



Activity Report 2018

**Project-Team AVIZ**

Analysis and Visualization

RESEARCH CENTER  
Saclay - Île-de-France

THEME  
Interaction and visualization



## Table of contents

<b>1. Team, Visitors, External Collaborators</b> .....	<b>1</b>
<b>2. Overall Objectives</b> .....	<b>2</b>
2.1. Objectives	2
2.2. Research Themes	3
<b>3. Research Program</b> .....	<b>4</b>
3.1. Scientific Foundations	4
3.2. Innovation	5
3.3. Evaluation Methods	6
3.4. Software Infrastructures	6
3.5. Emerging Technologies	6
3.6. Psychology	7
<b>4. Highlights of the Year</b> .....	<b>7</b>
<b>5. New Software and Platforms</b> .....	<b>7</b>
5.1. Cartolabe	7
5.2. BitConduite	7
<b>6. New Results</b> .....	<b>8</b>
6.1. Declarative Rendering Model for Multiclass Density Maps	8
6.2. Reducing Affective Responses to Surgical Images through Color Manipulation and Stylization	8
6.3. Conceptual and Methodological Issues in Evaluating Multidimensional Visualizations for Decision Support	9
6.4. Blinded with Science or Informed by Charts? A Replication Study	10
6.5. A Model of Spatial Directness in Interactive Visualization	11
6.6. Multiscale Visualization and Scale-Adaptive Modification of DNA Nanostructures	11
6.7. DimSUM: Dimension and Scale Unifying Maps for Visual Abstraction of DNA Origami Structures	12
6.8. Pondering the Concept of Abstraction in (Illustrative) Visualization	13
6.9. Is there a reproducibility crisis around here? Maybe not, but we still need to change	14
6.10. Visualizing Ranges over Time on Mobile Phones: A Task-Based Crowdsourced Evaluation	14
<b>7. Partnerships and Cooperations</b> .....	<b>14</b>
7.1. Regional Initiatives	14
7.2. National Initiatives	15
7.3. European Initiatives	15
7.3.1. FP7 & H2020 Projects	15
7.3.2. Collaborations in European Programs, Except FP7 & H2020	16
7.4. International Initiatives	16
7.4.1. Inria Associate Teams Not Involved in an Inria International Labs	16
7.4.2. Inria International Partners	16
7.5. International Research Visitors	17
<b>8. Dissemination</b> .....	<b>17</b>
8.1. Promoting Scientific Activities	17
8.1.1. Scientific Events Organisation	17
8.1.2. Scientific Events Selection	18
8.1.2.1. Chair of Conference Program Committees	18
8.1.2.2. Member of the Conference Program Committees	18
8.1.2.3. Reviewer	18
8.1.3. Journal	18
8.1.3.1. Member of the Editorial Boards	18
8.1.3.2. Reviewer - Reviewing Activities	18

8.1.4.	Invited Talks	18
8.1.5.	Leadership within the Scientific Community	19
8.1.6.	Scientific Expertise	19
8.1.7.	Research Administration	19
8.2.	Teaching - Supervision - Juries	19
8.2.1.	Teaching	19
8.2.2.	Supervision	20
8.2.3.	Juries	20
8.3.	Popularization	20
8.3.1.	Articles and contents	20
8.3.2.	Creation of media or tools for science outreach	20
<b>9.</b>	<b>Bibliography</b> .....	<b>20</b>

## Project-Team AVIZ

*Creation of the Team: 2007 February 08, updated into Project-Team: 2008 January 01*

### Keywords:

#### Computer Science and Digital Science:

- A1.3. - Distributed Systems
- A1.3.3. - Blockchain
- A3.1.4. - Uncertain data
- A3.1.7. - Open data
- A3.1.8. - Big data (production, storage, transfer)
- A3.3. - Data and knowledge analysis
- A3.3.1. - On-line analytical processing
- A3.3.3. - Big data analysis
- A3.5.1. - Analysis of large graphs
- A5.1. - Human-Computer Interaction
- A5.1.2. - Evaluation of interactive systems
- A5.1.6. - Tangible interfaces
- A5.1.8. - 3D User Interfaces
- A5.1.9. - User and perceptual studies
- A5.2. - Data visualization
- A6.3.3. - Data processing

#### Other Research Topics and Application Domains:

- B1. - Life sciences
- B1.1. - Biology
- B1.2. - Neuroscience and cognitive science
- B9.5.6. - Data science
- B9.6. - Humanities
- B9.6.1. - Psychology
- B9.6.3. - Economy, Finance
- B9.6.6. - Archeology, History
- B9.6.10. - Digital humanities

## 1. Team, Visitors, External Collaborators

### Research Scientists

- Jean-Daniel Fekete [Team leader, Inria, Senior Researcher, HDR]
- Tobias Isenberg [Team leader, Inria, Senior Researcher, HDR]
- Pierre Dragicevic [Inria, Researcher]
- Steve Haroz [Inria, Starting Research Position, from Sep 2018]
- Petra Isenberg [Inria, Researcher]
- Catherine Plaisant [Fondation Inria, Advanced Research Position, from Sep 2018 until Nov 2018]

### Post-Doctoral Fellows

- Tanja Blascheck [Inria]

Qing Chen [Ecole polytechnique, from Oct 2018]  
Paola Tatiana Llerena Valdivia [Inria, from Jun 2018]

#### **PhD Students**

Marc Barnabe [INRA]  
Sarkis Halladjian [Inria]  
Mickael Sereno [Inria, from Oct 2018]  
Natkamon Tovanich [Institut de recherche technologique System X, from Dec 2018]  
Xiyao Wang [Inria]

#### **Technical staff**

Christoph Kinkeldey [Inria, until Jan 2018]  
Christian Poli [Inria]

#### **Interns**

Mina Alipour [Inria, from Feb 2018 until Aug 2018]  
Jung Who Nam [Inria, from Jun 2018 until Aug 2018]  
Nicholas Stark [Inria, from Aug 2018]

#### **Administrative Assistant**

Katia Evrat [Inria]

#### **Visiting Scientists**

Qing Chen [Hong Kong University of Science and Technology, from Apr 2018 until Jun 2018]  
Michael McGuffin [École de Technologie Supérieure, Montréal, from Oct 2018 until Nov 2018]  
Claudio Silva [New York University, from Aug 2018]  
Wesley Willett [University of Calgary, Canada, from Nov 2018]

#### **External Collaborators**

Evelyne Lutton [INRA]  
Frédéric Vernier [Univ Paris-Sud, from Oct 2018]  
Christoph Kinkeldey [Freie Universität Berlin, Germany, from Apr 2018]

## **2. Overall Objectives**

### **2.1. Objectives**

Aviz (Analysis and VIualizatiOn) is a multidisciplinary project that seeks to improve visual exploration and analysis of large, complex datasets by tightly integrating analysis methods with interactive visualization.

Our work has the potential to affect practically all human activities for and during which data is collected and managed and subsequently needs to be understood. Often data-related activities are characterized by access to new data for which we have little or no prior knowledge of its inner structure and content. In these cases, we need to interactively *explore* the data first to gain insights and eventually be able to act upon the data contents. Interactive visual analysis is particularly useful in these cases where automatic analysis approaches fail and human capabilities need to be exploited and augmented.

Within this research scope Aviz focuses on five research themes:

- Methods to visualize and smoothly navigate through large datasets;
- Efficient analysis methods to reduce huge datasets to visualizable size;
- Visualization interaction using novel capabilities and modalities;
- Evaluation methods to assess the effectiveness of visualization and analysis methods and their usability;
- Engineering tools for building visual analytics systems that can access, search, visualize and analyze large datasets with smooth, interactive response.

## 2.2. Research Themes

Aviz's research on Visual Analytics is organized around five main Research Themes:

*Methods to visualize and smoothly navigate through large data sets:* Large data sets challenge current visualization and analysis methods. Understanding the structure of a graph with one million vertices is not just a matter of displaying the vertices on a screen and connecting them with lines. Current screens only have around two million pixels. Understanding a large graph requires both data reduction to visualize the whole and navigation techniques coupled with suitable representations to see the details. These representations, aggregation functions, navigation and interaction techniques must be chosen as a coordinated whole to be effective and fit the user's mental map.

