

MULTIPLE VIEWS IN IMMERSIVE ANALYTICS

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What changes does the ability to use more display space for analysis bring for people doing the analysis?

How do we communicate the relation between many views?

How do we create a sense of shared space between different surfaces and views?

IMMERSIVE TECHNOLOGIES ENABLE PEOPLE TO SEE MANY VIEWS AT THE SAME TIME. HOWEVER...

COORDINATION TECHNIQUES



Does existing coordination techniques break?

The existing coordination techniques were designed for a situation of two to perhaps eight views. With immersive analytics, people might use more than twenty views simultaneously.



Increased need for complex interaction techniques?

Moving beyond the mouse and keyboard is crucial in immersive analytics. Recent work described touch interaction techniques for single and multiple views. Additionally, proxemics has been considered in the context of information visualization. However, moving beyond a few views has not yet been explored in this context.



Increased need to understand design spaces in multiple views?

As the number of views increase, it is becoming more important to understand how views relate to each other. However, previous techniques have primarily considered either linking data points in different views, or linking entire views. We see a need for exploring these design spaces to enable us to compare these disparate ideas, and potentially show new possibilities.

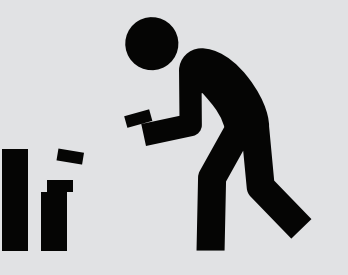
Reduced need for existing techniques

Some techniques were created for situations with limited display space. For example, pan-and-zoom and focus plus context techniques were created to allow people to navigate a large information space, without sacrificing detail. We think their use in the context of immersive analytics and multiple views might be less relevant, than on desktop or other smaller display form factors.

COLLABORATION

Increased need for spatial and temporal scopes of interaction?

When people use desktop computers or other individual devices, the spatial and temporal scope of interaction is clear, but with larger work spaces, for example provided by large displays, this is no longer the case. Can we use knowledge of visualization tools on desktops to create novel solutions for immersive analysis? Previous work has used the visualization pipeline to provide temporal and spatial scoping. Likewise, proxemics can also provide a way to scope interactions. Does other possibilities for scoping interactions exist beyond these?



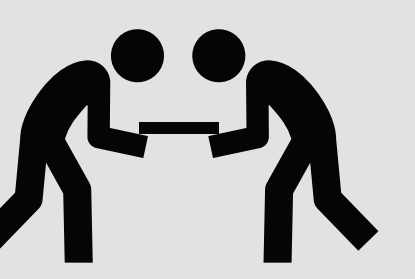
Increased need to support device and context transitioning?

Collaborations often take the form of a mix of close and loose collaboration. Additionally, we have observed situations of analysis stretches that lasted multiple days, consisting of longer stretches of independent and collaborative work sessions. To support this well, we think an important next step is to consider visualizations that work across device types. A range of questions arise from this. For example, how should visualizations and views adapt to display form factor?



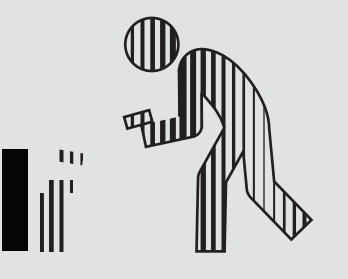
Increased need for notion of view ownership?

With immersive technologies such as large displays, collaborators might create many views. Thus, it is useful to have an overview of who created a view and potentially when. This relates to visualization provenance, which has mainly been considered on the desktop. However, the question of ownership becomes less clear with immersive analytics. For example, is it more important who created a view initially, or who last interacted with it? When should we rely on social contexts in designing interactions, and when should we provide system mechanisms to support collaboration?



Increased need for provenance?

Based on the understanding that collaborations can take form of close or loose collaboration, we have seen a need for supporting annotation and recording summaries and conclusions. But how might we summarise visualizations? What are the important parts of a long analysis session?



Immersive technologies provide opportunities for showing many views at the same time.

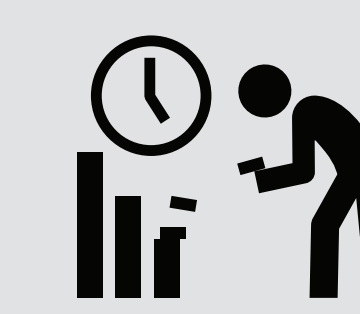
Working with many views allows people to break down information into different sets or variations of data, and, in this manner, helps them compare and reason about their data.

TASKS AND BEHAVIOR



Are our existing task models effective?

Given complex analyses in the context of large displays that involves many views and occur over long stretches of time, existing models might be less useful, due to a more fluid allocation of tasks over time and space. For example, is it useful to use the multilevel task typology to describe an analysis that lasts multiple days, or is this perhaps beyond the scope of any existing task models?



Increased need to understand visualization in longer analyses?

With immersive analytics, we think the boundary between menus, tools, and visualizations get more blurry. Perhaps some views that on their own, could be used to provide insights, in a longer analysis process would appear more as a tool to help achieve other insights from other views?

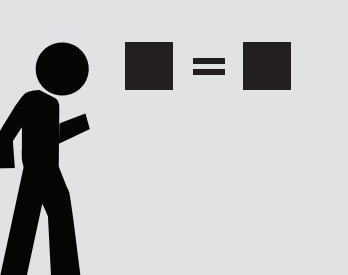
How do we need to change how we think about coordination of multiple views when those views are presented across multiple displays?

How do changes in display and input technology affect the our thoughts on the type and manner of tasks that can be done?

FORMALIZATIONS

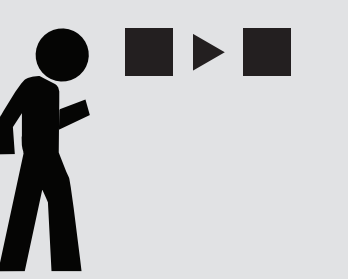
Increased utility of scagnostics?

Helping people understand similarities and differences between visualization views are important, when they are faced with many similar views. We think that models of visualization similarities might be a useful way to do this. Scagnostics is one approach to considering view similarities, and has been applied in the context of recommender systems. Are these ideas also applicable in combination with existing coordination techniques?



Revisit the visualization pipeline model?

As outlined in this paper, immersive analytics might multiply the amount of views presented simultaneously. The visualization pipeline model only accounts for a single view at a time. We consider extending the pipeline model to include multiple views, and are curious about the benefits this might bring.



How do we better understand the expanded opportunities that multiple display environments offer for team and collaborative analytics?

Can we re-assess our formalisms to develop a better conceptual understanding of new design spaces?