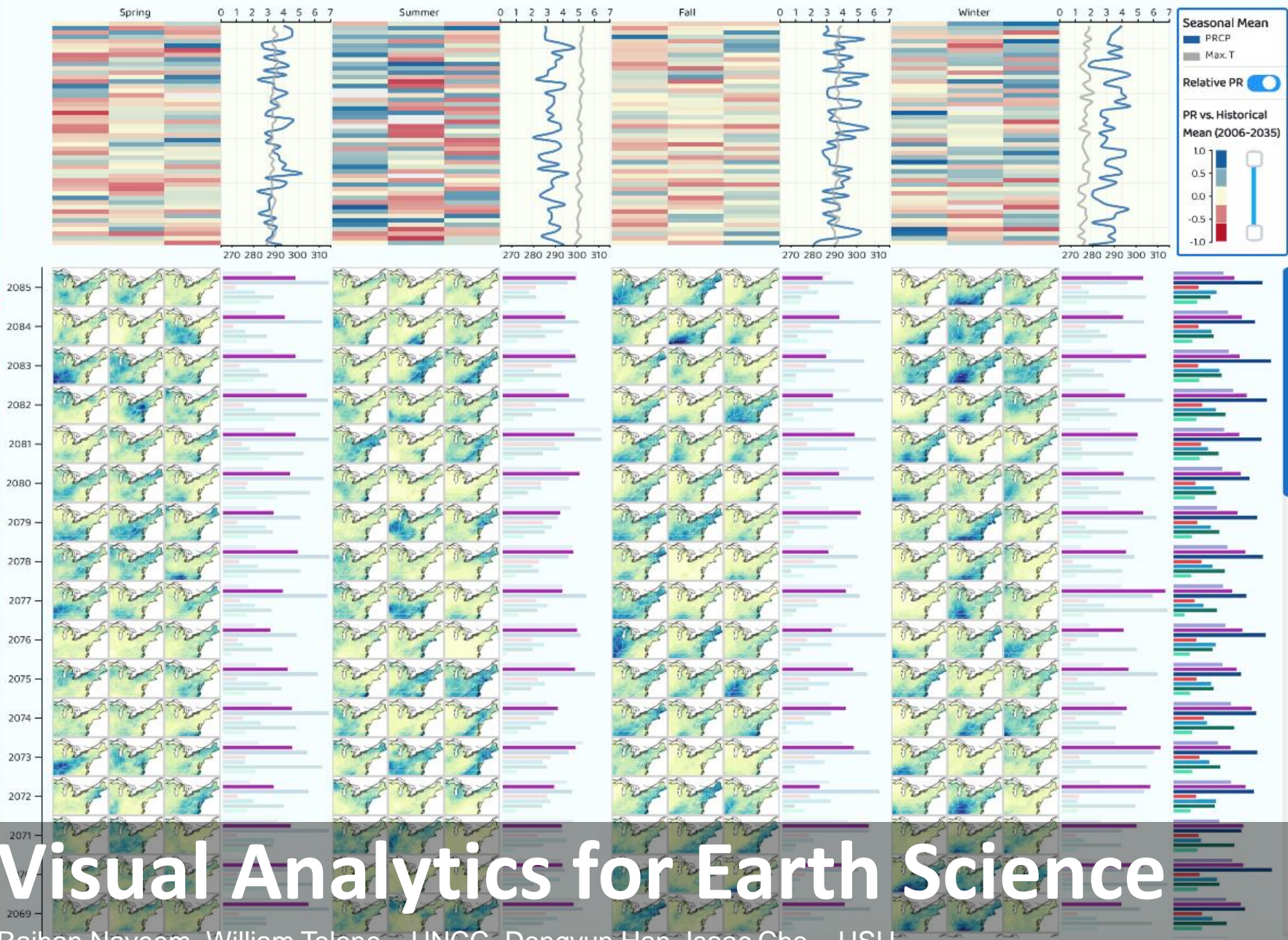
US

Time

Series

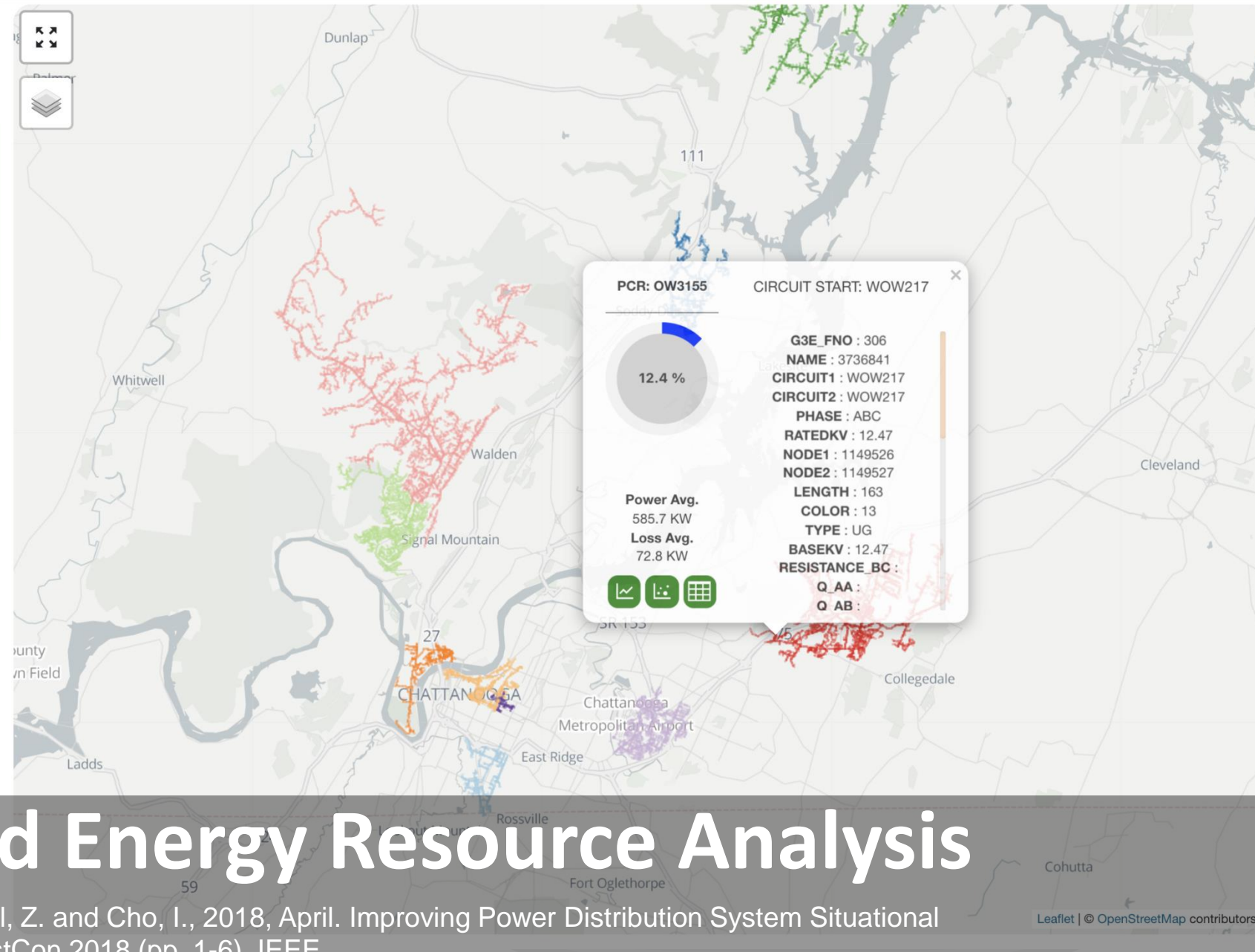
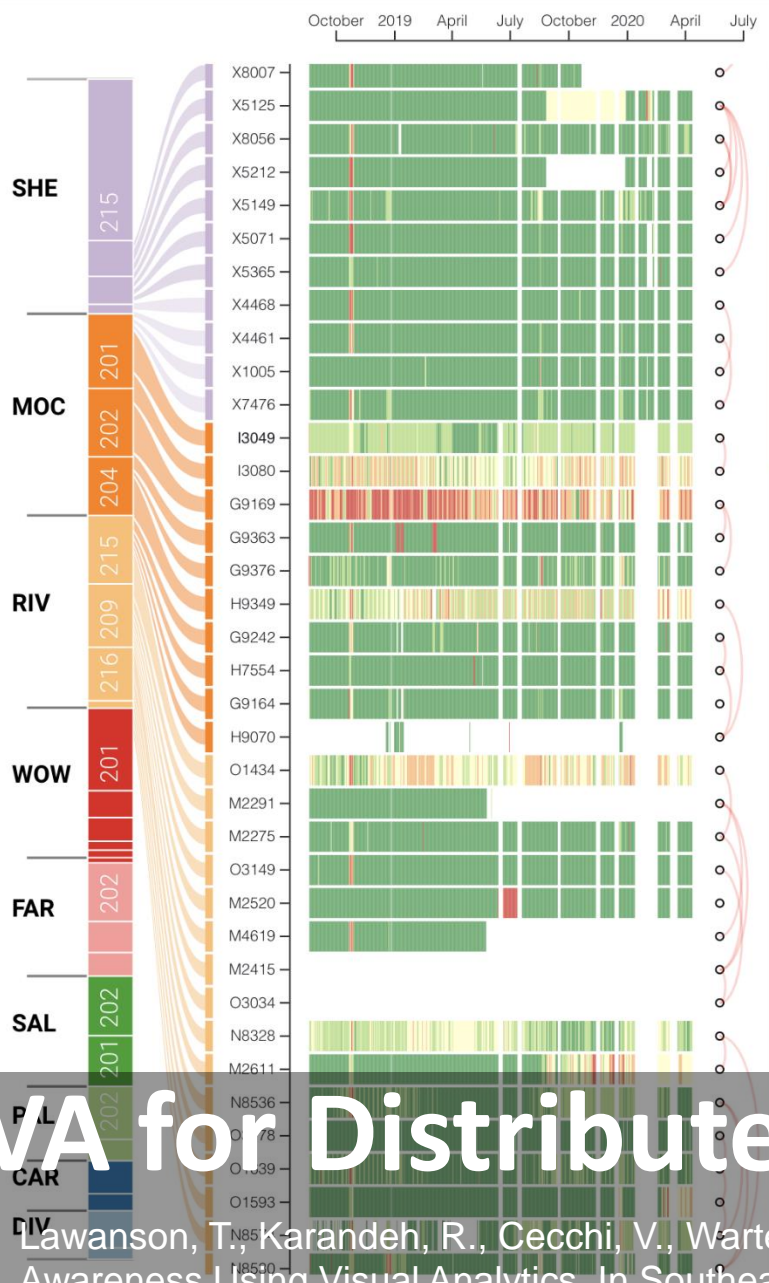
Histogram