Aviz designs new visualization representations and interactions to efficiently navigate and manipulate large data sets.

*Efficient analysis methods to reduce huge data sets to visualizable size:* Designing analysis components with interaction in mind has strong implications for both the algorithms and the processes they use. Some data reduction algorithms are suited to the principle of sampling, then extrapolating, assessing the quality and incrementally enhancing the computation: for example, all the linear reductions such as PCA, Factorial Analysis, and SVM, as well as general MDS and Self Organizing Maps. Aviz investigates the possible analysis processes according to the analyzed data types.

*Visualization interaction using novel capabilities and modalities:* The importance of interaction to Visualization and, in particular, to the interplay between interactivity and cognition is widely recognized. However, information visualization interactions have yet to take full advantage of these new possibilities in interaction technologies, as they largely still employ the traditional desktop, mouse, and keyboard setup of WIMP (Windows, Icons, Menus, and a Pointer) interfaces. At Aviz we investigate in particular interaction through tangible and touch-based interfaces to data.

*Evaluation methods to assess their effectiveness and usability:* For several reasons appropriate evaluation of visual analytics solutions is not trivial. First, visual analytics tools are often designed to be applicable to a variety of disciplines, for various different data sources, and data characteristics, and because of this variety it is hard to make general statements. Second, in visual analytics the specificity of humans, their work environment, and the data analysis tasks, form a multi-faceted evaluation context which is difficult to control and generalize. This means that recommendations for visual analytics solutions are never absolute, but depend on their context.

In our work we systematically connect evaluation approaches to visual analytics research—we strive to develop and use both novel as well as establish mixed-methods evaluation approaches to derive recommendations on the use of visual analytics tools and techniques. Aviz regularly published user studies of visual analytics and interaction techniques and takes part in dedicated workshops on evaluation.

*Engineering tools:* for building visual analytics systems that can access, search, visualize and analyze large data sets with smooth, interactive response.

Currently, databases, data analysis and visualization all use the concept of data tables made of tuples and linked by relations. However, databases are storage-oriented and do not describe the data types precisely. Analytical systems describe the data types precisely, but their data storage and computation model are not suited to interactive visualization. Visualization systems use in-memory data tables tailored for fast display and filtering, but their interactions with external analysis programs and databases are often slow.

Aviz seeks to merge three fields: databases, data analysis and visualization. Part of this merging involves using common abstractions and interoperable components. This is a long-term challenge, but it is a necessity because generic, loosely-coupled combinations will not achieve interactive performance.

Aviz's approach is holistic: these five themes are facets of building an analysis process optimized for discovery. All the systems and techniques Aviz designs support the process of understanding data and forming insights while minimizing disruptions during navigation and interaction.

## 3. Research Program

### 3.1. Scientific Foundations

The scientific foundations of Visual Analytics lie primarily in the domains of Visualization and Data Mining. Indirectly, it inherits from other established domains such as graphic design, Exploratory Data Analysis (EDA), statistics, Artificial Intelligence (AI), Human-Computer Interaction (HCI), and Psychology.

The use of graphic representation to understand abstract data is a goal Visual Analytics shares with Tukey's Exploratory Data Analysis (EDA) [71], graphic designers such as Bertin [60] and Tufte [70], and HCI researchers in the field of Information Visualization [59].

EDA is complementary to classical statistical analysis. Classical statistics starts from a *problem*, gathers *data*, designs a *model* and performs an *analysis* to reach a *conclusion* about whether the data follows the model. While EDA also starts with a problem and data, it is most useful *before* we have a model; rather, we perform visual analysis to discover what kind of model might apply to it. However, statistical validation is not always required with EDA; since often the results of visual analysis are sufficiently clear-cut that statistics are unnecessary.

Visual Analytics relies on a process similar to EDA, but expands its scope to include more sophisticated graphics and areas where considerable automated analysis is required before the visual analysis takes place. This richer data analysis has its roots in the domain of Data Mining, while the advanced graphics and interactive exploration techniques come from the scientific fields of Data Visualization and HCI, as well as the expertise of professions such as cartography and graphic designers who have long worked to create effective methods for graphically conveying information.

The books of the cartographer Bertin and the graphic designer Tufte are full of rules drawn from their experience about how the meaning of data can be best conveyed visually. Their purpose is to find effective visual representation that describe a data set but also (mainly for Bertin) to discover structure in the data by using the right mappings from abstract dimensions in the data to visual ones.

For the last 25 years, the field of Human-Computer Interaction (HCI) has also shown that interacting with visual representations of data in a tight perception-action loop improves the time and level of understanding of data sets. Information Visualization is the branch of HCI that has studied visual representations suitable to understanding and interaction methods suitable to navigating and drilling down on data. The scientific foundations of Information Visualization come from theories about perception, action and interaction.

Several theories of perception are related to information visualization such as the "Gestalt" principles, Gibson's theory of visual perception [64] and Triesman's "preattentive processing" theory [69]. We use them extensively but they only have a limited accuracy for predicting the effectiveness of novel visual representations in interactive settings.

Information Visualization emerged from HCI when researchers realized that interaction greatly enhanced the perception of visual representations.

To be effective, interaction should take place in an interactive loop faster than 100ms. For small data sets, it is not difficult to guarantee that analysis, visualization and interaction steps occur in this time, permitting smooth data analysis and navigation. For larger data sets, more computation should be performed to reduce the data size to a size that may be visualized effectively.



In 2002, we showed that the practical limit of InfoVis was on the order of 1 million items displayed on a screen [62]. Although screen technologies have improved rapidly since then, eventually we will be limited by the physiology of our vision system: about 20 millions receptor cells (rods and cones) on the retina. Another problem will be the limits of human visual attention, as suggested by our 2006 study on change blindness in large and multiple displays [61]. Therefore, visualization alone cannot let us understand very large data sets. Other techniques such as aggregation or sampling must be used to reduce the visual complexity of the data to the scale of human perception.

Abstracting data to reduce its size to what humans can understand is the goal of Data Mining research. It uses data analysis and machine learning techniques. The scientific foundations of these techniques revolve around the idea of finding a good model for the data. Unfortunately, the more sophisticated techniques for finding models are complex, and the algorithms can take a long time to run, making them unsuitable for an interactive environment. Furthermore, some models are too complex for humans to understand; so the results of data mining can be difficult or impossible to understand directly.

Unlike pure Data Mining systems, a Visual Analytics system provides analysis algorithms and processes compatible with human perception and understandable to human cognition. The analysis should provide understandable results quickly, even if they are not ideal. Instead of running to a predefined threshold, algorithms and programs should be designed to allow trading speed for quality and show the tradeoffs interactively. This is not a temporary requirement: it will be with us even when computers are much faster, because good quality algorithms are at least quadratic in time (e.g. hierarchical clustering methods). Visual Analytics systems need different algorithms for different phases of the work that can trade speed for quality in an understandable way.

Designing novel interaction and visualization techniques to explore huge data sets is an important goal and requires solving hard problems, but how can we assess whether or not our techniques and systems provide real improvements? Without this answer, we cannot know if we are heading in the right direction. This is why we have been actively involved in the design of evaluation methods for information visualization [68], [67], [65], [66], [63]. For more complex systems, other methods are required. For these we want to focus on longitudinal evaluation methods while still trying to improve controlled experiments.

## 3.2. Innovation

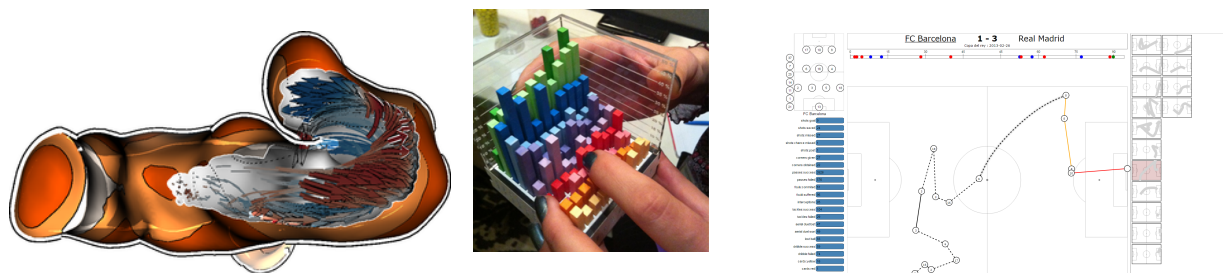


Figure 1. Example novel visualization techniques and tools developed by the team. Left: a non-photorealistic rendering technique that visualizes blood flow and vessel thickness. Middle: a physical visualization showing economic indicators for several countries, right: SoccerStories a tool for visualizing soccer games.

