
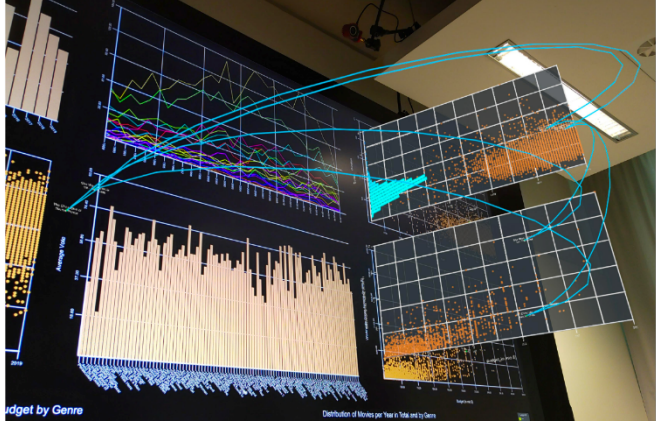
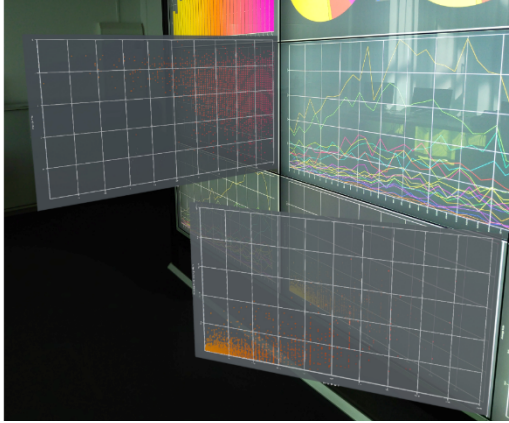

Personal Augmented Reality for Information Visualization on Large Interactive Displays

Patrick Reipschläger[1*], **Tamara Flemisch**[1*], Raimund Dachselt[1,2,3]

[1] *Interactive Media Lab Dresden, Technische Universität Dresden, Germany*

[2] *Centre for Tactile Internet with Human-in-the-Loop (CeTI), Technische Universität Dresden, Germany*

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* Authors contributed equally



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Large Interactive Displays

+

Personal Augmented Reality

Information Visualization

Large Interactive Displays

+ Supports touch and digital pen input
+ Can be used by multiple analysts
+ Shows big amount of data in high resolution

— Issues with perception of data
— Disturbances by other analysts

Personal Augmented Reality

Large Interactive Displays

\+ Spatial immersion and embodied interaction

\+ Personal views for each analyst

\+ Provides additional space to display data

— No native support for co-located data analysis

— Lacks tactile and precise input modalities

Personal Augmented Reality

\+ Supports touch and digital pen input

\+ Can be used by multiple analysts

\+ Shows big amount of data in high resolution

– Issues with perception of data

– Disturbances by other analysts

Augmented Displays

[Reipschläger & Dachselt 2019]

– No native support for co-located data analysis

– Lacks tactile and precise input modalities

\+ Spatial immersion and embodied interaction

\+ Personal views for each analyst

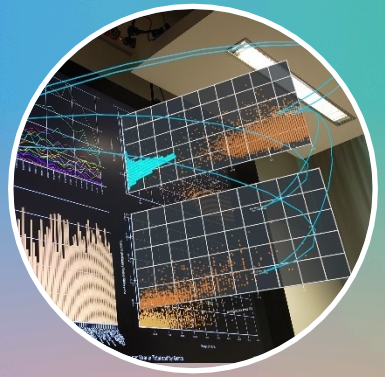
\+ Provides additional space to display data


Year
Duration
Year
Average Vote
Worldwide Gross Income (in mio $)
Legend
Total Budget by Genre
Distribution of Movies per Year in Total and by Genre
Microsoft

Augmented Displays

Large Interactive Displays

Mixed and Augmented Reality

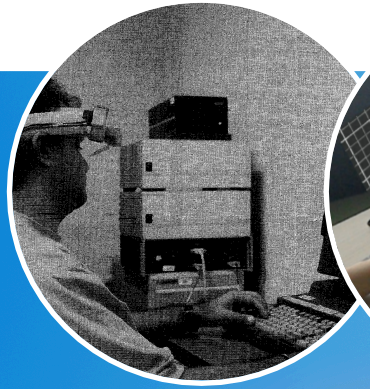


PARVIS

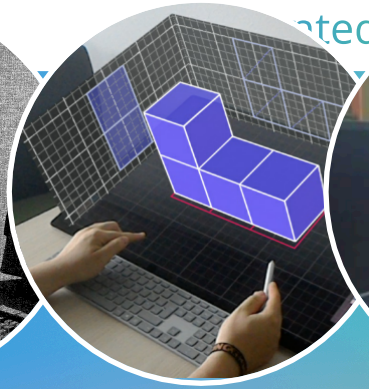
Visualization on Large Displays

Immersive Analytics

Information Visualization



Hybrid User Interfaces
[Feiner & Shamash 1991]



DesignAR
[Reipschläger & Dachselt 2019]

DualCAD
[Millette & McGuffin 2016]

SymbiosisSketch
[Arora et al. 2018]

Visualization on Large Displays

Immersive Analytics

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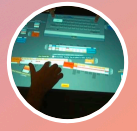
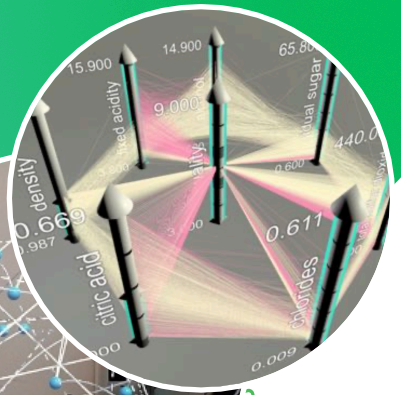
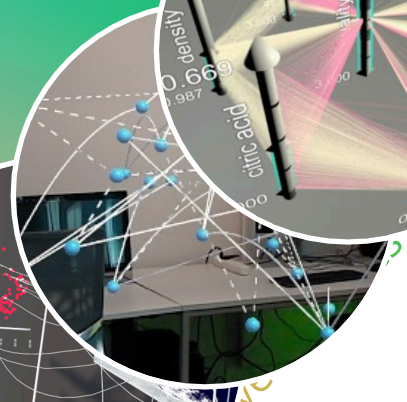


ImAxes
[Cordeil et al. 2017]



AR Graphs
[Büschel et al. 2019]



[Prouzeau et al. 2019]

PapARVis
[Chen et al. 2019]

Visualization on Large Displays

Augmented Displays

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[Feiner & Shamash 1991]

DesignAR
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AR Graphs
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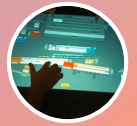


PapARVis
[Chen et al. 2019]

