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# Immersive Analytics: Exploring Future Interaction and Visualization Technologies for Data Analytics

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**Abstract**

We propose to conduct a workshop on the topic of *Immersive Analytics*: a new multidisciplinary initiative to explore future interaction technologies for data analytics. Immersive Analytics aims to bring together researchers in Information Visualisation, Visual Analytics, Virtual and Augmented Reality and Natural User Interfaces.

<http://www.aviz.fr/~bbach/immersiveanalytics>

**Author Keywords**

Visualization, Interaction, Virtual and Augmented Reality, Visual Analytics

**Relevance to ISS**

Due to the recent advances in immersive technologies (VR, AR, large displays, tangible surfaces), we see new opportunities to using these technologies to analyse and explore data. Several research areas are concerned with the development of methods to support the analysis of such data, including information visualisation, data sciences, and visual analytics. Visual analytics, introduced a decade ago as “the science of analytical reasoning facilitated by interactive visual interfaces” [1], has now become a key technology for dealing with big data [2], and there is massive potential for its use in further emerging application areas like health informatics, business intelligence; transport and logistics; scientific applications including

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astronomy and physics; environmental monitoring; and personal information management.

The definition for visual analytics given above is agnostic of the actual interface devices employed by visual analysis systems. Nevertheless, the affordances of the display and input devices used for analyzing data strongly affect the experience of the users of such systems, and so, their degree of engagement and productivity. Ultimately, therefore, it affects the adoption and ubiquity of sophisticated data analysis tools. For practical visual analysis tools used in the industries and areas of data science described above, the platform for interaction is almost always a standard desktop computer: a single average-sized display, keyboard and mouse.

While visual analytics and information visualisation researchers sometimes publish studies exploring some data visualisation application in 3D or using natural user interfaces, this has never been a core topic. By contrast, 3D user interface researchers have tended to focus more on lower-level technologies rather than practical applications. Therefore, a systematic approach to developing visual analytic tools that move beyond the desktop is lacking. We propose a new facet of data analytics research that seeks to unify these efforts to identify the most enabling aspects of these emerging natural-user-interface and augmented-reality technologies for real-world analysis of data. We call this new research thrust "*Immersive Analytics*", a topic that will explore the applicability and development of emerging user-interface technologies for creating more engaging experiences and seamless work-flows for data analysis applications.

We feel that this workshop is a perfect fit for collocation with the 2016 ISS conference with its focus on different emerging display, interaction and natural user-interface

technologies. The workshop differs from the more general ISS themes by being focused in collaboration between Information Visualisation, Visual Analytics, novel display/interaction and Virtual and Augmented Reality researchers. This basic definition of Immersive Analytics has already been explored in some depth at meetings at NII Shonan, Japan and a seminar at Dagstuhl, Germany. The goal of these meetings was to establish the field with by authoring an introductory book and "manifesto". This book is now in production. This workshop would differ by being a forum for researchers to prevent their work-in-progress on this topic, position papers, and original research.

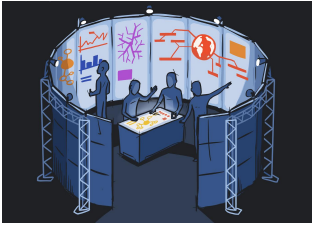
### Topics Covered in the Workshop

The overarching goal of immersive analytics research is to understand how (and whether) new interface and display technologies can be used to create a more immersive kind of data analysis and exploration. The kinds of devices and environments include augmented and virtual reality displays, large high-resolution 2- and 3-D displays, haptic and audio feedback, and gesture and touch controlled interaction. These potentially require very different interaction and visualisation models and techniques to those used in standard visual analytics. Some of the main research questions are:

**Real-World VA:** What questions do technologies like augmented reality raise for visual analytics? Traditional information visualization supports open-ended exploration based on Shneiderman's information mantra: overview first, zoom and filter, then details on demand. In our view a different model is required for analytical applications grounded in the physical world. In this case objects in the physical environment provide the immediate and primary focus and so the natural model is to provide detailed



**Figure 1:** A possible use-case to be explored by immersive analytics: data analysis in Augmented Reality.



**Figure 2:** “Immersing people in their data” does not necessarily involve 3D or stereo display. In this concept, analysts work in a purpose-built, collaborative data analytics room.

information about these objects and only provide contextual information on demand.