We design novel visualization and interaction techniques (see, for example, Figure 1). Many of these techniques are also evaluated throughout the course of their respective research projects. We cover application domains such as sports analysis, digital humanities, fluid simulations, and biology. A focus of Aviz' work is the improvement of graph visualization and interaction with graphs. We further develop individual techniques

for the design of tabular visualizations and different types of data charts. Another focus is the use of animation as a transition aid between different views of the data. We are also interested in applying techniques from illustrative visualization to visual representations and applications in information visualization as well as scientific visualization.

### 3.3. Evaluation Methods

Evaluation methods are required to assess the effectiveness and usability of visualization and analysis methods. Aviz typically uses traditional HCI evaluation methods, either quantitative (measuring speed and errors) or qualitative (understanding users tasks and activities). Moreover, Aviz is also contributing to the improvement of evaluation methods by reporting on the best practices in the field, by co-organizing workshops (BELIV 2010, 2012, 2014, 2016) to exchange on novel evaluation methods, by improving our ways of reporting, interpreting and communicating statistical results, and by applying novel methodologies, for example to assess visualization literacy.

### 3.4. Software Infrastructures

We want to understand the requirements that software and hardware architectures should provide to support exploratory analysis of large amounts of data. So far, “big data” has been focusing on issues related to storage management and predictive analysis: applying a well-known set of operations on large amounts of data. Visual Analytics is about exploration of data, with sometimes little knowledge of its structure or properties. Therefore, interactive exploration and analysis is needed to build knowledge and apply appropriate analyses; this knowledge and appropriateness is supported by visualizations. However, applying analytical operations on large data implies long-lasting computations, incompatible with interactions, and generates large amounts of results, impossible to visualize directly without aggregation or sampling. Visual Analytics has started to tackle these problems for specific applications but not in a general manner, leading to fragmentation of results and difficulties to reuse techniques from one application to the other. We are interested in abstracting-out the issues and finding general architectural models, patterns, and frameworks to address the Visual Analytics challenge in more generic ways.

### 3.5. Emerging Technologies



*Figure 2. Example emerging technology solutions developed by the team for multi-display environments, wall displays, and token-based visualization.*

We want to empower humans to make use of data using different types of display media and to enhance how they can understand and visually and interactively explore information. This includes novel display equipment and accompanying input techniques. The Aviz team specifically focuses on the exploration of the use of large displays in visualization contexts as well as emerging physical and tangible visualizations. In terms of interaction modalities our work focuses on using touch and tangible interaction. Aviz participates to the Digiscope project that funds 11 wall-size displays at multiple places in the Paris area (see <http://www.>

[digiscope.fr](http://digiscope.fr)), connected by telepresence equipment and a Fablab for creating devices. Aviz is in charge of creating and managing the Fablab, uses it to create physical visualizations, and is also using the local wall-size display (called WILD) to explore visualization on large screens. The team also investigates the perceptual, motor and cognitive implications of using such technologies for visualization.

### 3.6. Psychology

More cross-fertilization is needed between psychology and information visualization. The only key difference lies in their ultimate objective: understanding the human mind vs. helping to develop better tools. We focus on understanding and using findings from psychology to inform new tools for information visualization. In many cases, our work also extends previous work in psychology. Our approach to the psychology of information visualization is largely holistic and helps bridge gaps between perception, action and cognition in the context of information visualization. Our focus includes the perception of charts in general, perception in large display environments, collaboration, perception of animations, how action can support perception and cognition, and judgment under uncertainty.

## 4. Highlights of the Year

### 4.1. Highlights of the Year

- Steve Haroz joined Aviz as a research scientist (SRP) for three years.
- Catherine Plaisant joined Aviz as an International Chair for 5 years.
- The team welcomed two invited professors (Claudio Silva and Michael McGuffin).
- Aviz members presented seven papers at IEEE VIS 2018 and won a best paper award at Eurovis 2018.
- Former Aviz PhD student [Lonni Besançon](#) received a [PhD thesis prize honorable mention award from GDR, AFIG, AFRV, and EGFR](#) for his thesis “[An interaction Continuum for 3D Data Visualization.](#)”
- Aviz started an Associated Team with the ilab at the University of Calgary on the topic of Situated and Embedded Visualization.

## 5. New Software and Platforms

### 5.1. Cartolabe

KEYWORD: Information visualization

FUNCTIONAL DESCRIPTION: The goal of Cartolabe is to build a visual map representing the scientific activity of an institution/university/domain from published articles and reports. Using the HAL Database and building upon the AnHALytics processing chain, Cartolabe provides the user with a map of the thematics, authors and articles and their dynamics along time. ML techniques are used for dimensionality reduction, cluster and topics identification, visualisation techniques are used for a scalable 2D representation of the results.

NEWS OF THE YEAR: Improvement of the graphical interface

- Contact: Philippe Caillou
- URL: <http://cartolabe.lri.fr/>

### 5.2. BitConduite

*BitConduite Bitcoin explorer*

KEYWORDS: Data visualization - Clustering - Financial analysis - Cryptocurrency

**FUNCTIONAL DESCRIPTION:** BitConduite is a web-based visual tool that allows for a high level explorative analysis of the Bitcoin blockchain. It offers a data transformation back end that gives us an entity-based access to the blockchain data and a visualization front end that supports a novel high-level view on transactions over time. In particular, it facilitates the exploration of activity through filtering and clustering interactions. This gives analysts a new perspective on the data stored on the blockchain.

- Contact: Petra Isenberg

## 6. New Results

### 6.1. Declarative Rendering Model for Multiclass Density Maps

**Participants:** Jaemin Jo [Dept. of Computer Science and Engineering, Seoul National University, South Korea], Pierre Dragicevic, Jean-Daniel Fekete [correspondent].

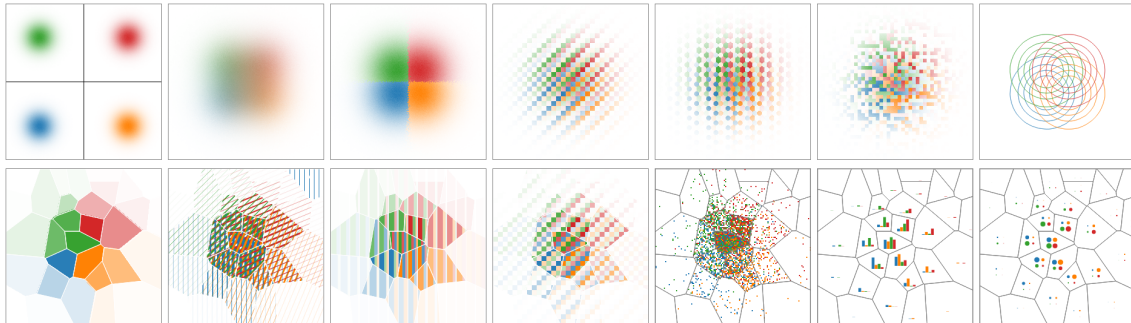


Figure 3. Design alternatives for a four-class density map.

Multiclass maps are scatterplots, multidimensional projections, or thematic geographic maps where data points have a categorical attribute in addition to two quantitative attributes. This categorical attribute is often rendered using shape or color, which does not scale when overplotting occurs. When the number of data points increases, multiclass maps must resort to data aggregation to remain readable. We use a novel model called *multiclass density maps*: multiple 2D histograms computed for each of the category values. Multiclass density maps are meant as a building block to improve the expressiveness and scalability of multiclass map visualization. This library implements our declarative model: a simple yet expressive JSON grammar associated with visual semantics, that specifies a wide design space of visualizations for multiclass density maps. Our declarative model is expressive and can be efficiently implemented in visualization front-ends such as modern web browsers. Furthermore, it can be reconfigured dynamically to support data exploration tasks without recomputing the raw data. Finally, we demonstrate how our model can be used to reproduce examples from the past and support exploring data at scale.