Visualization on Large Displays

Immersive Analytics

Augmented Displays

Design Space for Combining Large Displays and Personal AR

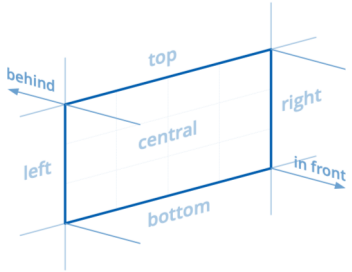
Visualization Techniques

u2vis – Universal Unity Visualization Framework

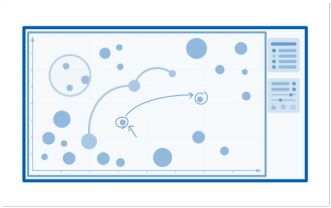
Prototype Implementation and Use Case

Design Space

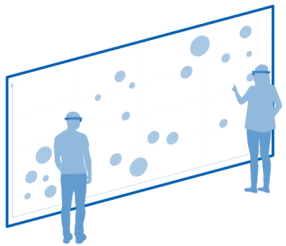
Design Space



Spatial Alignment

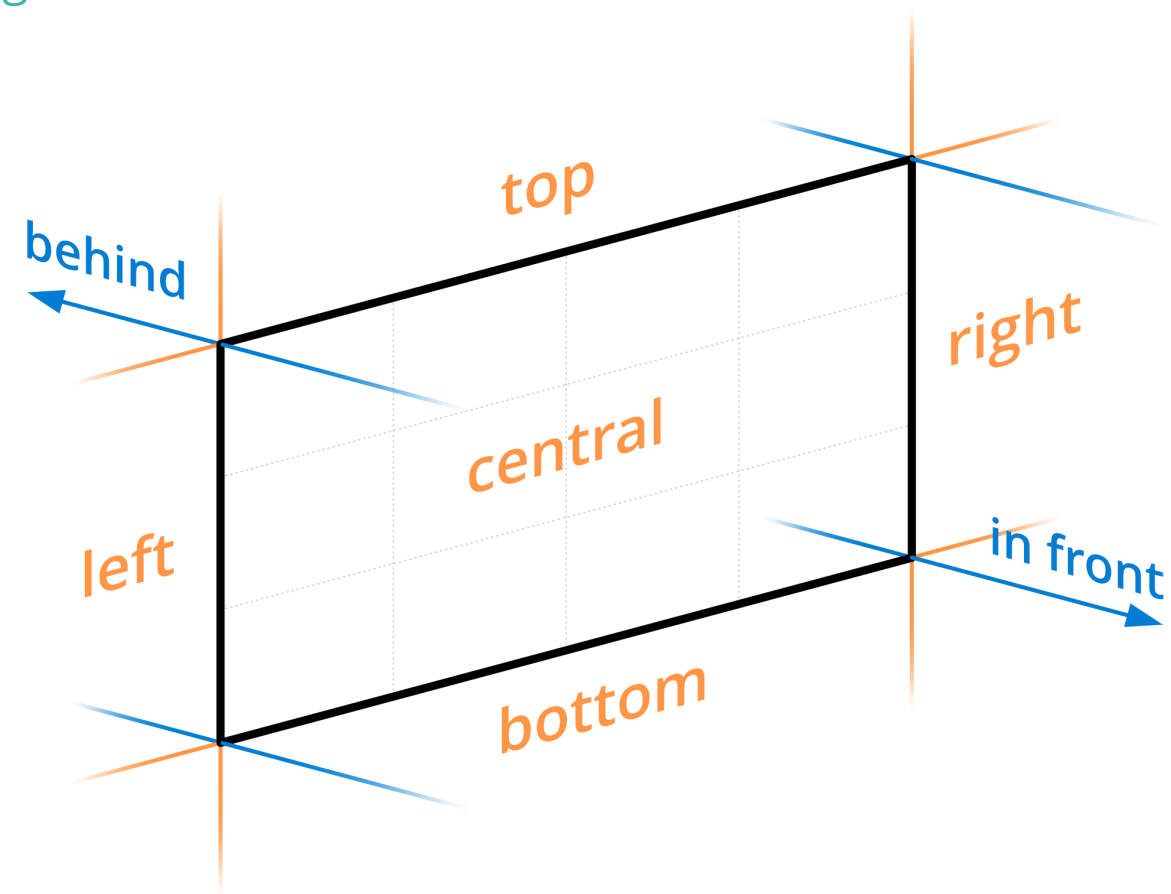


Visualization Parts



Personal Views

Spatial Alignment



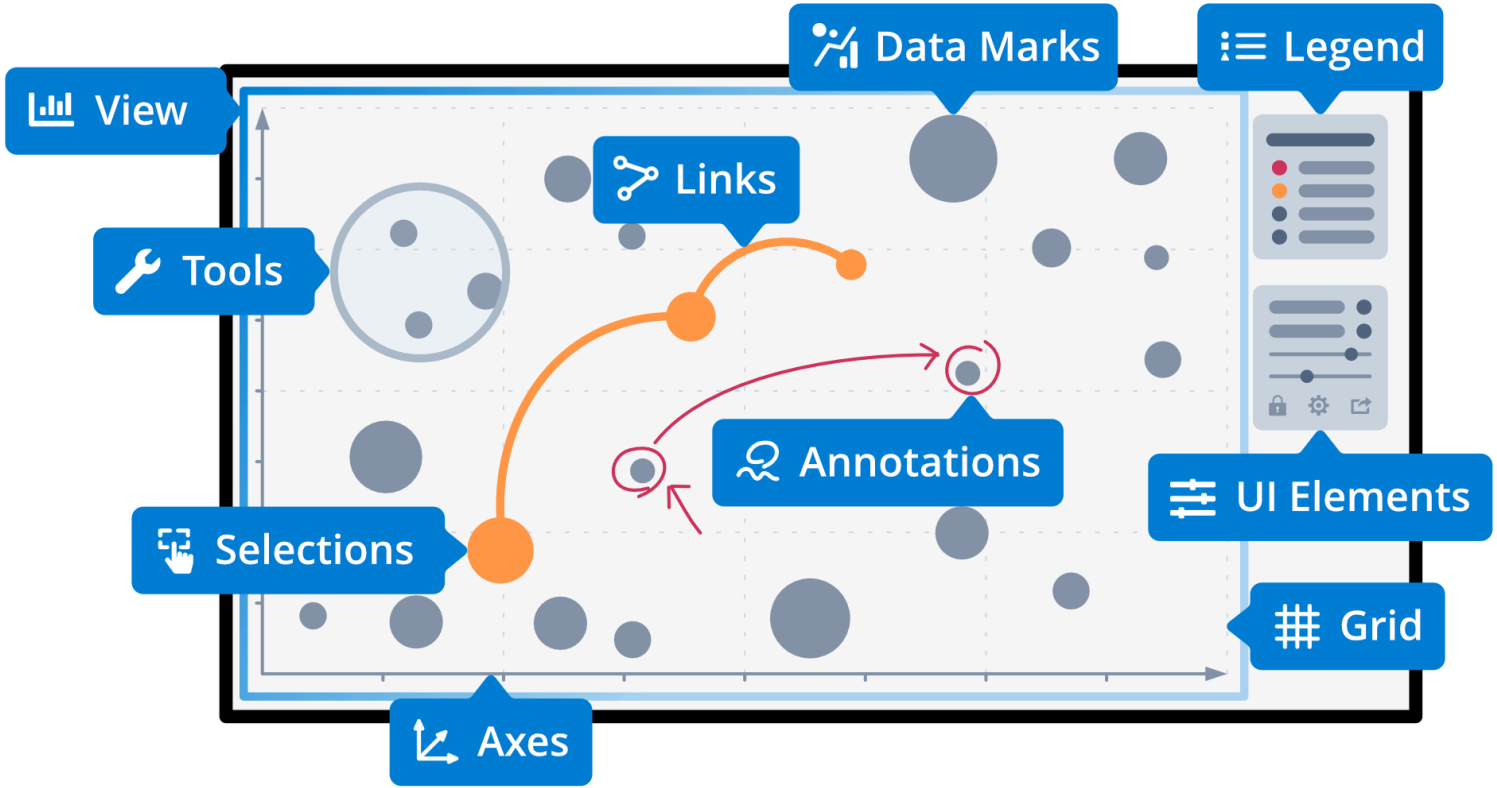
Visualization Parts

Personal Views

Spatial Alignment

Personal Views

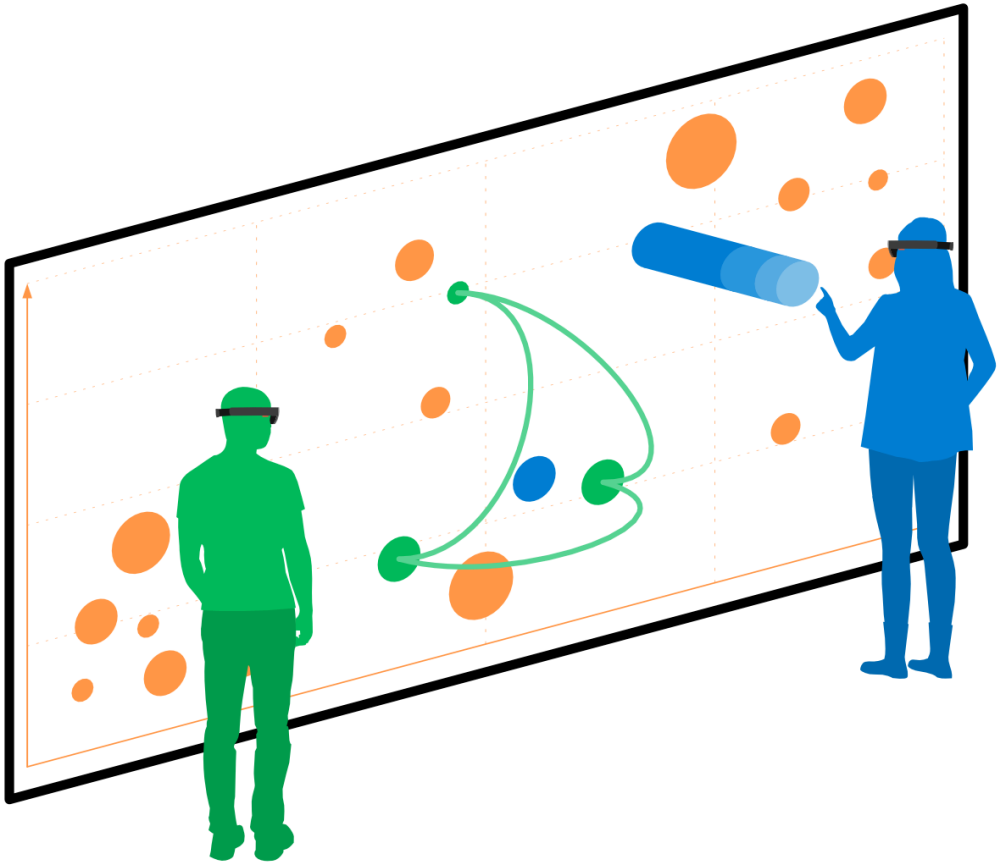
Visualization Parts



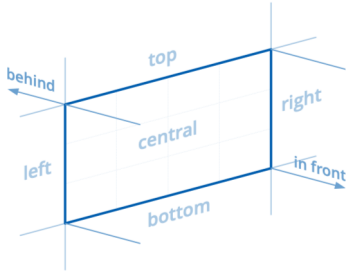
Spatial Alignment

Visualization Parts

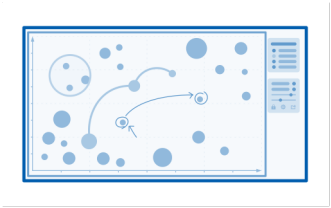