Treemap



# Visual Analytics for Earth Science

Raihan Nayeem, William Tolone – UNCC, Dongyun Han, Isaac Cho – USU  
 Kyo Lee, Daniel Crichton – NASA JPL



# VA for Distributed Energy Resource Analysis

Lawson, T., Karandeh, R., Cecchi, V., Wartell, Z. and Cho, I., 2018, April. Improving Power Distribution System Situational Awareness Using Visual Analytics. In SoutheastCon 2018 (pp. 1-6). IEEE.

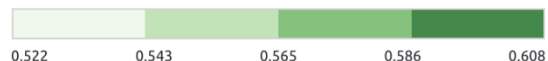
Analysis:

Network Centrality

Policy Topic: ALL

Year: 1950 ~2017

Measurement: Closeness



Sort By:

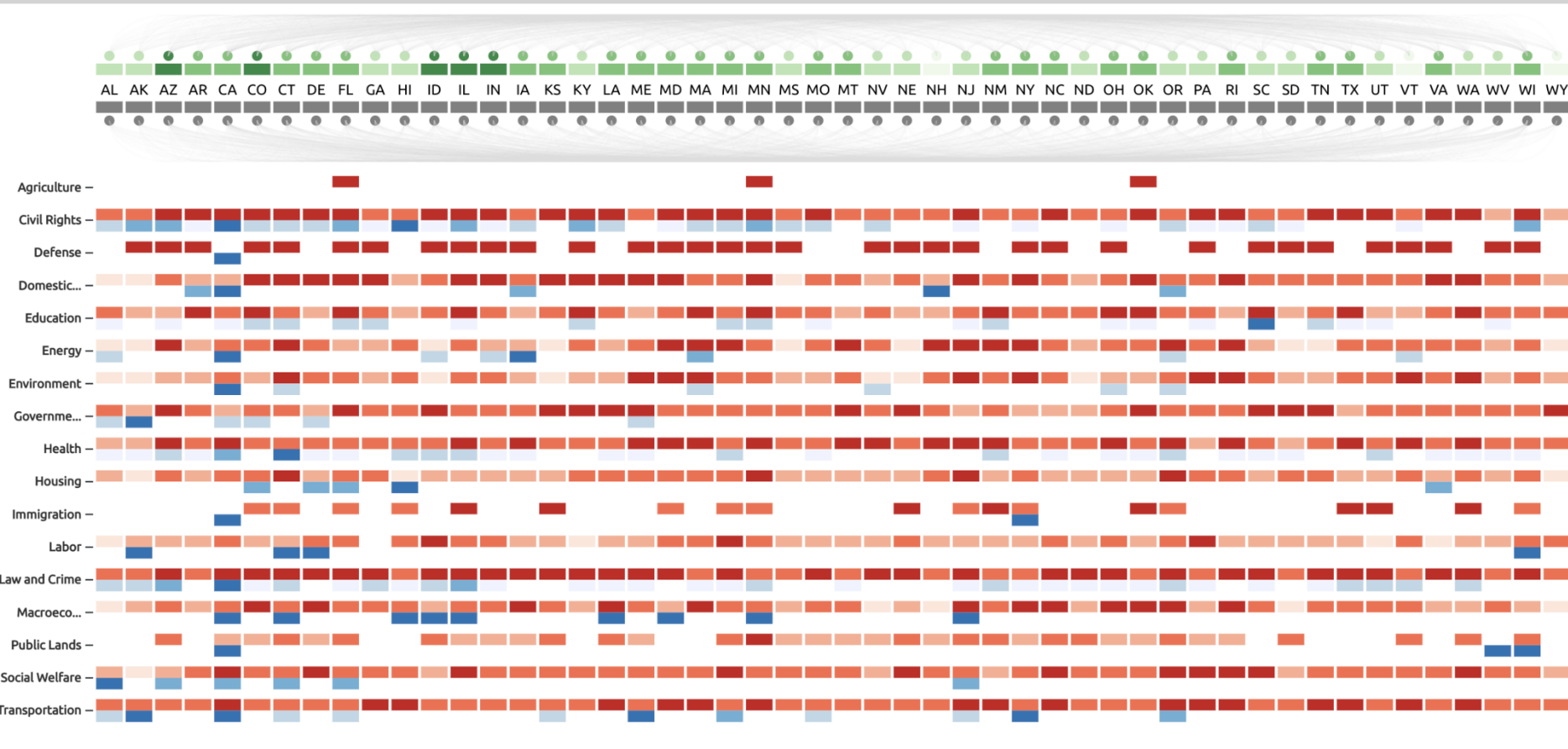
State: Alphabetic

Policy: Alphabetic

- Policy Diffusion Analysis View -

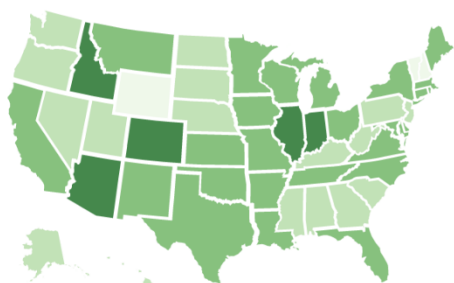
- Incoming / Outgoing / Bi-Direction Path
- # New Policy Adoption Color
- # Existing Policy Adoption Colors