More on the project page: [Multiclass Density Maps](#).

### 6.2. Reducing Affective Responses to Surgical Images through Color Manipulation and Stylization

**Participants:** Lonni Besançon [Linköping University Norrköping, Sweden], Amir Semmo [Hasso Plattner Institute, University of Potsdam, Germany], David Biau [Assistance Publique – Hôpitaux de Paris, France], Bruno Frachet [Assistance Publique – Hôpitaux de Paris, France], Virginie Pineau [Institut Curie, France], El Hadi Sariali [Assistance Publique – Hôpitaux de Paris, France], Rabah Taouachi [Institut Curie, France], Tobias Isenberg, Pierre Dragicevic [correspondant].



Figure 4. One of the surgery filters used in our study.

We presented the first empirical study on using color manipulation and stylization to make surgery images more palatable [38]. While aversion to such images is natural, it limits many people’s ability to satisfy their curiosity, educate themselves, and make informed decisions. We selected a diverse set of image processing techniques, and tested them both on surgeons and lay people. While many artistic methods were found unusable by surgeons, edge-preserving image smoothing gave good results both in terms of preserving information (as judged by surgeons) and reducing repulsiveness (as judged by lay people). Color manipulation turned out to be not as effective.

This study is an initial investigation but opens up exciting avenues for future research. These include supporting surgery videos, other types of medical images than open surgery (e.g., skin diseases), as well as disturbing imagery outside the medical domain, such as offensive user-generated content that can psychologically impact professionals who monitor it.

All supplemental material is on the OSF page: [osf.io/4pfes/](https://osf.io/4pfes/).

### 6.3. Conceptual and Methodological Issues in Evaluating Multidimensional Visualizations for Decision Support

**Participants:** Evanthia Dimara [ISIR, Sorbonne Université, France], Anastasia Bezerianos [ISIR, Sorbonne Université, France], Pierre Dragicevic [correspondant].

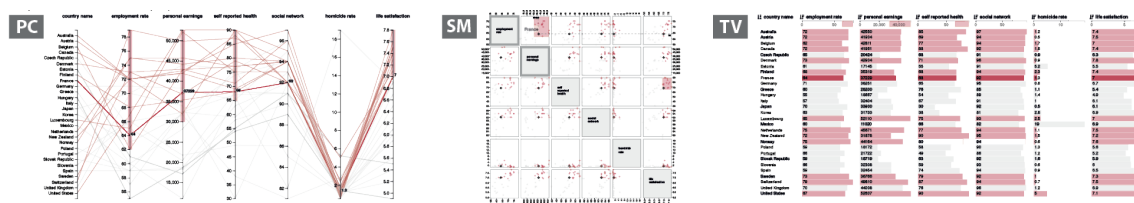


Figure 5. The three visualization techniques tested in our study.



We explored how to rigorously evaluate multidimensional visualizations for their ability to support decision making [22]. We first defined multi-attribute choice tasks, a type of decision task commonly performed with such visualizations. We then identified which of the existing multidimensional visualizations are compatible with such tasks, and evaluated three elementary visualizations: parallel coordinates, scatterplot matrices and tabular visualizations. Our method consisted in first giving participants low-level analytic tasks, in order to ensure that they properly understood the visualizations and their interactions. Participants were then given multi-attribute choice tasks consisting of choosing holiday packages. We assessed decision support through multiple objective and subjective metrics, including a decision accuracy metric based on the consistency between the choice made and self-reported preferences for attributes. We found the three visualizations to be comparable on most metrics, with a slight advantage for tabular visualizations. In particular, tabular visualizations allowed participants to reach decisions faster. Thus, although decision time is typically not central in assessing decision support, it can be used as a tie-breaker when visualizations achieve similar decision accuracy. Our results also suggest that indirect methods for assessing choice confidence may allow to better distinguish between visualizations than direct ones.

All supplemental material is on the project web page: [aviz.fr/dm](http://aviz.fr/dm).

## 6.4. Blinded with Science or Informed by Charts? A Replication Study

**Participants:** Pierre Dragicevic [correspondant], Yvonne Jansen [ISIR, Sorbonne Université, France].

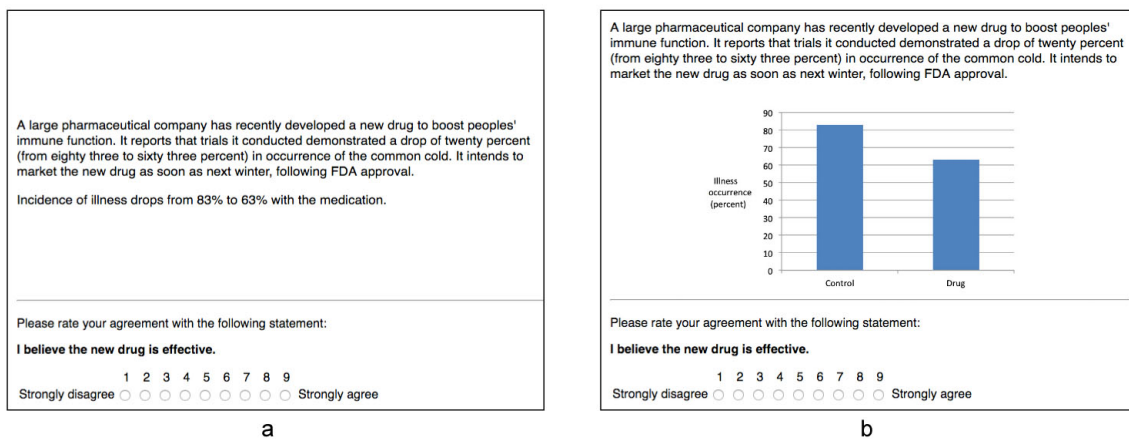


Figure 6. a) text without chart, b) text with “trivial” chart.

We provided a reappraisal of Tal and Wansink’s study “Blinded with Science”, where seemingly trivial charts were shown to increase belief in drug efficacy, presumably because charts are associated with science. Through a series of four replications conducted on two crowdsourcing platforms, we investigated an alternative explanation, namely, that the charts allowed participants to better assess the drug’s efficacy [24]. Considered together, our experiments suggested that the chart seems to have indeed promoted understanding, although the effect is likely very small. Meanwhile, we were unable to replicate the original study’s findings, as text with chart appeared to be no more persuasive – and sometimes less persuasive – than text alone. This suggests that the effect may not be as robust as claimed and may need specific conditions to be reproduced. Regardless, within our experimental settings and considering our study as a whole (N = 623), the chart’s contribution to understanding was clearly larger than its contribution to persuasion.

The main lesson from our study is that with charts, the peripheral route of persuasion cannot be studied independently from the central route: in order to establish that a chart biases judgment, it is necessary to also rigorously establish that it does not aid comprehension. Our replication also opens many relevant questions for infovis. Are charts really associated with science? More generally, what associations do charts or visualizations trigger depending on their visual design? When exactly is a chart trivial?

All supplemental material is on the project web page: [aviz.fr/blinded](http://aviz.fr/blinded).

## 6.5. A Model of Spatial Directness in Interactive Visualization

**Participants:** Stefan Bruckner [University of Bergen, Norway], Tobias Isenberg [correspondant], Timo Ropinski [Ulm University, Germany], Alexander Wiebel [Hochschule Worms University of Applied Sciences, Germany].

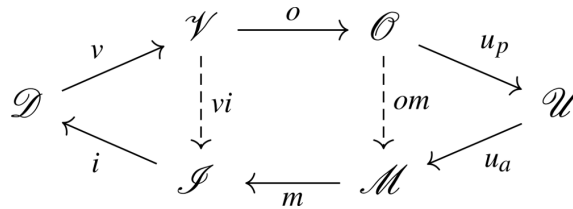


Figure 7. Illustration of the model of spatial directness.

We discussed the concept of directness in the context of spatial interaction with visualization. In particular, we proposed a model (see Figure 7) that allows practitioners to analyze and describe the spatial directness of interaction techniques, ultimately to be able to better understand interaction issues that may affect usability. To reach these goals, we distinguished between different types of directness. Each type of directness depends on a particular mapping between different spaces, for which we consider the data space, the visualization space, the output space, the user space, the manipulation space, and the interaction space. In addition to the introduction of the model itself, we also showed how to apply it to several real-world interaction scenarios in visualization, and thus discussed the resulting types of spatial directness, without recommending either more direct or more indirect interaction techniques. In particular, we demonstrated descriptive and evaluative usage of the proposed model, and also briefly discussed its generative usage.