Personal Views



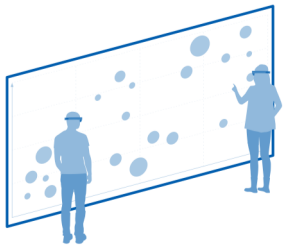
Design Space



Spatial Alignment



Visualization Parts

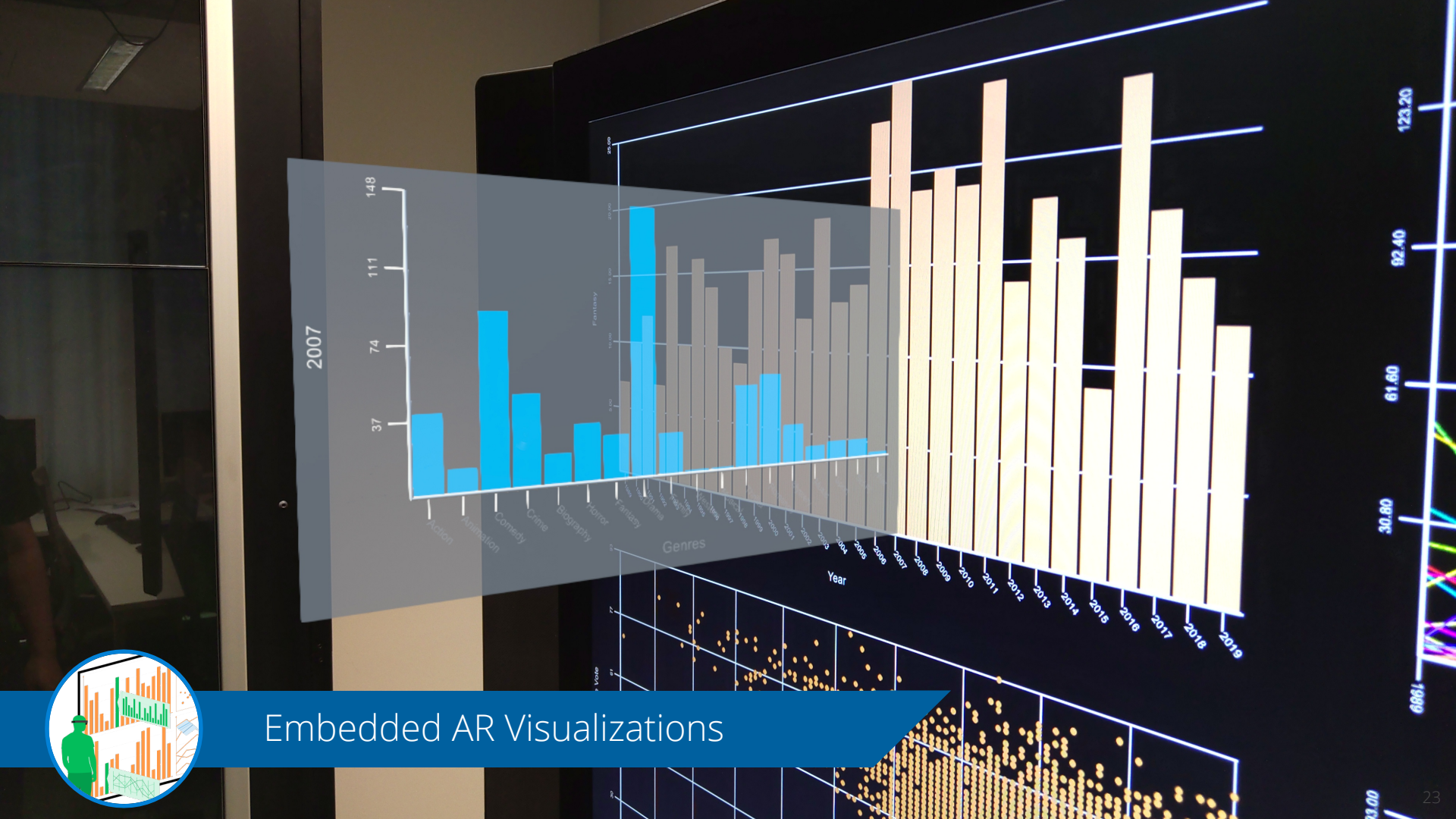


Personal Views

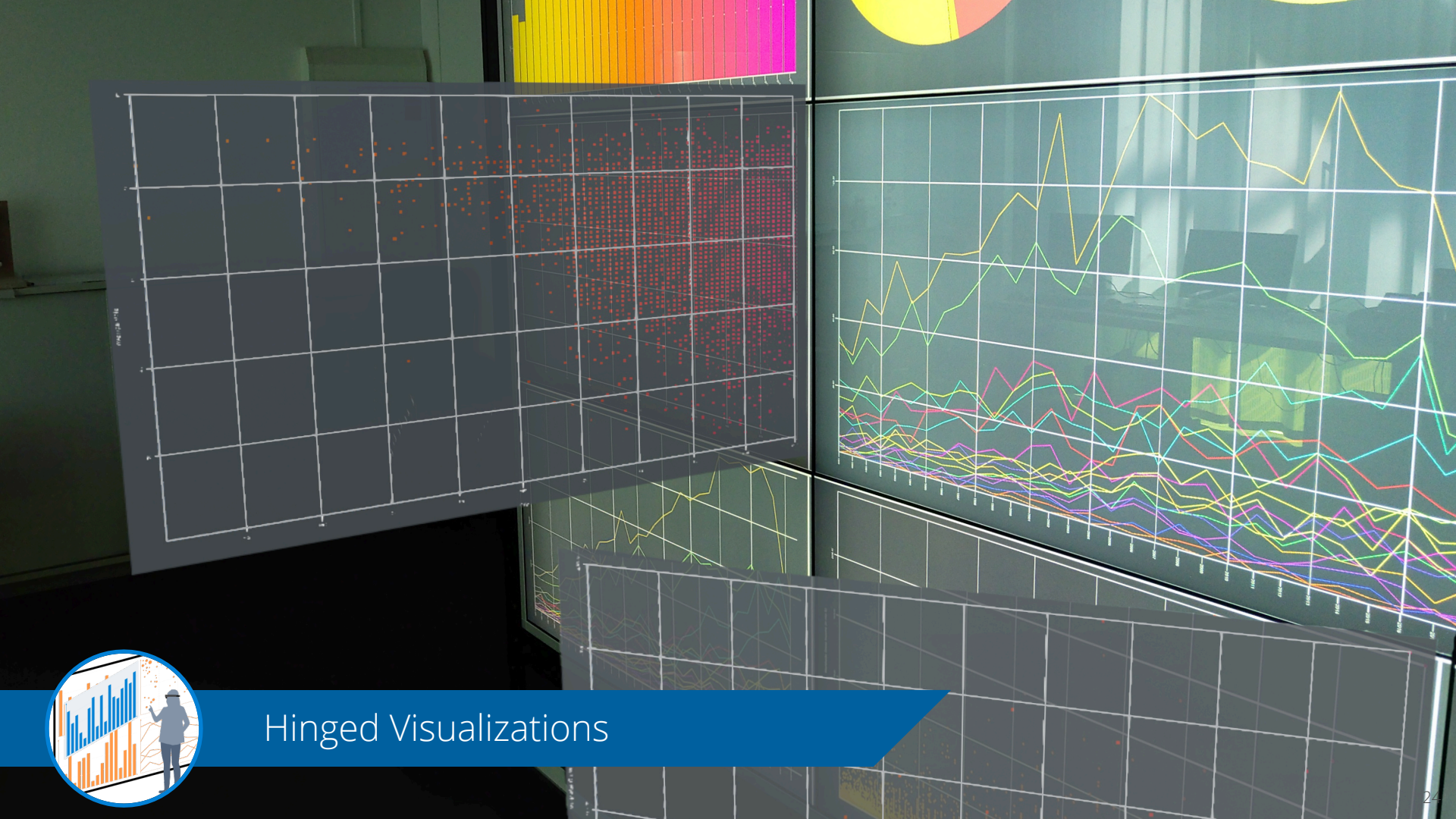
Visualization Techniques

Perceptual Issues on Large Displays

Managing Density and Complexity

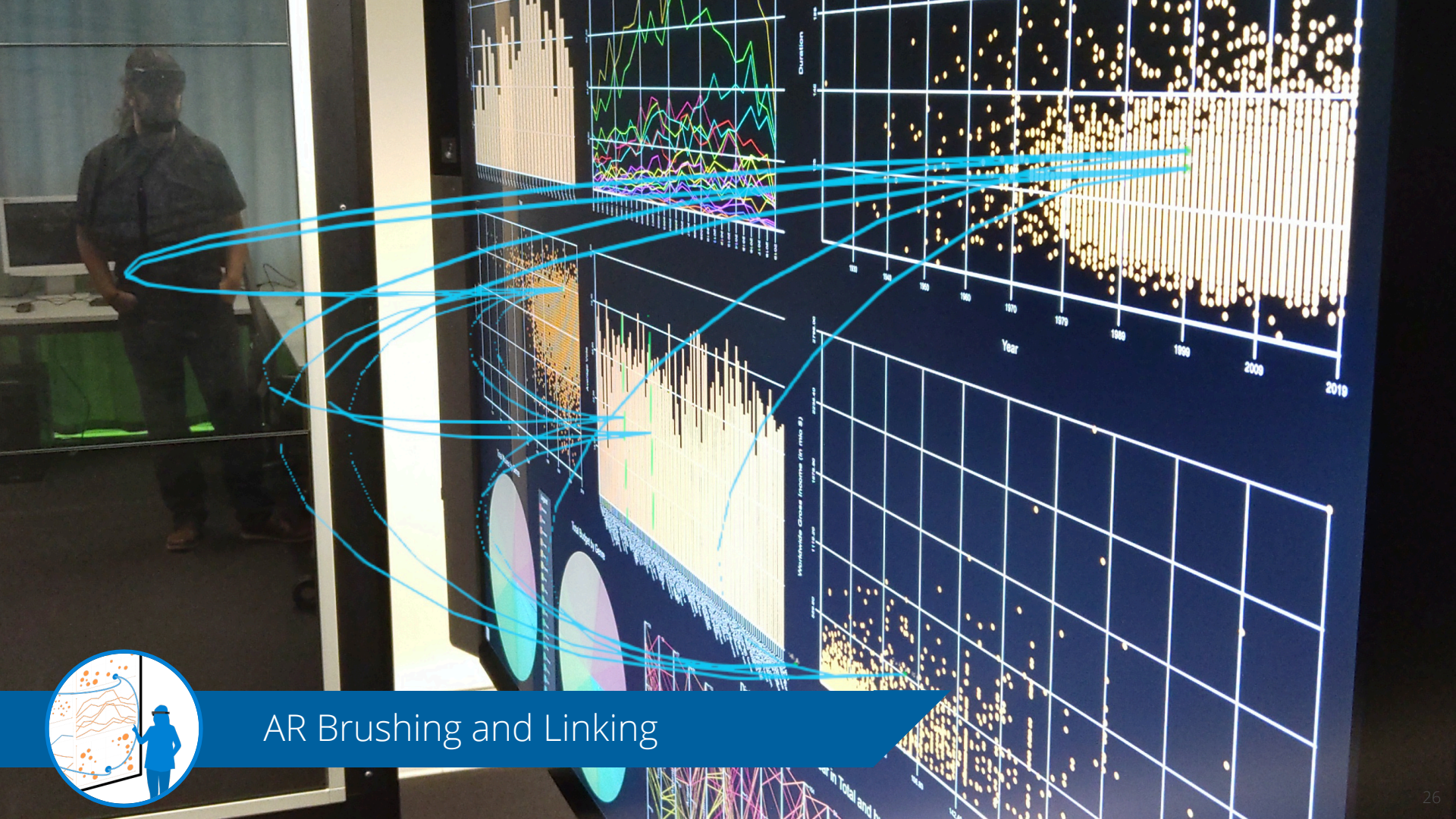


Embedded AR Visualizations