Policy Diffusion Analysis View



Geographic View

US State Hexbin

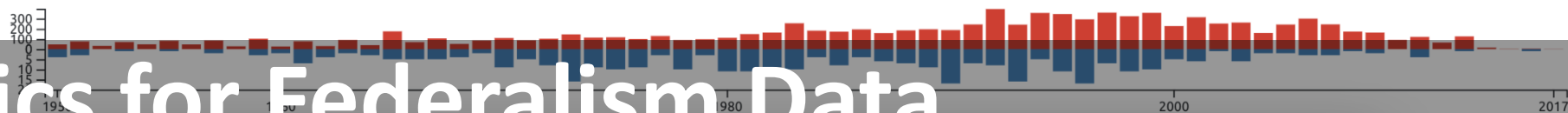


Policy Adoption View

By Year By State By Topic By Census

- # Existing Policy Adoption
- # New Policy Creation

Share Y Domain:



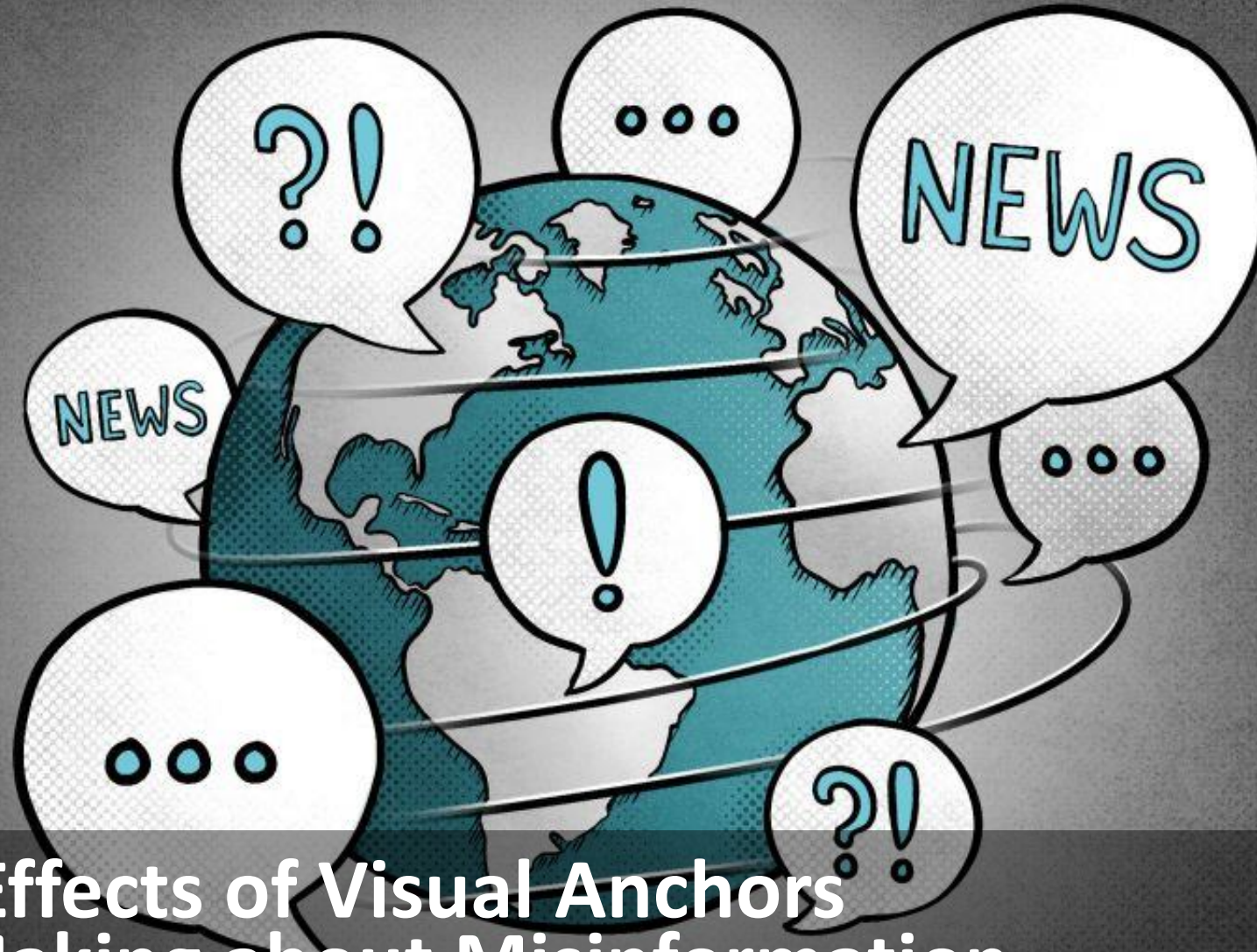
# Visual Analytics for Federalism Data

NSF - Convergence Accelerator (C-Accel) Dongyun Han, Isaac Cho – USU, Jason Windett, Samira Shaikh – UNCC  
 OpenState, RPI, University of Notre Dame, Northwestern etc



# The Anchoring Effect in Decision-Making with Visual Analytics

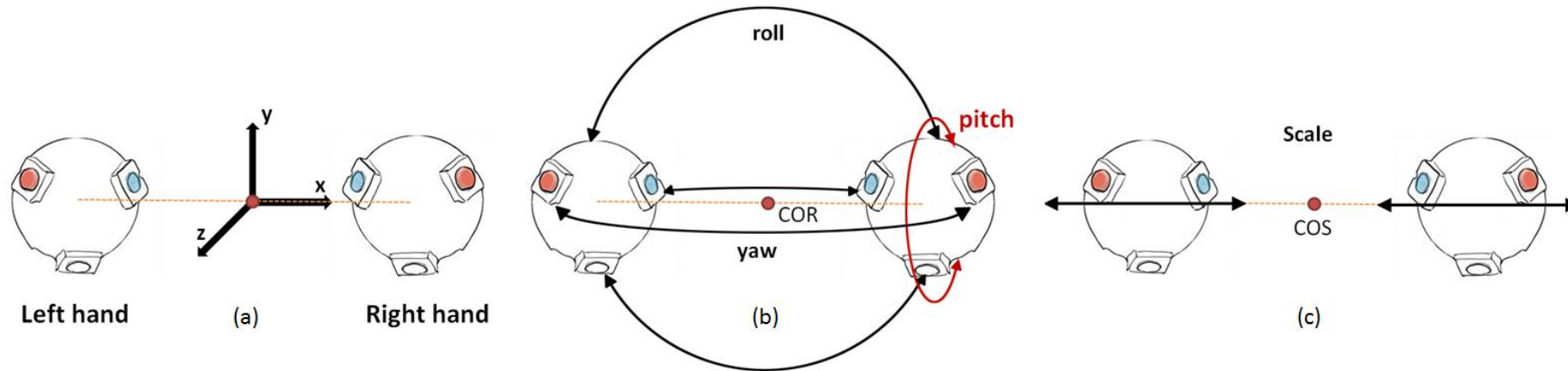
Cho I, Wesslen R, Karduni A, Santhanam S, Shaikh S, Dou W. The anchoring effect in decision-making with visual analytics. In 2017 IEEE Conference on Visual Analytics Science and Technology (VAST) 2017 Oct 3 (pp. 116-126). IEEE.