More on the project Web page: <https://tobias.isenberg.cc/VideosAndDemos/Bruckner2018MSD>.

## 6.6. Multiscale Visualization and Scale-Adaptive Modification of DNA Nanostructures

**Participants:** Haichao Miao [TU Wien, Austria, and Austrian Institute of Technology, Vienna, Austria], Elisa de Llano [Austrian Institute of Technology, Vienna, Austria], Johannes Sorger [Complexity Science Hub Vienna, Austria], Yasaman Ahmadi [Austrian Institute of Technology, Vienna, Austria], Tadija Kekic [Austrian Institute of Technology, Vienna, Austria], Tobias Isenberg [correspondant], M. Eduard Gröller [TU Wien, Austria], Ivan Barišić [Austrian Institute of Technology, Vienna, Austria], Ivan Viola [TU Wien, Austria and KAUST, Kingdom of Saudi Arabia].

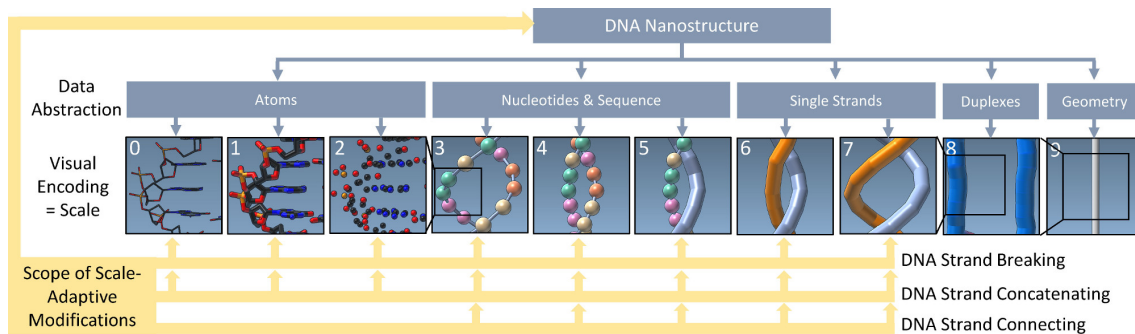


Figure 8. Illustration of the abstraction space.

We presented an approach to represent DNA nanostructures in varying forms of semantic abstraction, describe ways to smoothly transition between them, and thus create a continuous multiscale visualization and interaction space for applications in DNA nanotechnology. This new way of observing, interacting with, and creating DNA nanostructures enables domain experts to approach their work in any of the semantic abstraction levels, supporting both low-level manipulations and high-level visualization and modifications. Our approach allows them to deal with the increasingly complex DNA objects that they are designing, to improve their features, and to add novel functions in a way that no existing single-scale approach offers today. For this purpose we collaborated with DNA nanotechnology experts to design a set of ten semantic scales (see Figure 8). These scales take the DNA’s chemical and structural behavior into account and depict it from atoms to the targeted architecture with increasing levels of abstraction. To create coherence between the discrete scales, we seamlessly transition between them in a well-defined manner. We used special encodings to allow experts to estimate the nanoscale object’s stability. We also added scale-adaptive interactions that facilitate the intuitive modification of complex structures at multiple scales. We demonstrate the applicability of our approach on an experimental use case. Moreover, feedback from our collaborating domain experts confirmed an increased time efficiency and certainty for analysis and modification tasks on complex DNA structures. Our method thus offers exciting new opportunities with promising applications in medicine and biotechnology.

More on the project Web page: <https://tobias.isenberg.cc/VideosAndDemos/Miao2018MVS>.

## 6.7. DimSUM: Dimension and Scale Unifying Maps for Visual Abstraction of DNA Origami Structures

**Participants:** Haichao Miao [TU Wien, Austria, and Austrian Institute of Technology, Vienna, Austria], Elisa de Llano [Austrian Institute of Technology, Vienna, Austria], Tobias Isenberg [correspondant], M. Eduard Gröller [TU Wien, Austria], Ivan Barišić [Austrian Institute of Technology, Vienna, Austria], Ivan Viola [TU Wien, Austria and KAUST, Kingdom of Saudi Arabia].

We presented a novel visualization concept for DNA origami structures that integrates a multitude of representations into a DimSUM. This novel abstraction map (see Figure 9) provides means to analyze, smoothly transition between, and interact with many visual representations of the DNA origami structures in an effective way that was not possible before. DNA origami structures are nanoscale objects, which are challenging to model in silico. In our holistic approach we seamlessly combined three-dimensional realistic shape models, two-dimensional diagrammatic representations, and ordered alignments in one-dimensional arrangements, with semantic transitions across many scales. To navigate through this large, two-dimensional abstraction map we highlighted locations that users frequently visit for certain tasks and datasets. Particularly interesting viewpoints can be explicitly saved to optimize the workflow. We have developed DimSUM together



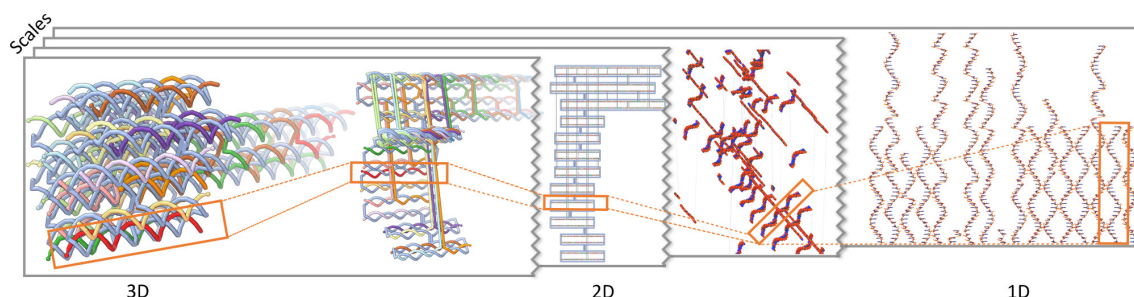


Figure 9. Illustration of the DimSUM space.

with domain scientists specialized in DNA nanotechnology. In the paper we discussed our design decisions for both the visualization and the interaction techniques. We demonstrated two practical use cases in which our approach increases the specialists' understanding and improves their effectiveness in the analysis. Finally, we discussed the implications of our concept for the use of controlled abstraction in visualization in general.

More on the project Web page: <https://tobias.isenberg.cc/VideosAndDemos/Miao2018DDS>.

## 6.8. Pondering the Concept of Abstraction in (Illustrative) Visualization

**Participants:** Ivan Viola [TU Wien, Austria and KAUST, Kingdom of Saudi Arabia], Tobias Isenberg [correspondant].

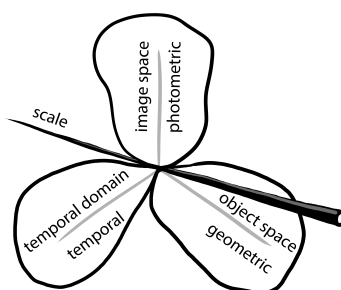


Figure 10. Illustration of the abstraction concept.

We discussed the concept of directness in the context of spatial interaction with visualization (Figure 10). In particular, we proposed a model (autoreffig:directness) that allows practitioners to analyze and describe the spatial directness of interaction techniques, ultimately to be able to better understand interaction issues that may affect usability. To reach these goals, we distinguished between different types of directness. Each type of directness depends on a particular mapping between different spaces, for which we consider the data space, the visualization space, the output space, the user space, the manipulation space, and the interaction space. In addition to the introduction of the model itself, we also showed how to apply it to several real-world interaction scenarios in visualization, and thus discussed the resulting types of spatial directness, without recommending either more direct or more indirect interaction techniques. In particular, we demonstrated descriptive and evaluative usage of the proposed model, and also briefly discussed its generative usage.

More on the project Web page: <https://tobias.isenberg.cc/VideosAndDemos/Bruckner2018MSD>.