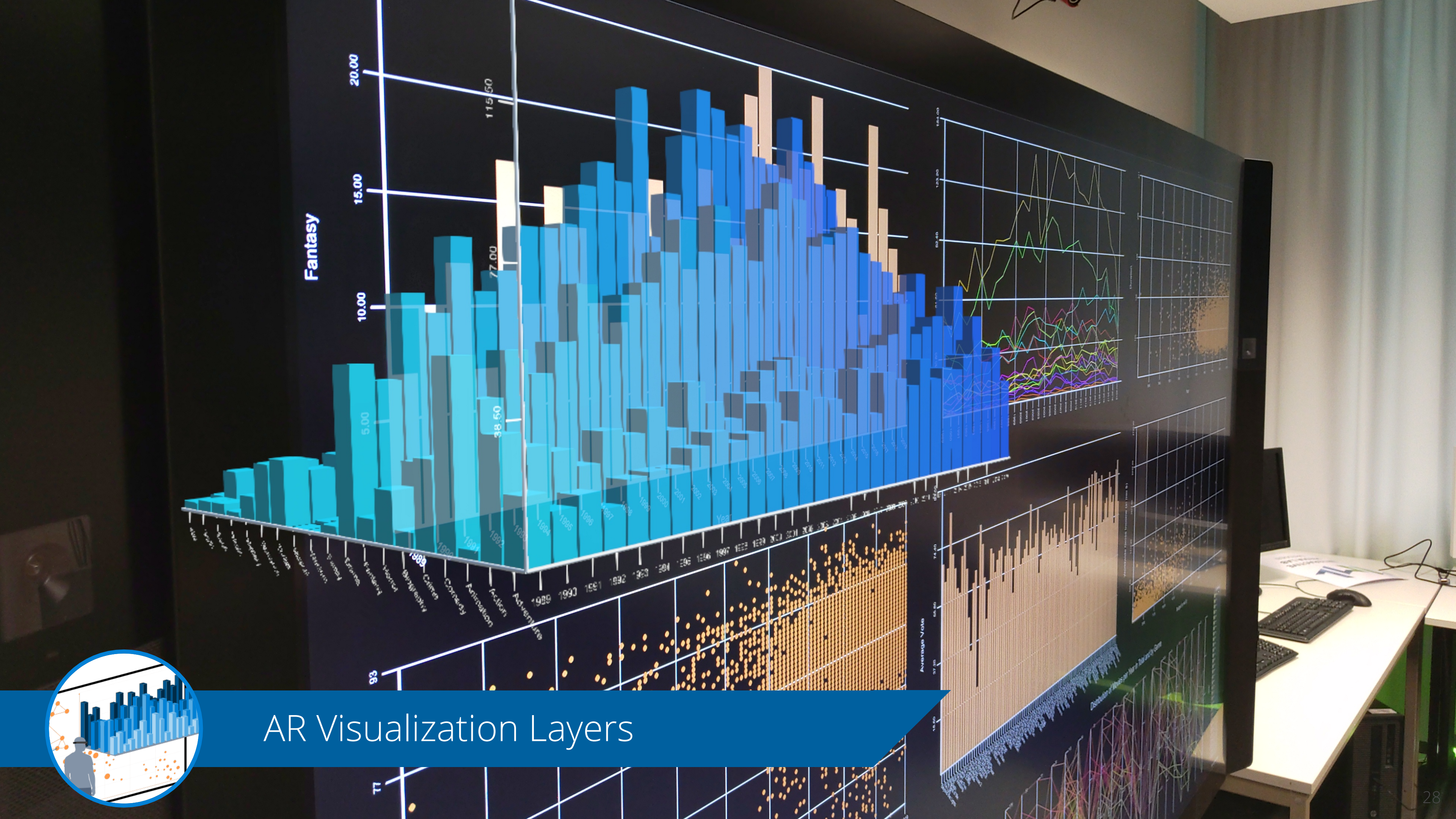
Hinged Visualizations

Curved AR Screen

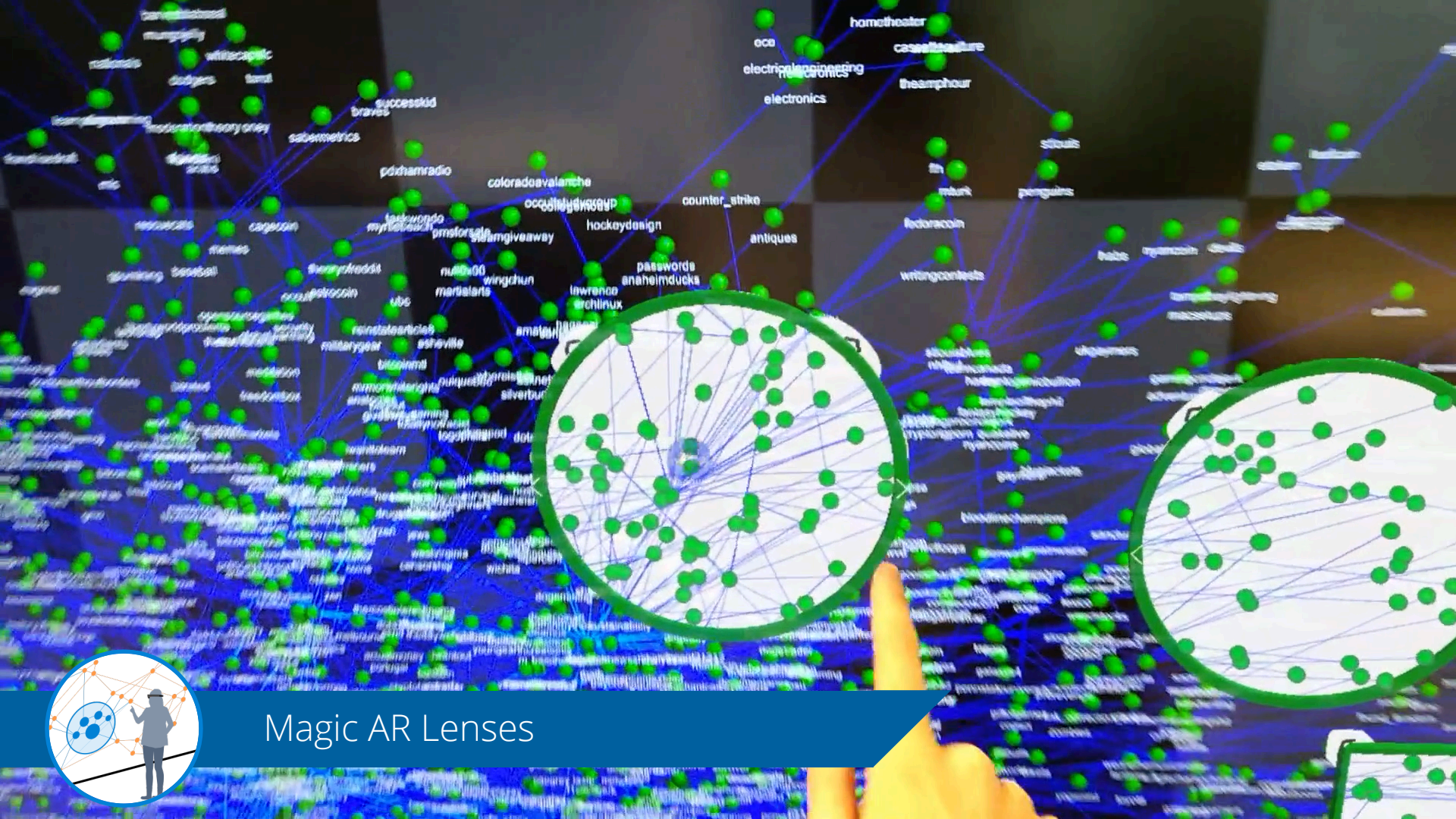


AR Brushing and Linking

Extended Axis Views

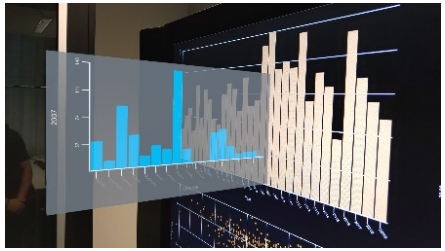
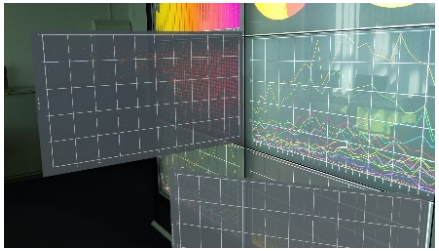
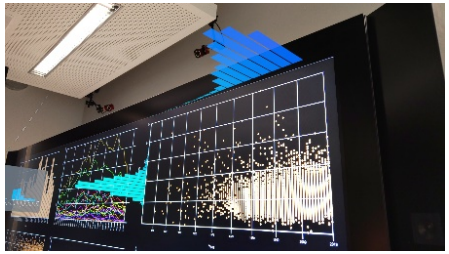
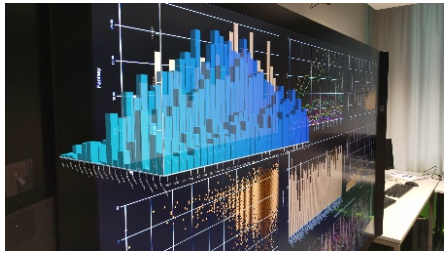
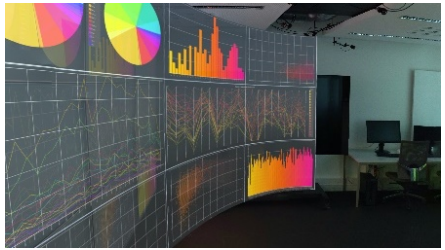
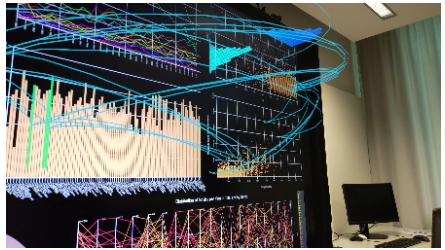
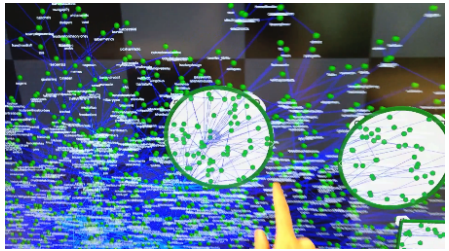
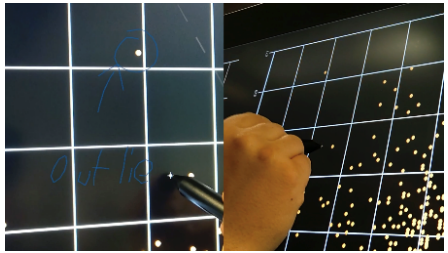


AR Visualization Layers


hometheater
eco
electricalengineering
electronics
thesamphour
successkid
sabermetrics
pdxhamradio
coloradoavalanche
counter_strike
hockeydesign
antiques
fedoracoin
passwords
anaheimducks
lawrence
archlinux
martialarts
wingchun
writingcontests
penguins
stlouis
Magic AR Lenses