**Collaboration:** Much research has been devoted to computer-assisted collaboration both synchronous and asynchronous, local and remote. These new devices and environments potentially support new models for collaboration as shown in Figures 1 and 2. What paradigms are potentially enabled by these new interaction modalities? How do we evaluate them?

**Hybrid 2D/3D:** Traditionally 3D visualisation has been used in the physical sciences, engineering and design; while 2D visualisations have been used to display statistical and abstract data in information visualisations. Increasingly there is a need to combine both sorts of visualisation in holistic visualisations. For instance in the life sciences different aspects of a cell are displayed using 2- and 3-D images, 2-D network data and the various -omics. Can these new technologies support more holistic visualisations of such data incorporating 3-D spatial information as well as abstract data?

**Affordances for Immersion:** What are the interface “tricks” and affordances such as high-resolution displays, sound, touch, responsive interaction that change the user perception from an allocentric view of the data to a more egocentric and immersive view of the data?

**Changing Technologies:** What are the lessons that can be learnt from previous research into the use of 3D visualisation for information visualisation? Do the new technologies invalidate the current wisdom that it is better to use 2D visualisation for abstract data since the designer of the visualisation has complete freedom to map data to an occlusion free 2D display?

**Application Areas** What are the most fertile application areas for immersive analytics? For example, these could be in life-sciences, disaster and emergency management, archaeology, and many more.

**Platforms and Toolkits:** How do we develop generic platforms that support immersive analytics? Currently there is a wide range of different development platforms and existing cross-platform tools however they do not quite have a broad enough focus for immersive analytics. For example, Unity<sup>1</sup> is designed for gaming applications rather than analytics while the Visualization Toolkit (VTK)<sup>2</sup> is targeted at scientific visualisation applications.

## Nature of the Workshop

The aims of the workshop are as follows:

1. To bring together experts from the Human Computer Interaction, Information Visualisation, Augmented Reality and Visual Analytics communities; as well as industry representatives, and domain experts from application areas that require analysis of complex data.
2. To investigate the potential and the challenges of immersive analytics in research and industry.
3. To investigate how existing interaction models and techniques can be adapted to new environments, and where new approaches are necessary. Based on this to formulate guidelines for the use of such interaction models and techniques in immersive analytics.
4. Initial design of open-source tools and platforms for supporting immersive analytics research and practice.
5. To investigate how the evaluation of new concepts can be done, including interaction efficiency.
6. To explore the design space for immersive analytics for effective collaborative data analysis in various forms, e.g. distributed or local, synchronous or asynchronous.

<sup>1</sup>[unity3d.org](http://unity3d.org)

<sup>2</sup>[www.vtk.org](http://www.vtk.org)

### *Outcomes*

We plan to prepare a special journal issue (IEEE Computer Graphics and Applications would be appropriate) compiling expanded versions of the submitted workshop papers and also inviting new papers evolved from the discussions at the workshop.

Another goal of the workshop is to “test the waters” to see if there is sufficient interest to develop a continuing symposium on Immersive Analytics. This will be a focus of the “Community Building” activities scheduled for the afternoon session.

### **Format of the Workshop**

We propose to run a one-day workshop collocated with the 2016 ISS conference. The workshop would be a forum for:

- Invited talks from one or two important figures in the relevant communities.
- Work-in-Progress and novel research presentations (with submitted and reviewed short papers).
- Brain storming activities and new project formation around the themes of the workshop.
- Community building and panel discussions about how to progress the topic of Immersive Analytics.