# Investigating Effects of Visual Anchors on Decision-Making about Misinformation

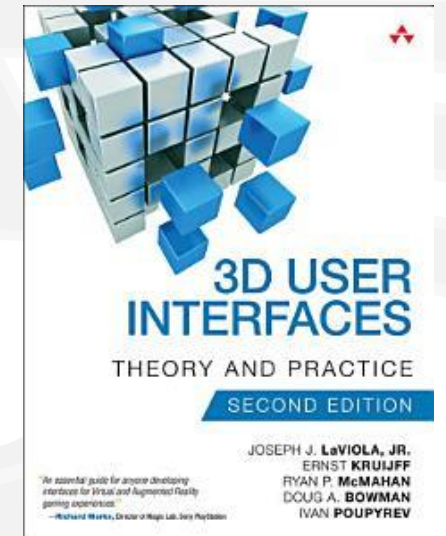
Wesslen, R., Santhanam, S., Karduni, A., Cho, I., Shaikh, S. and Dou, W., 2019, June. Investigating Effects of Visual Anchors on Decision-Making about Misinformation. In Computer Graphics Forum (Vol. 38, No. 3, pp. 161-171)

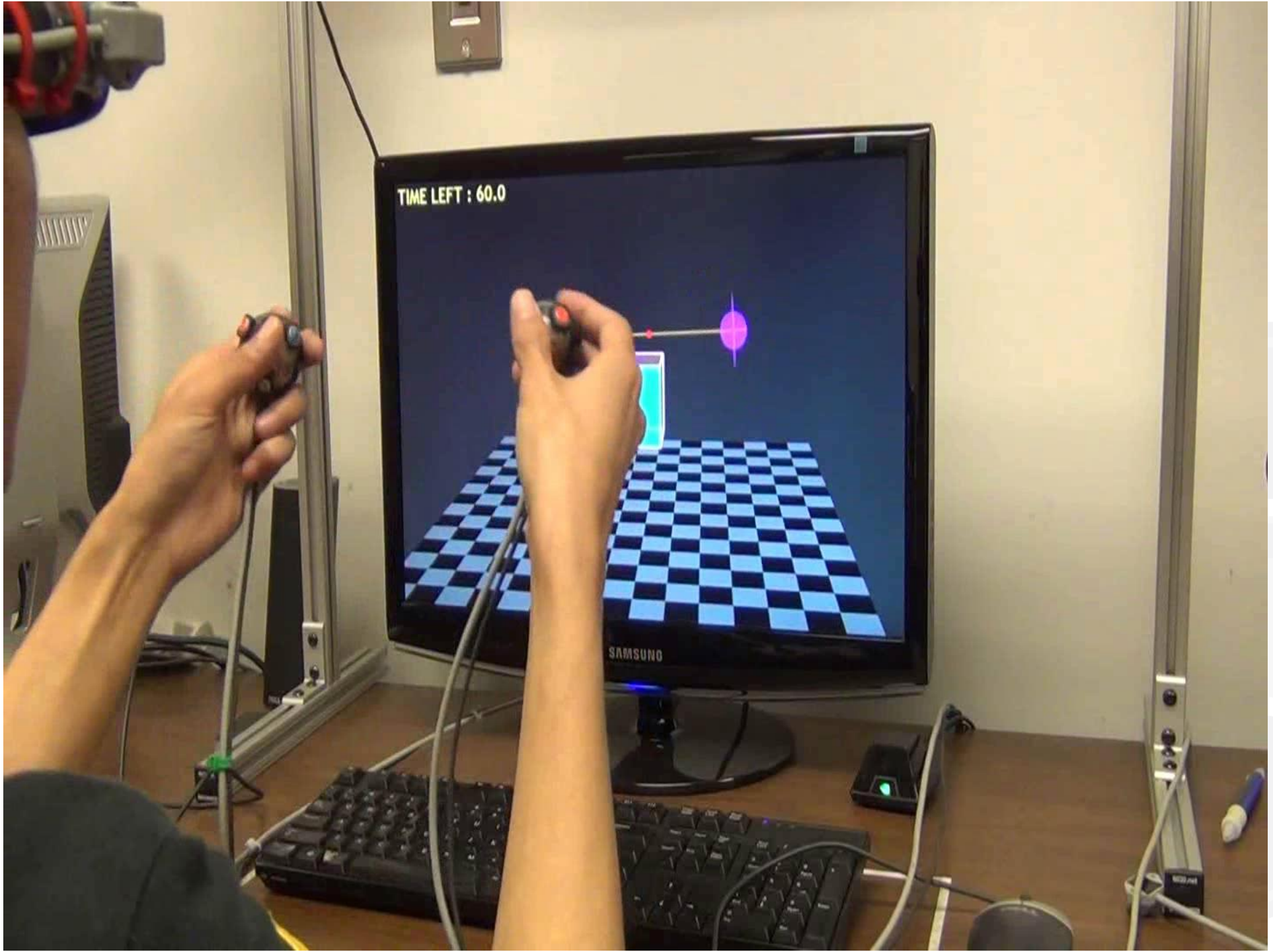
# 3D User Interfaces in Virtual Environments



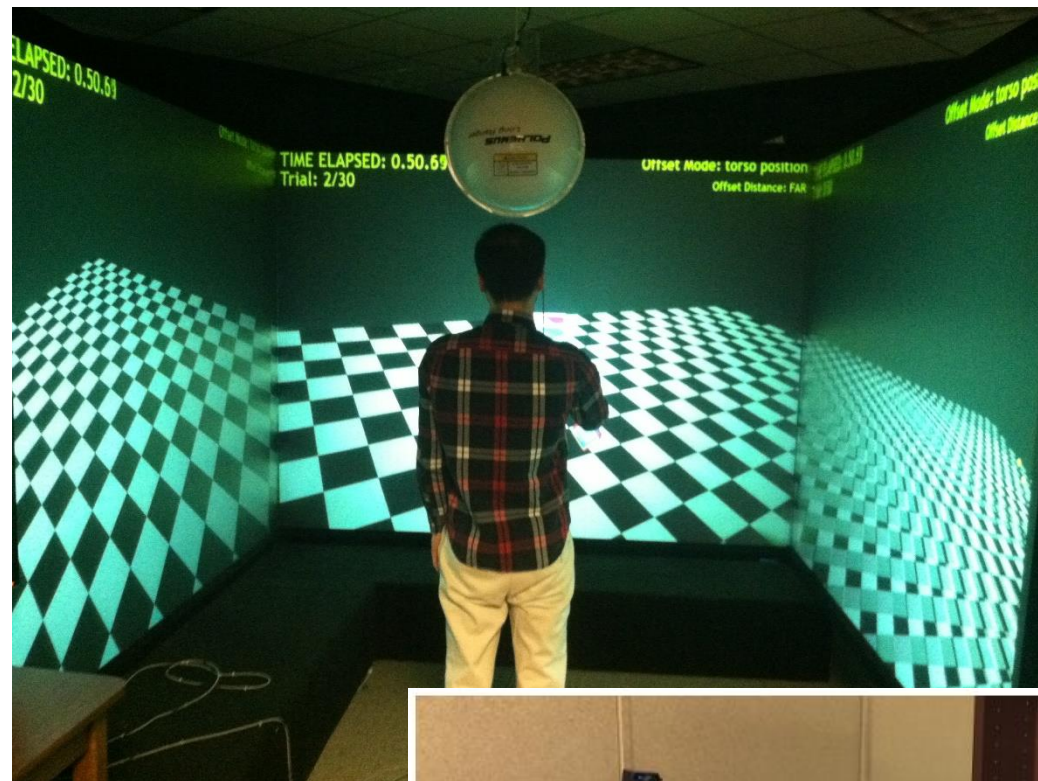
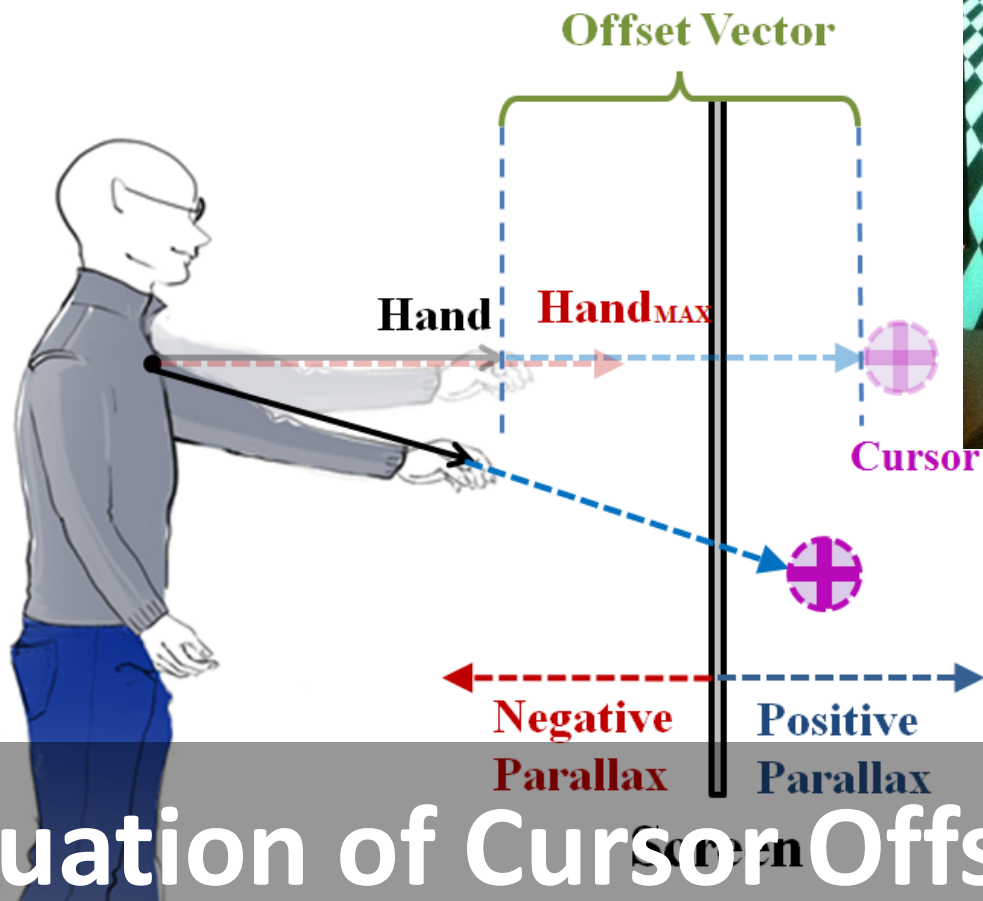
## 7DOF Manipulation: $x, y, z + \text{yaw}, \text{pitch}, \text{roll} + \text{scale}$