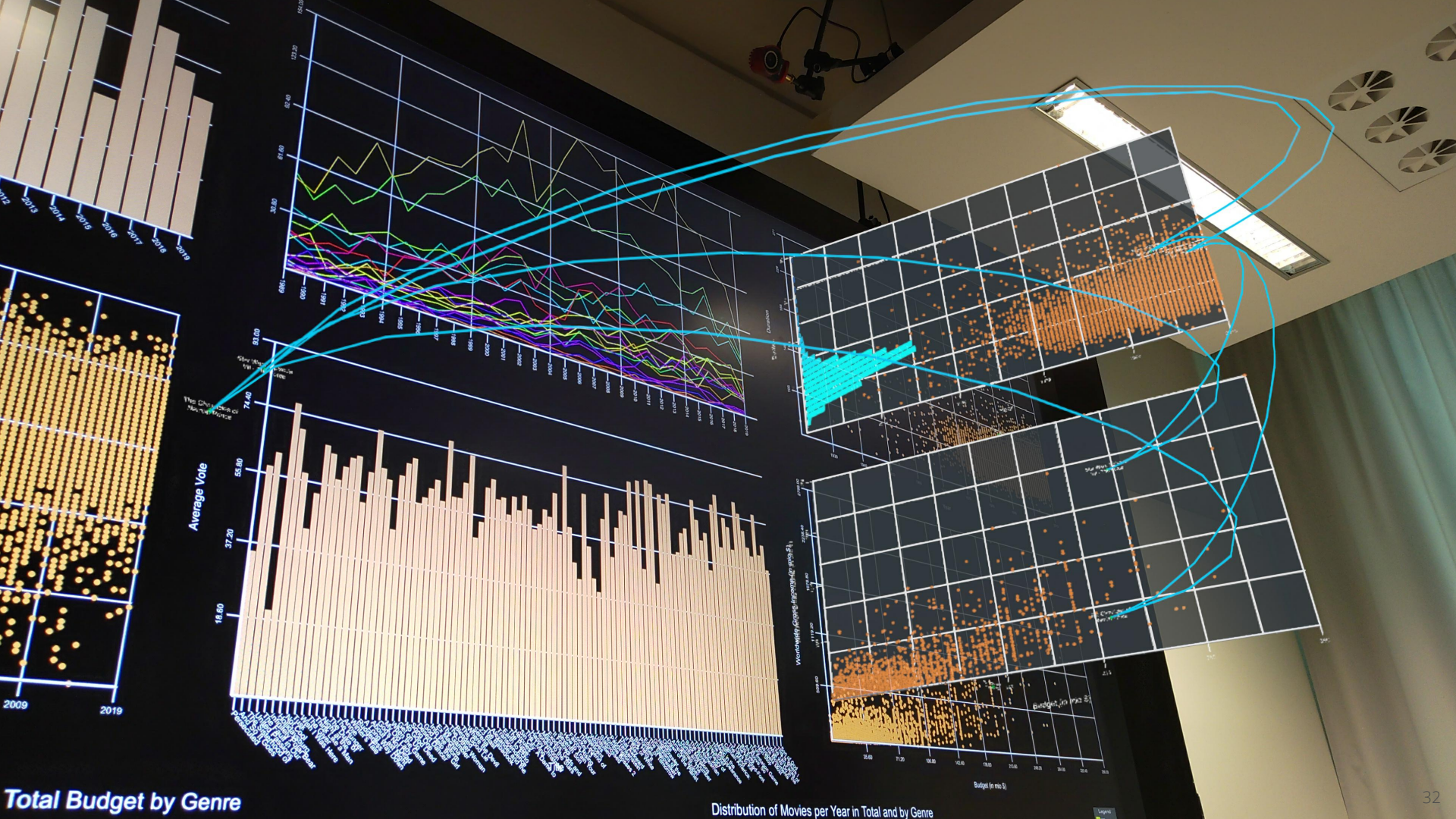
Personal View | Observing View

Personal AR Annotations

Perceptual Issues on Large Displays

Managing Density and Complexity


Average Vote
Total Budget by Genre
Distribution of Movies per Year in Total and by Genre

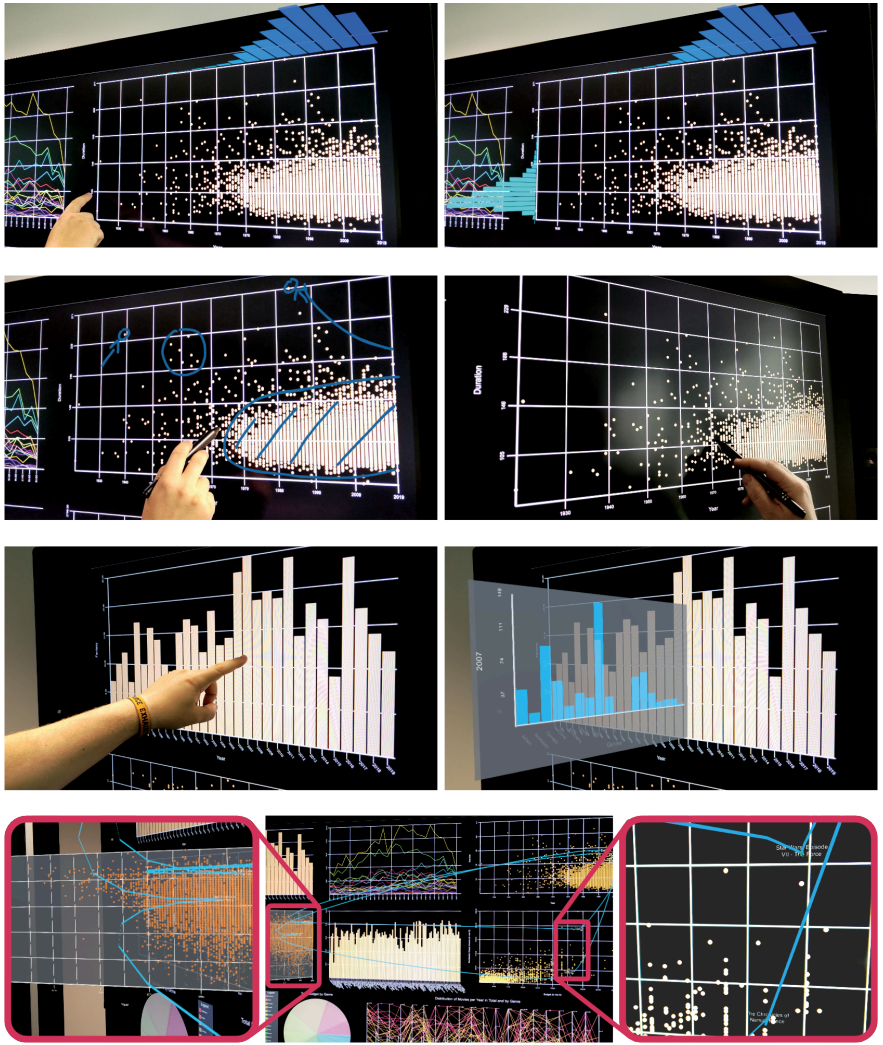
Validation: Use Case

Cognitive Walkthrough

Exploration of a IMDB movie data set in multiple coordinated views

Various Tasks

- Identify clusters using *Extended Axis Views*
- Individual annotations in AR
- Comparison of movies using *Embedded Visualizations*
- Guide awareness to connected views using *AR Brushing and Linking* as well as *Hinged Visualizations*