A possible schedule is provided in the left margin.

### **Program Committee**

We will invite a mixture of Information Visualization, Virtual and Augmented Reality and HCI researchers to join our program committee. Each will be asked to review 2-3 submissions on work-in-progress and novel research in Immersive Analytics. We plan to initially invite attendees from the Shonan and Dagstuhl workshops, beginning with the following:

Steve Drucker, Microsoft Research, USA

Nathalie Henry Riche, Microsoft Research, USA  
Pierre Dragicevic, Inria, France, France  
Niklas Elmqvist, University of Maryland, USA  
Bruce Thomas, University of South Australia, Australia  
Mark Billingham, University of South Australia, Australia  
Petra Isenberg, Inria, France  
Tobias Isenberg, Inria, France  
Yvonne Jansen, University of Copenhagen, Denmark  
Emmanuel Pietriga, Inria, France  
Aaron Quigley, University of St. Andrews, UK  
Christophe Hurter, ENAC, France  
Carla Freitas, Fed. University of Rio Grande do Sul, Brazil  
Falk Schreiber, Konstanz University, Germany  
Chris North, Virginia Tech, USA  
Miguel Nacenta, University of St. Andrews, UK  
Gerik Scheuermann, University of Leipzig, Germany  
Wolfgang Stuerzlinger, Simon Fraser University, Canada  
Aurélien Tabard, University Claude Bernard – Lyon, France  
Maxime Cordeil, Monash University, Australia

### **REFERENCES**

1. Thomas, James J., and Kristin A. Cook, eds. Illuminating the path: The research and development agenda for visual analytics. IEEE Computer Society Press, 2005.
2. Keim, Daniel A., Florian Mansmann, Jörn Schneidewind, Jim Thomas, and Hartmut Ziegler. Visual analytics: Scope and challenges. Springer Berlin Heidelberg, 2008.

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### **Schedule**

9:00	Intro. & overview of the workshop structure
9:15	One minute introductions from participants
9:45	Invited talks
10:30	Submitted paper talks
12:00	Lunch
13:00	Topic Brainstorming
13:45	Group Formation
14:00	Group Discussions
16:00	Group Reports
16:30	Community Building
17:00	Closing

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### **Call-for-papers**

The CfP summarizes the outline and topics of the workshop as stated in this proposal. It will be distributed on the ISS website, mailing-lists for IEEE VIS, ACM CHI, and UIST, as well as on the internal mailing lists of the organizer's respective institutions, on the organizers' webpages and social media. The call-for-papers is as follows:

Due to the recent advances in immersive technologies (VR, AR, large displays, tangible surfaces, etc.), we see new opportunities to leverage these technologies to analyse and explore data. Visual analytics is concerned with analytical reasoning facilitated by interactive visual interfaces. This definition is agnostic of the actual interface devices employed by visual analysis systems. Nevertheless, the affordances of the display and input devices used for analyzing data strongly affect the experience of the users of such systems, and so, their degree of engagement and productivity. However, a systematic approach to developing visual analytic tools that move beyond the desktop is yet lacking.

In this call, we are looking for innovative research, design, and view-points, mature or work-in-progress, that fall into or are related to the following topics: Real-world VA, Collaboration, Hybrid 2D/3D, Affordances for Immersion, Changing Technologies, Application Areas, Platforms and Toolkits. We call this new research thrust "Immersive Analytics", a topic that will explore the applicability and development of emerging user-interface technologies for creating more engaging experiences and seamless work-flows for data analysis applications.

Submissions will be peer-reviewed and accepted submissions will be published as a special issue of IEEE Computer Graphics and Application in early 2017.

### **Room Requirements**

We expect around 30 participants for the workshop and the room should provide tables for participants to gather into groups (5-6 persons per group and table). We also need a standard projector for talks to be held. Whiteboards for group discussions.