- Cho, I., & Wartell, Z. (2015, March). Evaluation of a bimanual simultaneous 7DOF interaction technique in virtual environments. In *2015 IEEE Symposium on 3D User Interfaces (3DUI)* (pp. 133-136). IEEE.
  - <https://www.youtube.com/watch?v=nF4egFHLYM>
- 3D User Interfaces: Theory and Practice, Edition 2, Joseph J. LaViola Jr. Ernst Kruijff Ryan P. McMahan Doug Bowman Ivan P. Poupyrev, Addison-Wesley Professional







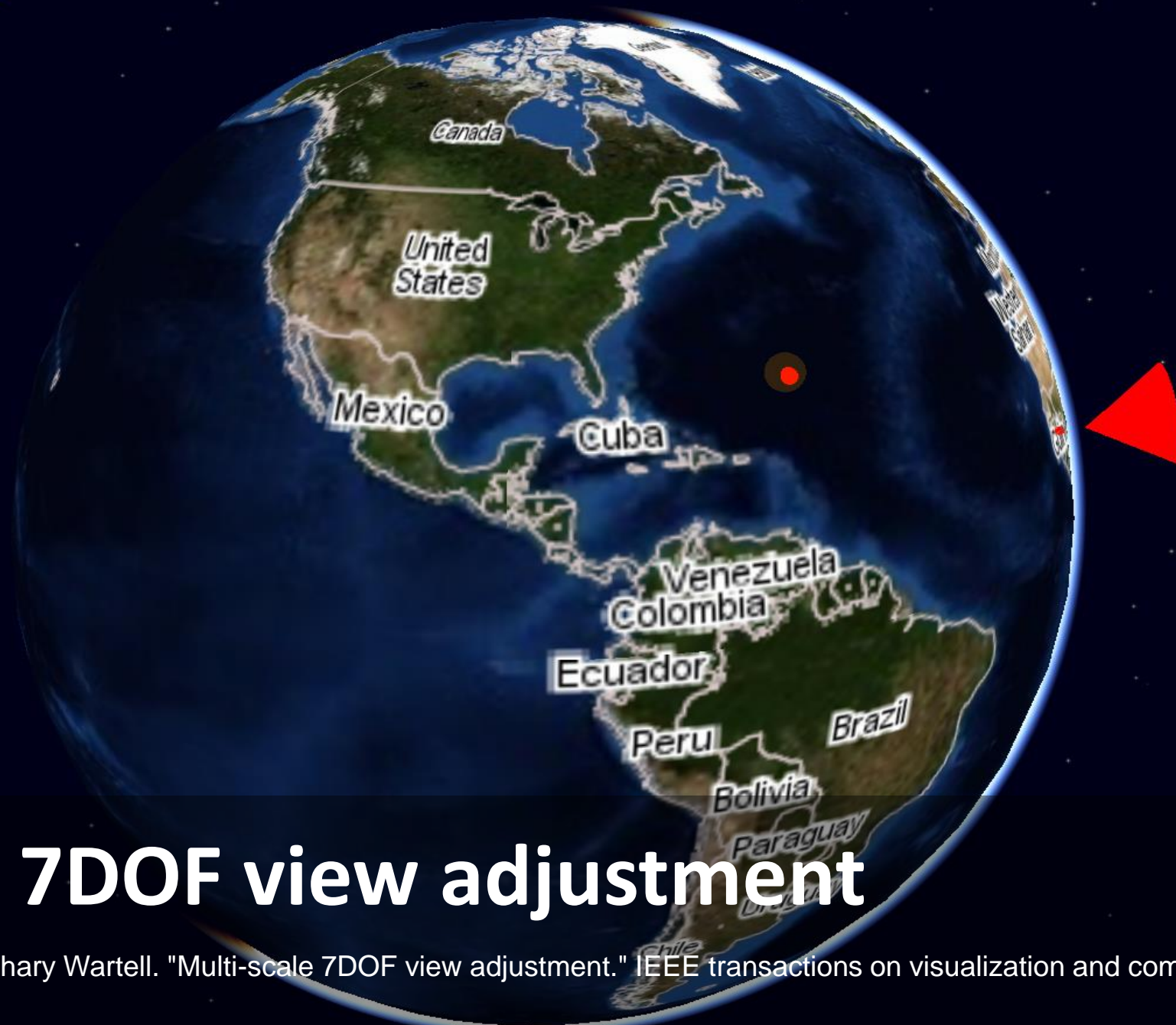


# Evaluation of Cursor Offset on 3D Selection in VR

Li, J., Cho, I. and Wartell, Z., 2018, October. Evaluation of cursor offset on 3d selection in vr. In Proceedings of the Symposium on Spatial User Interaction (pp. 120-129).

**BEST : 99.99.99**  
**TIME : 0.15.48**  
**Trial: 1/20**

Auto-Adjustment mode: Cyclopean Scale  
City: Bissau



# Multi-scale 7DOF view adjustment

Cho, Isaac, Jialei Li, and Zachary Wartell. "Multi-scale 7DOF view adjustment." IEEE transactions on visualization and computer graphics 24.3 (2017): 1331-1344.

scale : 7.86207e-007

00  
Tutorial

BEST : 99.99.99  
TIME : 0.00.00  
Trial: Tutorial

Adjustment mode:  
City:

00.00.99  
TIME : 0.00.00  
Tutorial



2.92226



**6 DOF Input Mode**



**3 DOF Input Mode**



**3D & 2D Gesture**



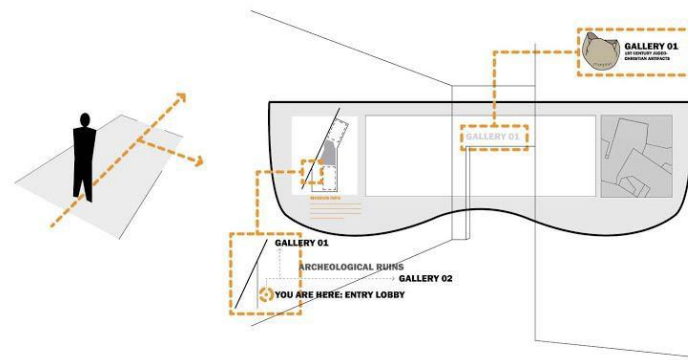
# HyFinBall: a two-handed, hybrid 2D/3D desktop VR interface for multi-dimensional visualization

Cho, Isaac, Xiaoyu Wang, and Zachary J. Wartell. "HyFinBall: a two-handed, hybrid 2D/3D desktop VR interface for multi-dimensional visualization." Visualization and Data Analysis 2014. Vol. 9017. International Society for Optics and Photonics, 2014.