## 6.9. Is there a reproducibility crisis around here? Maybe not, but we still need to change

**Participants:** Alex Holcombe [School of Psychology, The University of Sydney], Charles Ludowici [School of Psychology, The University of Sydney], Steve Haroz [correspondant].

Those of us who study large effects may believe ourselves to be unaffected by the reproducibility problems that plague other areas. However, we will argue that initiatives to address the reproducibility crisis, such as preregistration and data sharing, are worth adopting even under optimistic scenarios of high rates of replication success. We searched the text of articles published in the Journal of Vision from January through October of 2018 for URLs (our code is here: <https://osf.io/cv6ed/>) and examined them for raw data, experiment code, analysis code, and preregistrations. We also reviewed the articles' supplemental material. Of the 165 articles, approximately 12% provide raw data, 4% provide experiment code, and 5% provide analysis code. Only one article contained a preregistration. When feasible, preregistration is important because p-values are not interpretable unless the number of comparisons performed is known, and selective reporting appears to be common across fields. In the absence of preregistration, then, and in the context of the low rates of successful replication found across multiple fields, many claims in vision science are shrouded by uncertain credence. Sharing de-identified data, experiment code, and data analysis code not only increases credibility and ameliorates the negative impact of errors, it also accelerates science. Open practices allow researchers to build on others' work more quickly and with more confidence. Given our results and the broader context of concern by funders, evident in the recent NSF statement that "transparency is a necessary condition when designing scientifically valid research" and "pre-registration. . . can help ensure the integrity and transparency of the proposed research", there is much to discuss.

## 6.10. Visualizing Ranges over Time on Mobile Phones: A Task-Based Crowdsourced Evaluation

**Participants:** Matthew Brehmer [Microsoft Research, USA], Bongshin Lee [Microsoft Research, USA], Petra Isenberg [correspondant], Eun Kyong Choe [University of Maryland, USA].

In the first crowdsourced visualization experiment conducted exclusively on mobile phones, we experimentally compare approaches to visualizing ranges over time on small displays. People routinely consume such data via a mobile phone, from temperatures in weather forecasting apps to sleep and blood pressure readings in personal health apps. However, we lack guidance on how to effectively visualize ranges on small displays in the context of different value retrieval and comparison tasks, or with respect to different data characteristics such as periodicity, seasonality, or the cardinality of ranges. Central to our experiment is a comparison between two ways to lay out ranges: a more conventional linear layout strikes a balance between quantitative and chronological scale resolution, while a less conventional radial layout emphasizes the cyclicity of time and may prioritize discrimination between values at its periphery. With results from 87 crowd workers, we found that while participants completed tasks more quickly with linear layouts than with radial ones, there were few differences in terms of error rate between layout conditions. We also found that participants performed similarly with both layouts in tasks that involved comparing superimposed observed and average ranges.

More on the [project Web page](#).

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

- Tobias Isenberg received an equipment grant from STIC, Paris-Saclay, for approx. EUR 5K

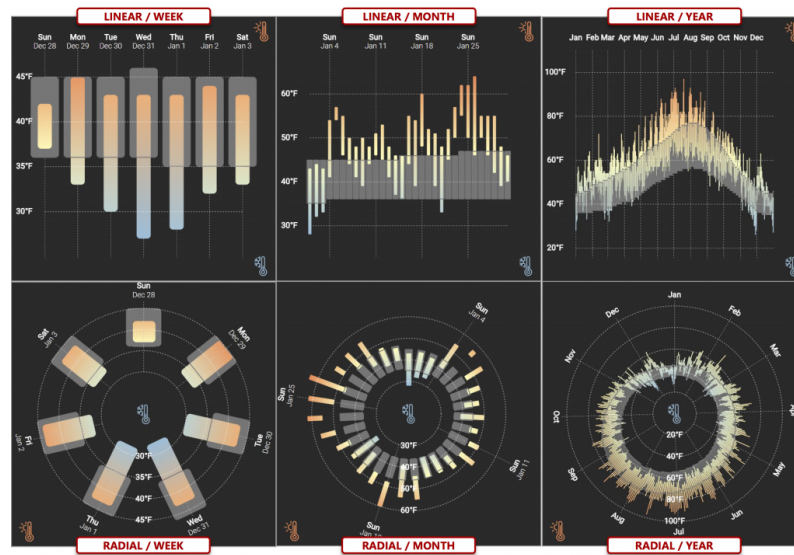


Figure 11. Linear and Radial temperature range charts designed for mobile phone displays, representative of the stimuli used in our crowdsourced experiment. The gradient bars encode observed temperature ranges and are superimposed on gray bars encoding average temperature ranges. Corresponding Week, Month, and Year charts display the same data.

## 7.2. National Initiatives

- Naviscope Inria Project Lab on Image-guided Navigation and Visualization of large data sets in live cell imaging and microSCOPY; collaboration with several Inria project teams and external collaborators; this grant supports a PhD position and funds travel and equipment.

## 7.3. European Initiatives

### 7.3.1. FP7 & H2020 Projects

#### 7.3.1.1. IVAN

Title: Interactive and Visual Analysis of Networks

Programm: CHIST-ERA

Duration: May 2018 - April 2021

Coordinator: Dr. Torsten Möller, Uni Wien, Austria

Partners:

EPFL, Switzerland

Inria France

Uni Wien, Austria

Inria contact: Jean-Daniel Fekete

The main goal of IVAN is to create a visual analysis system for the exploration of dynamic or time-dependent networks (from small to large scale). Our contributions will be in three principle areas:

1. novel algorithms for network clustering that are based on graph harmonic analysis and level-of-detail methods;

2. the development of novel similarity measures for networks and network clusters for the purpose of comparing multiple network clusterings and the grouping (clustering) of different network clusterings; and
3. a system for user-driven analysis of network clusterings supported by novel visual encodings and interaction techniques suitable for exploring dynamic networks and their clusterings in the presence of uncertainties due to noise and uncontrolled variations of network properties.

Our aim is to make these novel algorithms accessible to a broad range of users and researchers to enable reliable and informed decisions based on the network analysis.

### **7.3.2. Collaborations in European Programs, Except FP7 & H2020**

- Illustrare project co-funded by ANR, France, and FWF, Austria, funding a PhD position and funds for travel and equipment. The project investigates integrative visual abstraction of molecular data and is a collaboration with TU Wien, Austria

## **7.4. International Initiatives**

### **7.4.1. Inria Associate Teams Not Involved in an Inria International Labs**

#### **7.4.1.1. SEVEN**

Title: Situated and Embedded Visualization for Data Analysis

International Partner (Institution - Laboratory - Researcher):

University of Calgary (Canada) - ILab - Wesley Willett

Start year: 2018

See also: <http://aviz.fr/seven>

The goal of this joint work between the Aviz team at Inria Saclay and the ILab at the University of Calgary is to develop and study situated data visualizations to address the limitations of traditional platforms of data analytics. In a situated data visualization, the data is directly visualized next to the physical space, object, or person it refers to. Situated data visualizations can surface information in the physical environment and allow viewers to interpret data in-context, monitor changes over time, make decisions, and act on the physical world in response to the insights gained. However, research on this topic remains scarce and limited in scope. We will build on our track record of successful collaborations to jointly develop situated visualization as a novel research direction. The objective for the first year is to design and implement situated visualizations to support health and aging. Our joint work is expected generate benefits at multiple levels, including to society and industry (by empowering individuals and professionals with technology), to the scientific community (by developing a new research direction), to the academic partners (by reinforcing existing research links and establishing them as leaders on the topic), and to students (by providing them with unique training opportunities with a diverse team of world-class researchers).