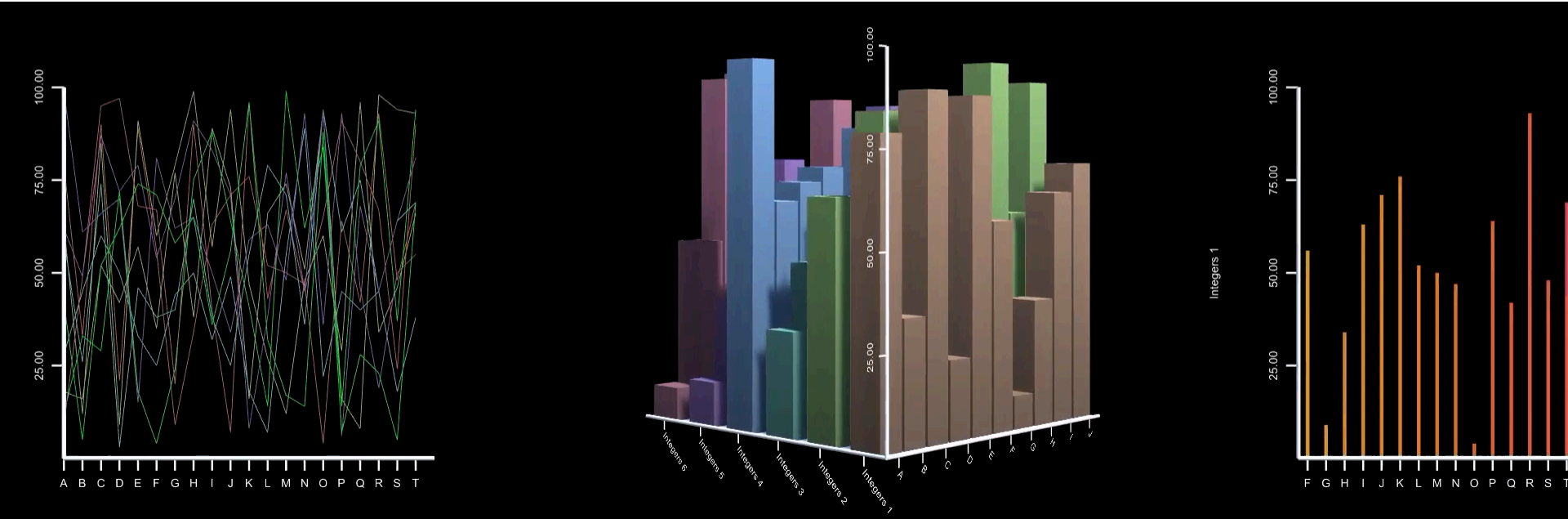
u2vis

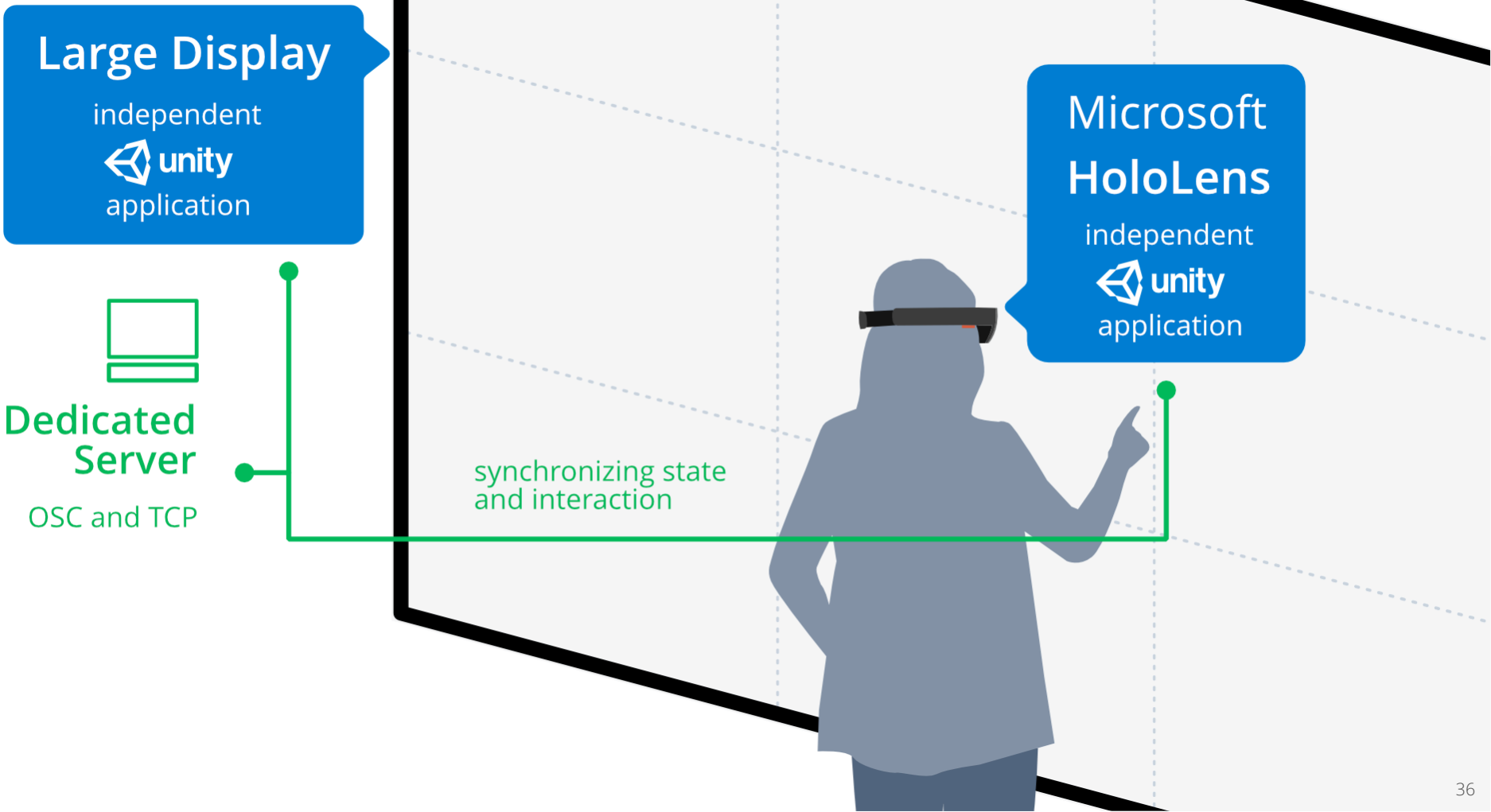
u2vis

Universal Unity Visualization Framework

Available on **GitHub**

https://github.com/imldresden/u2vis




Large Display
independent
unity
application
Microsoft
HoloLens
independent
unity
application
Dedicated
Server
OSC and TCP
synchronizing state
and interaction

Discussion

Perception of AR Content and Display

Combining Environments for Data Analysis

Alignment of AR Content in Relation to the Display

Collaboration Between Multiple Analysts

Connecting Multiple Visualizations with AR

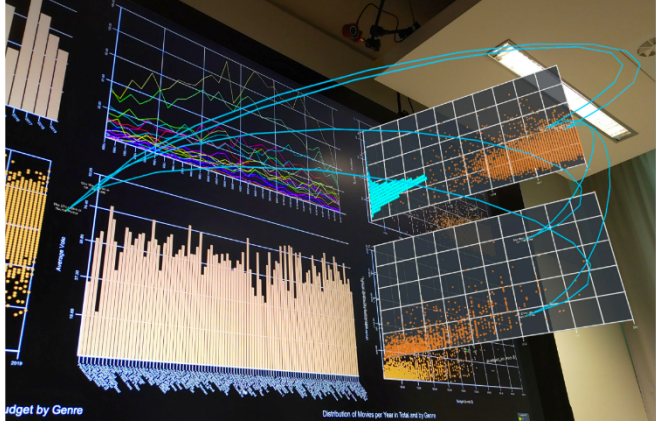
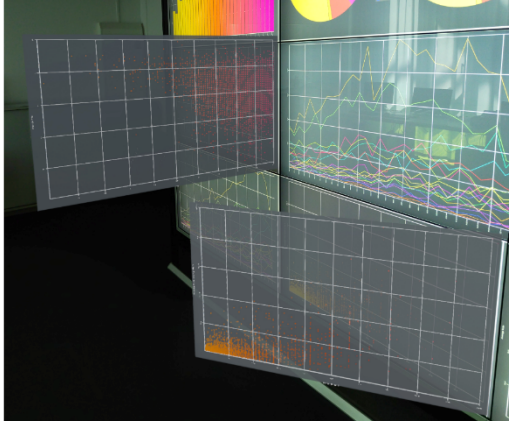
Further Potential Utilization of AR

Augmented Displays

Design Space for Combining Large Displays and Personal AR

Visualization Techniques

u2vis – Universal Unity Visualization Framework

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Tamara Flemisch* - Interactive Media Lab, Technische Universität Dresden – tamara.flemisch@tu-dresden.de

Raimund Dachselt – Interactive Media Lab, Technische Universität Dresden – dachselt@acm.org

*Authors contributed equally

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Image Sources

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