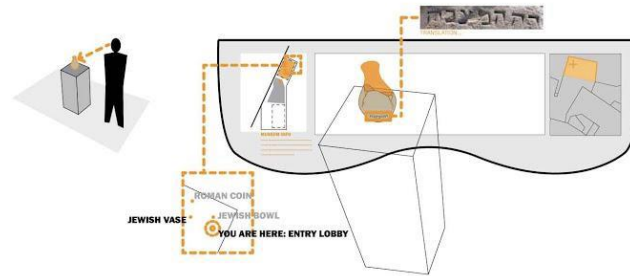
# Mixed Reality & 3DUI

- Mixed Reality for Architecture Design

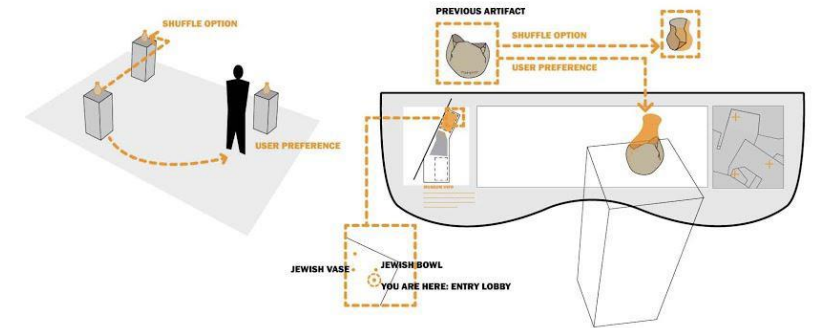
## HOLENS INTERFACE



USER DEFINED EXPERIENCE

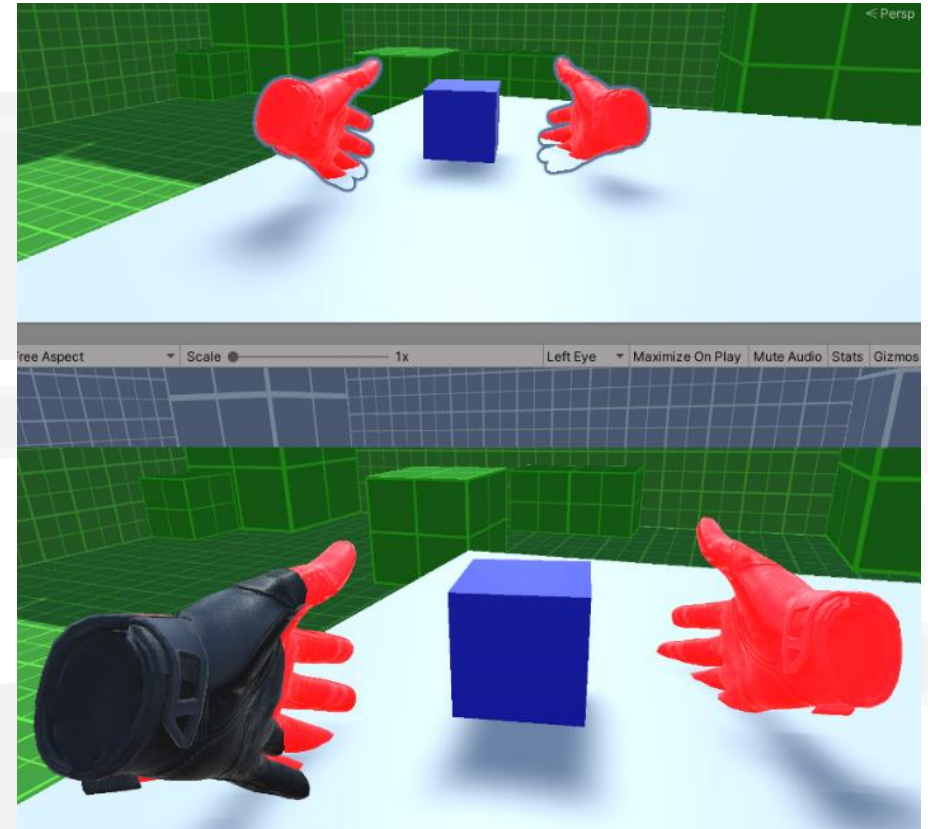
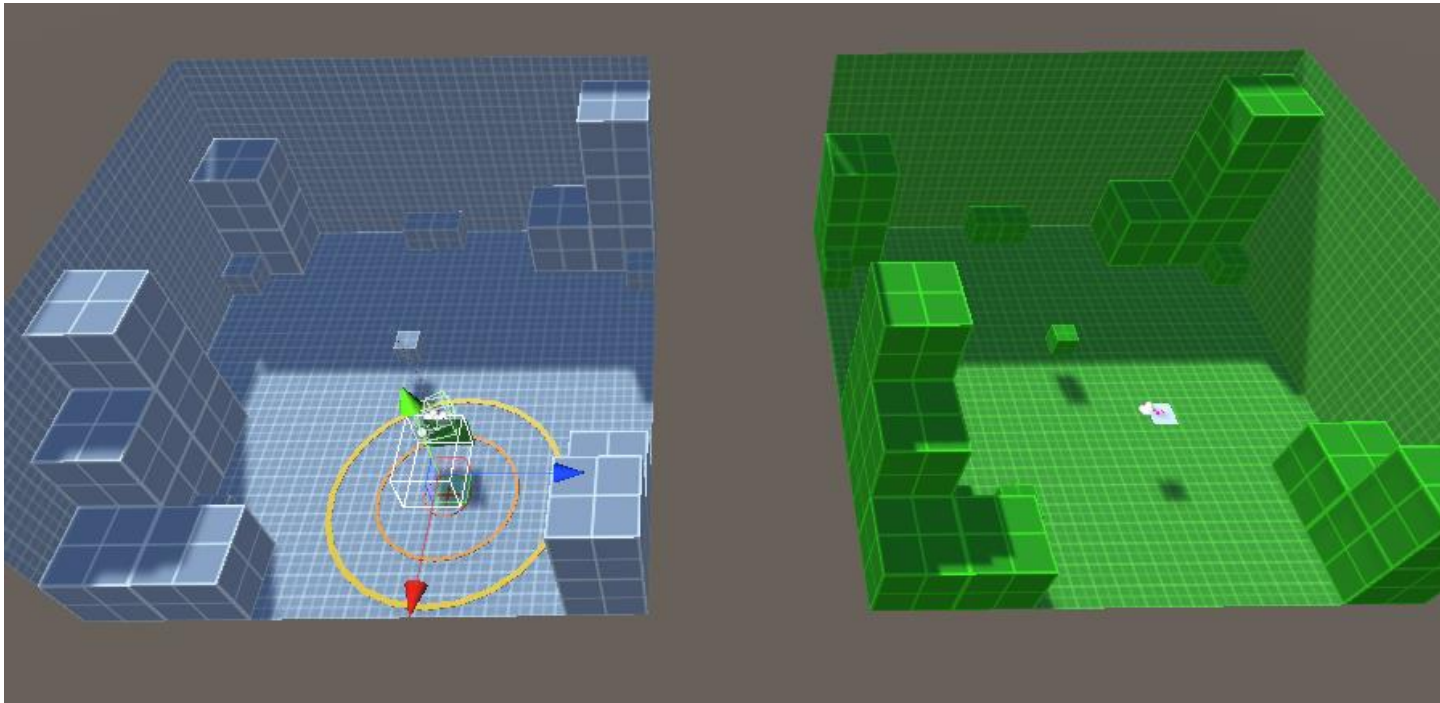