### **7.4.2. Inria International Partners**

#### **7.4.2.1. Informal International Partners**

- University of Maryland (USA), University of Roma (Italy), TU Darmstadt (Germany): Jean-Daniel Fekete collaborates with Leilani Battle, Giuseppe Santucci, Carsten Binnig and colleagues on the design of database benchmarks to better support visualization;
- University of Seoul (Korea): Jean-Daniel Fekete collaborates with Jaemin Jo and Jinwook Seoh on progressive algorithms and visualization techniques;
- University of Bari (Italy): Jean-Daniel Fekete collaborates with Paolo Buono on hypergraph visualization;

- Stanford University. Pierre Dragicevic and Jean-Daniel Fekete collaborate with Sean Follmer on swarm user interfaces.
- Hasso Plattner Institute. Pierre Dragicevic and Tobias Isenberg collaborate with Amir Semmo on stylization filters for facilitating the examination of disturbing visual content.
- University of Minnesota, USA: Tobias Isenberg is collaborating with Daniel F. Keefe on topics of the interactive exploration of 3D data.
- University of Granada, Spain: Tobias Isenberg is collaborating with Domingo Martin and German Arroyo on digital stippling.
- The University of Sydney, Australia. Steve Haroz collaborate with Alex Holcombe on analyzing open practices in vision science.
- Massachusetts Institute of Technology (CSAIL). Steve Haroz collaborates with Aude Oliva on investigating the impact of titles on memory of visualized data.
- University of Washington, University of Zurich and University of Toronto. Pierre Dragicevic and Steve Haroz collaborate with Matthew Kay and Chat Wacharamanatham on transparent statistical reporting and efficient statistical communication. Pierre Dragicevic collaborates with Matthew Kay and Fanny Chevalier on supporting research transparency with interactive research papers.
- University of Calgary. Pierre Dragicevic, Tobias Isenberg, and Petra Isenberg collaborate with Wesley Willett, Sheelagh Carpendale, and Lora Oehlberg on situated data visualization.
- Microsoft Research Redmond and University of Maryland. Petra Isenberg collaborate with Bongshin Lee, Mathieu Brehmer, and Eun Kyoung Choe on Mobile Visualization
- Microsoft Research Redmond. Petra Isenberg and Tanja Blascheck collaborate with Bongshin Lee on Micro Visualizations for Smartwatches

## 7.5. International Research Visitors

### 7.5.1. Visits of International Scientists

- Claudio Silva (August 2018 – June 2019): Sabbatical from New York University (USA). Also, invited professor through a DigiCosme grant for 3 months. Claudio Silva is spending one year with Aviz. We launched a bi-weekly seminar on explainable machine-learning with visualization.
- Michael McGuffin (October – November): visit from ETS Montreal (Canada). Michael McGuffin has spent a month with Aviz working on augmented reality and visualization, collaborating with Pierre Dragicevic, Jean-Daniel Fekete, and students.

#### 7.5.1.1. Internships

- Jung Nam from the University of Minnesota visited for 3 months in the summer of 2018. His work centered on the use of storytelling mechanisms to support and communicate results of the exploration 3D data. This collaboration is still ongoing.

## 8. Dissemination

### 8.1. Promoting Scientific Activities

#### 8.1.1. Scientific Events Organisation

##### 8.1.1.1. General Chair, Scientific Chair

- Jean-Daniel Fekete co-organized the Dagstuhl Seminar on [Progressive Data Analysis and Visualization](#) in 2018
- Jean-Daniel Fekete co-organized the Dagstuhl Seminar on [Provenance and Logging for Sense Making](#) in 2018

- Pierre Dragicevic co-organized the **Journée Visu 2018**.
- Tobias Isenberg co-organized for BELIV 2018.

### 8.1.2. Scientific Events Selection

#### 8.1.2.1. Chair of Conference Program Committees

- Petra Isenberg was paper chair for InfoVis 2019.

#### 8.1.2.2. Member of the Conference Program Committees

- Jean-Daniel Fekete was a member of the program committee for VIS 2018
- Jean-Daniel Fekete was a member of the best paper committee for PacificVis 2018.
- Pierre Dragicevic was a member of the program committee for VIS 2018.
- Tobias Isenberg was a member of the program committee for ACM/Eurographics Expressive 2018.
- Tobias Isenberg was a member of the program committee for IEEE VR 2018.
- Tobias Isenberg was a member of the program committee for EuroVis 2018.
- Tobias Isenberg was a member of the program committee for IVAPP 2018.
- Petra Isenberg was a member of the program committee for CHI.

#### 8.1.2.3. Reviewer

- Jean-Daniel Fekete reviewed for CHI and PacificVis
- Pierre Dragicevic reviewed for VIS, UIST, EuroVis, alt.CHI, EICS, TEI, IHM.
- Tobias Isenberg reviewed for CHI, Expressive, InfoVis, PacificVis, SciVis, VAST, VISAP, and VR.
- Xiyao Wang reviewed for IHM, and TEI.
- Petra Isenberg reviewed for: CHI, EuroVA, EuroVis, ISS

### 8.1.3. Journal

#### 8.1.3.1. Member of the Editorial Boards

- Pierre Dragicevic is member of the editorial board of the Journal of Perceptual Imaging (JPI).
- Pierre Dragicevic is member of the editorial board of the Springer Human-Computer Interaction Series (HCIS).
- Tobias Isenberg is member of the editorial board of Elsevier's Computers & Graphics journal.
- Petra Isenberg is member of the editorial board of IEEE Transactions on Visualization and Computer Graphics.
- Petra Isenberg is Associate Editor in Chief for IEEE Computer Graphics and Applications.

#### 8.1.3.2. Reviewer - Reviewing Activities

- Jean-Daniel Fekete reviewed for TVCG
- Pierre Dragicevic reviewed for TOCHI, TVCG, JPI.
- Steve Haroz reviewed for Cognition, Journal of Experimental Psychology: General, Meta-Psychology
- Petra Isenberg reviewed for: Morgan Claypool (book proposal)

### 8.1.4. Invited Talks

- Jean-Daniel Fekete: Seminar EDF Lab Chatou "Progressive data analysis: a new language paradigm for scalability in exploratory data analysis", Chatou, Sep. 19, 2018
- Jean-Daniel Fekete: séminaire de recherche Medialab, « Nouvelles visualisations de réseaux pour de nouvelles formes d'explorations et d'analyses », Sciences Po Paris, April 3rd, 2018

- Jean-Daniel Fekete: Delft Data Science Seminar: Visual Data Science and its role in Computational Medicine The role of visualization in the hypothetico-deductive method, Delft University of Technology, January 6th, 2018.
- Tobias Isenberg: “Illustrative Visualization and Abstraction of Scientific Data”. M3DISIM joined Inria/Ecole Polytechnique research team, Orsay, France, November 2018.
- Tobias Isenberg: “Illustrative Visualization and Abstraction of Scientific Data”. GraphDeco research team, Sophia-Antipolis, France, December 2018.
- Steve Haroz: “Open Practices in Visualization Research”. Panel discussion at Evaluation and Beyond - Methodological Approaches for Visualization workshop, 21 Oct 2018.
- Petra Isenberg: “Evaluation in Visualization”. Keynote at the EMBL-EBI Workshop on Innovations in data visualisation for drug discovery, June 2018.
- Petra Isenberg: “Micro Visualizations for Pervasive and Mobile Data Exploration”. Seminar Series Talk, Technical University of Dresden, May 2018.

### **8.1.5. Leadership within the Scientific Community**

- Jean-Daniel Fekete is the Chair of the Steering Committee of the IEEE Information Visualization Conference.
- Jean-Daniel Fekete is member of the VIS Executive Committee.
- Jean-Daniel Fekete is a member of the Eurographics Publication Board.
- Jean-Daniel Fekete is the Chair of the EuroVis Best Phd Award.
- Tobias Isenberg has been a member of the Executive Committee of the Visualization and Computer Graphics Technical Committee of the IEEE Computer Society and served as Publications Chair.
- Tobias Isenberg is a member of the Steering Committee of Expressive (Joined Symposium on Computational Aesthetics, Sketch-Based Interfaces & Modeling, and Non-Photorealistic Animation & Rendering).
- Steve Haroz is the Open Practices chair of the IEEE Information Visualization conference.

### **8.1.6. Scientific Expertise**

- Pierre Dragicevic reviewed for an NSERC Discovery Grant proposal.

### **8.1.7. Research Administration**

- Pierre Dragicevic: Member of the Commission Consultative de Spécialistes de l’Université Paris-Sud (CCSU).