ARTIFACT ENGAGEMENT INTERFACE



MULTI-USER EXPERIENCE INTERFACE

# 3DUI



**What I want to do at STATE ?**



- **VizUS (Visualization lab at Utah State)**

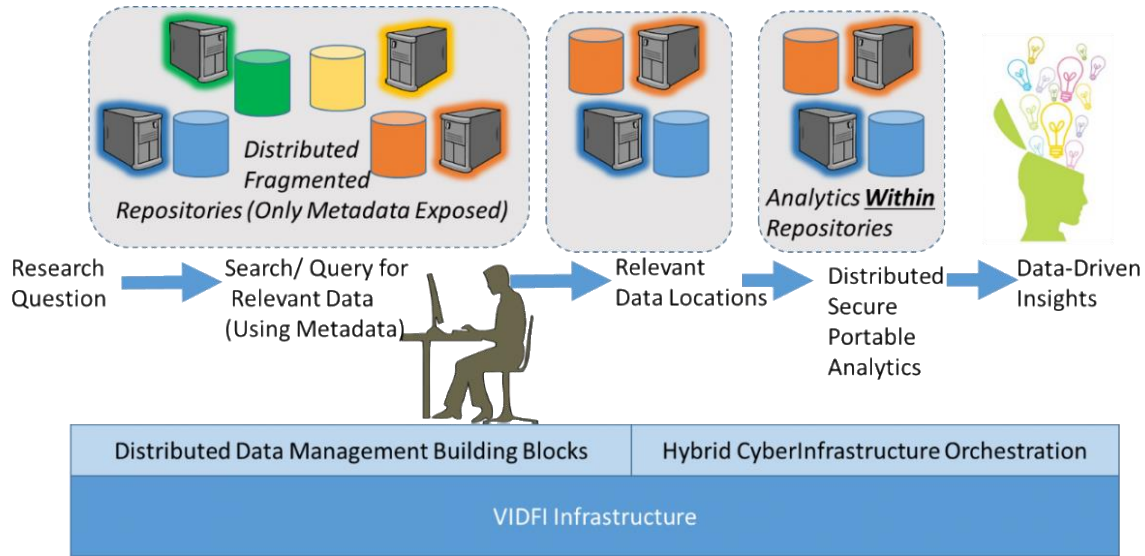
- Viz + VR Makerspace
- Old Main 406
- <https://cs.usu.edu/faculty-sites/vizus-lab/>



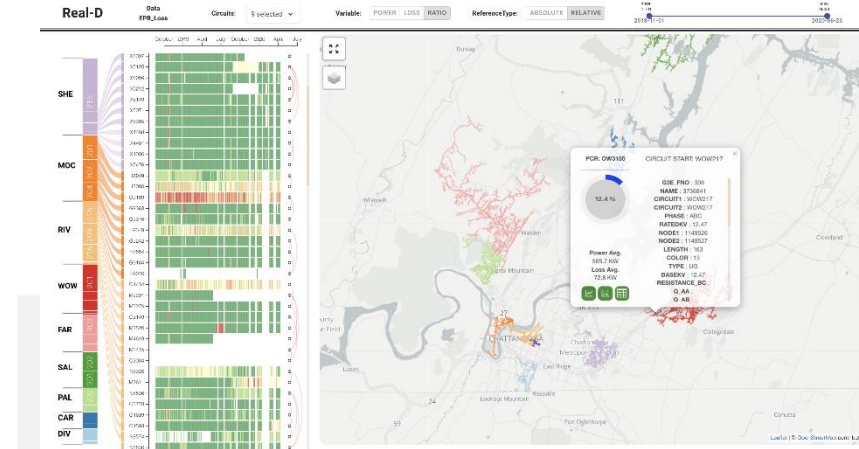
- Vive Pro Eye system
- Oculus Quest 2
- Workstation with GTX 3090, 64 GB Ram
- 49" ultra wide display
- Data/Web server
- hololens 2
- Motion Capture Cameras
- 120" 3D ready display
- 3D printer
- AI server (with 2 high-end Qaudro GPUs with 512 ram)
- Workstation with Quadro GPU for stereoscopic 3D applications
- iMac/mac mini
- Microsoft Azure Kinect DKs
- Driving simulator
- 3D ready workstations laptop
- ....



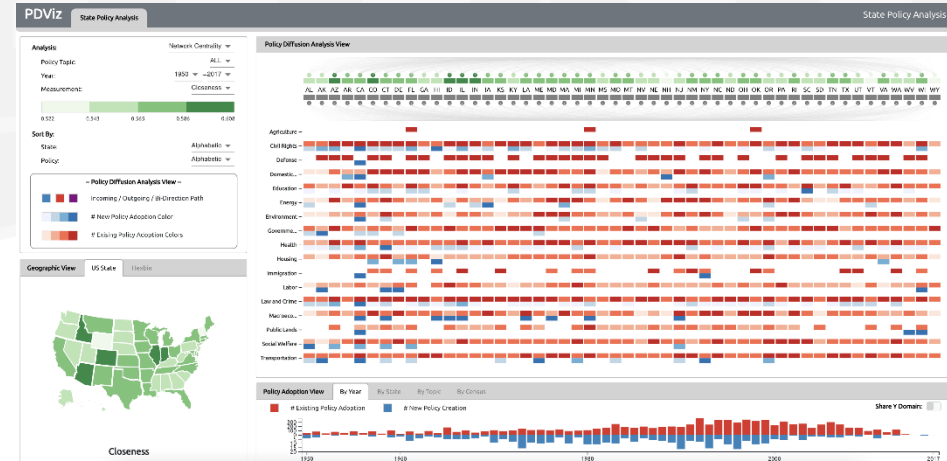
# Virtual Information Fabric Infrastructure (VIFI)



# Visual Analytics for Enhanced Decision-Making and Situational Awareness in Modern Distribution Systems



# Building the Federalism Data and Advanced Statistics Hub (FDASH)





**Computer Science**

**Computer Engineering**

**Architecture**

**Information Technology**

**Psychological Science**

**Political Science**

**Data Science**

**Parks, Recreation and Tourism Management**

**Systems Engineering and Engineering Management**

**Mechanical Engineering**

**Construction Management**

...

# Interaction Log Analysis

← → ↻ ⓘ Not Secure | projects.flowingdata.com/tut/linked\_small\_multiples\_demo/

## The Rise and Decline of Ask MetaFilter

Metafilter's revenue has been on the decline, but has its content dried up as well?

Here we look at new posts on Ask Metafilter by category. Categories like **computers & internet** have been dropping in use for a long time, most likely due to competition like Stack Overflow. Other smaller categories have had consistent use patterns until more recently.

Disclaimer: 2014 is included, even though the year is not over yet.

COUNT NAME

Ask Metafilter Small Multiples

#ce\_vis\_1  
time spent: 0.00 sec

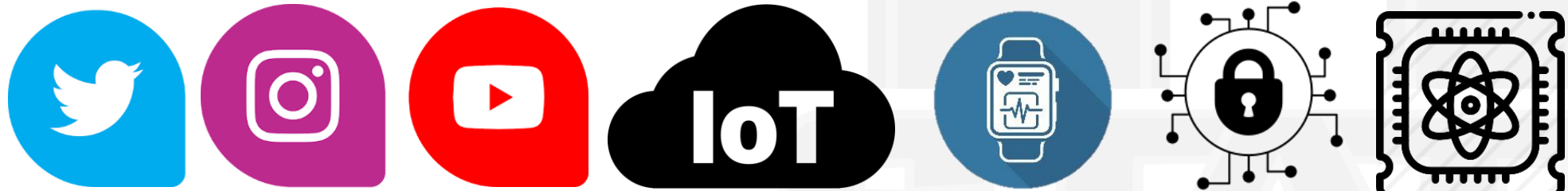
0.01 s  
0 s

Track

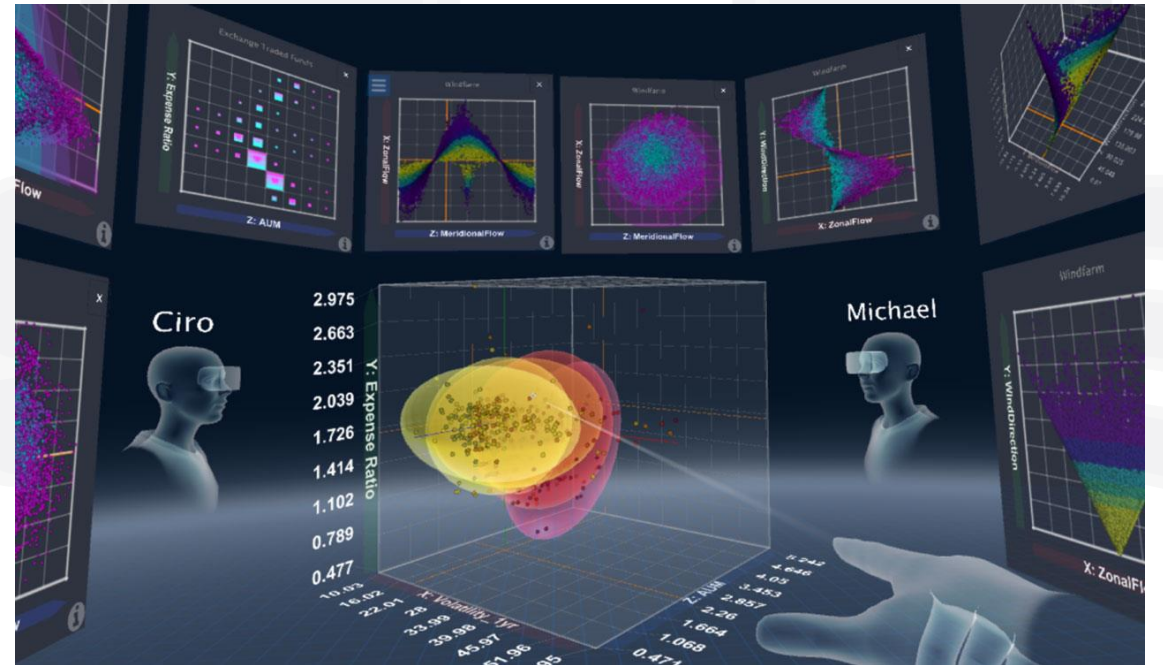
To enable interaction tracking, please click the "Track" button.

choissac Logout

# Interactive Visual Analytics with ML and AI for heterogeneous data



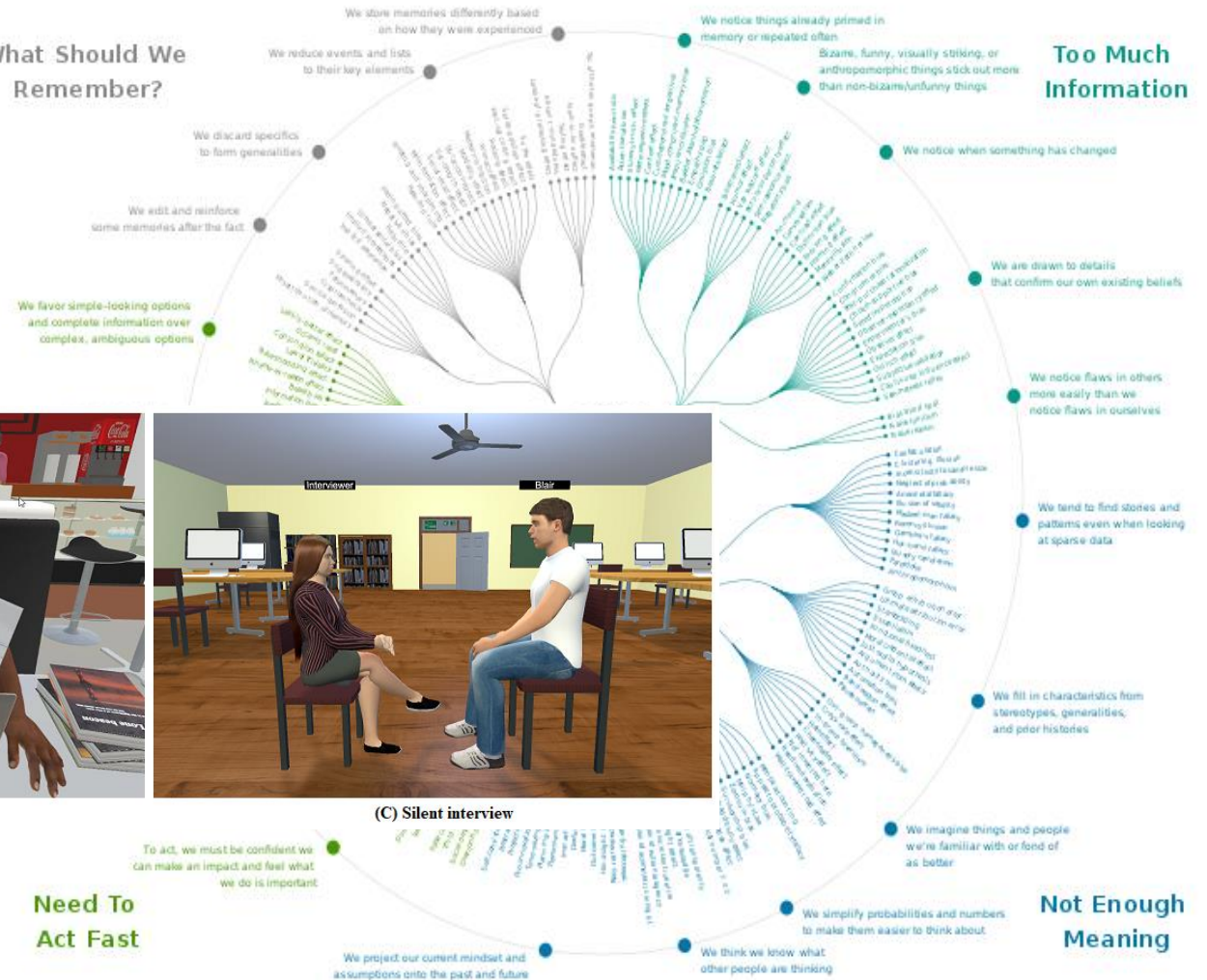
# AR/VR/MR + Visual Analytics = Immersive Analytics



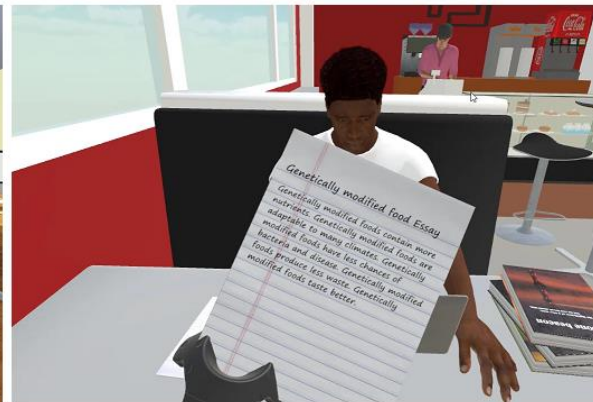
# Human Cognitions in Decision Making (VA/VR/AR)

## THE COGNITIVE BIAS CODEX

What Should We Remember?



(A) Classroom



(B) Cafeteria



(C) Silent interview

# Thank you

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- <https://cs.usu.edu/people/Isaac-cho/>
- Google "Isaac Cho"

- **VizUS:**

- <https://cs.usu.edu/faculty-sites/vizus-lab/>
- <https://cs.usu.edu/faculty-sites/vizus-lab/pstudent>