## **8.2. Teaching - Supervision - Juries**

### **8.2.1. Teaching**

- “Visualization and Visual Analytics” taught by Jean-Daniel Fekete, Master 2 in Data Science, 32 hours, École Polytechnique, France.
- “Photorealistic Rendering” taught by Tobias Isenberg at Polytech Paris-Sud and Université Paris-Saclay, France.
- “Introduction to Computer Graphics” taught by Tobias Isenberg at Polytech Paris-Sud, France.
- “Non-Photorealistic Rendering” taught by Tobias Isenberg at the University of Granada, Spain.
- guest lecture on “Introduction to Data Visualization” taught by Tobias Isenberg at Université Côte d’Azur, Nice, France.
- guest lecture on “Illustrative Visualization” taught by Tobias Isenberg at ENSTA, France.
- “Interactive Information Visualization” taught by Petra Isenberg at Université Paris Sud.
- “Visual Analytics” taught by Petra Isenberg at CentraleSupélec.



### 8.2.2. Supervision

- PhD: Marc Barnabé, Multiscale reconstruction of microbial ecosystems using semi-supervised machine learning, Université Paris-Sud, 2018, Jean-Daniel Fekete, Evelyne Lutton, INRA.
- PhD in progress: Mickaël Sereno, Collaborative Data Exploration and Discussion Supported by AR, Univ. Paris-Sud; 2018, Tobias Isenberg
- PhD in progress: Xiyao Wang, Augmented Reality Environments for the Interactive Exploration of 3D Data, Univ. Paris-Sud; 2017, Tobias Isenberg
- PhD in progress: Sarkis Halladjian, Spatially Integrated Abstraction of Genetic Molecules, Univ. Paris-Sud; 2017, Tobias Isenberg
- PhD in progress: Haichao Miao, Visual Abstraction and Modeling for DNA Nanotechnology, TU Wien, Austria, 2016, Tobias Isenberg

### 8.2.3. Juries

- Jean-Daniel Fekete: Member of the PhD committee of Dr. Marion Dumont.
- Jean-Daniel Fekete: Member of the PhD committee of Dr. Germán Leiva.
- Jean-Daniel Fekete: Member of the HdR committee of Dr. Eric Lecolinet.
- Pierre Dragicevic: Member of the hiring committee for Concours CRCN 2018 Centre Inria Rennes Bretagne Atlantique.
- Pierre Dragicevic: PhD defense committee of Bruno Fruchard (Télécom Paris Tech).
- Pierre Dragicevic: Mid-term PhD evaluation committee of Stacy Hsueh (Université Paris-Saclay).
- Pierre Dragicevic: Reviewer for Marguerite Peron's M2 internship.
- Petra Isenberg: Member of the PhD committee of Dr. Ulrike Kister
- Petra Isenberg: Reviewer Master Pro thesis, Ayoub Jaa, Université Paris Sud
- Petra Isenberg: Co-Supervisor Master thesis, Mathieu Louvet, Université Paris Sud
- Petra Isenberg: Co-Supervisor Master thesis, Mina Alipour, CentraleSupélec
- Petra Isenberg: Academic Tutor Master thesis: Marvin Rea

## 8.3. Popularization

### 8.3.1. Articles and contents

- [Lonni Besançon](#)'s PhD work was featured in [Le Monde's Binaire blog](#).
- Steve Haroz was interviewed on the [Data Stories podcast](#), October 10, 2018

### 8.3.2. Creation of media or tools for science outreach

- Pierre Dragicevic and Yvonne Jansen: the [data physicalization wiki](#) and the [List of Physical Visualizations and Related Artefacts](#) (500 weekly visits) are continuously being updated.

## 9. Bibliography

### Major publications by the team in recent years

- [1] B. BACH, P. DRAGICEVIC, D. ARCHAMBAULT, C. HURTER, S. CARPENDALE. *A Review of Temporal Data Visualizations Based on Space-Time Cube Operations*, in "Eurographics Conference on Visualization", Swansea, Wales, United Kingdom, June 2014, <https://hal.inria.fr/hal-01006140>



- 
- [2] M. BEHRISCH, B. BACH, N. HENRY RICHE, T. SCHRECK, J.-D. FEKETE. *Matrix Reordering Methods for Table and Network Visualization*, in "Computer Graphics Forum", 2016, vol. 35, 24 p. [DOI : 10.1111/CGF.12935], <https://hal.inria.fr/hal-01326759>
- [3] J. BOY, L. EVEILLARD, F. DETIENNE, J.-D. FEKETE. *Suggested Interactivity: Seeking Perceived Affordances for Information Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", January 2016, vol. 22, n<sup>o</sup> 1, pp. 639-648 [DOI : 10.1109/TVCG.2015.2467201], <https://hal.inria.fr/hal-01188973>
- [4] S. BRUCKNER, T. ISENBERG, T. ROPINSKI, A. WIEBEL. *A Model of Spatial Directness in Interactive Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", 2018, To appear [DOI : 10.1109/TVCG.2018.2848906], <https://hal.inria.fr/hal-01813889>
- [5] E. DIMARA, A. BEZERIANOS, P. DRAGICEVIC. *The Attraction Effect in Information Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", 2017, vol. 23, n<sup>o</sup> 1 [DOI : 10.1109/TVCG.2016.2598594], <https://hal.inria.fr/hal-01355750>
- [6] P. ISENBERG, N. ELMQVIST, J. SCHOLTZ, D. CERNEA, K.-L. MA, H. HAGEN. *Collaborative Visualization: Definition, Challenges, and Research Agenda*, in "Information Visualization Journal (IVS)", 2011, vol. 10, n<sup>o</sup> 4, pp. 310–326, Published online before print July 29, 2011 [DOI : 10.1177/1473871611412817], <https://hal.inria.fr/inria-00638540>
- [7] T. ISENBERG, P. ISENBERG, J. CHEN, M. SEDLMAIR, T. MÖLLER. *A Systematic Review on the Practice of Evaluating Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", 2013, vol. 19, n<sup>o</sup> 12, pp. 2818-2827 [DOI : 10.1109/TVCG.2013.126], <https://hal.inria.fr/hal-00846775>
- [8] Y. JANSEN, P. DRAGICEVIC, P. ISENBERG, J. ALEXANDER, A. KARNIK, J. KILDAL, S. SUBRAMANIAN, K. HORNBAEK. *Opportunities and Challenges for Data Physicalization*, in "Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI)", New York, NY, United States, ACM, April 2015 [DOI : 10.1145/2702123.2702180], <https://hal.inria.fr/hal-01120152>
- [9] H. LAM, E. BERTINI, P. ISENBERG, C. PLAISANT, S. CARPENDALE. *Empirical Studies in Information Visualization: Seven Scenarios*, in "IEEE Transactions on Visualization and Computer Graphics", 2012, vol. 18, n<sup>o</sup> 9, pp. 1520–1536 [DOI : 10.1109/TVCG.2011.279], <http://hal.inria.fr/hal-00932606>
- [10] M. LE GOC, L. H. KIM, A. PARSAEI, J.-D. FEKETE, P. DRAGICEVIC, S. FOLLMER. *Zooids: Building Blocks for Swarm User Interfaces*, in "Proceedings of the 29th Annual Symposium on User Interface Software and Technology (UIST)", Tokyo, Japan, October 2016 [DOI : 10.1145/2984511.2984547], <https://hal.inria.fr/hal-01391281>
- [11] B. LEE, P. ISENBERG, N. HENRY RICHE, S. CARPENDALE. *Beyond Mouse and Keyboard: Expanding Design Considerations for Information Visualization Interactions*, in "IEEE Transactions on Visualization and Computer Graphics", 2012, vol. 18, n<sup>o</sup> 12, pp. 2689–2698 [DOI : 10.1109/TVCG.2012.204], <https://hal.inria.fr/hal-00717203>
- [12] H. MIAO, E. DE LLANO, T. ISENBERG, M. E. GRÖLLER, I. BARIŠIĆ, I. VIOLA. *DimSUM: Dimension and Scale Unifying Maps for Visual Abstraction of DNA Origami Structures*, in "Computer Graphics Forum", June 2018, vol. 37, n<sup>o</sup> 3, pp. 403-413 [DOI : 10.1111/CGF.13429], <https://hal.inria.fr/hal-01795734>

- [13] H. MIAO, E. DE LLANO, J. SORGER, Y. AHMADI, T. KEKIC, T. ISENBERG, M. E. GRÖLLER, I. BARIŠIĆ, I. VIOLA. *Multiscale Visualization and Scale-Adaptive Modification of DNA Nanostructures*, in "IEEE Transactions on Visualization and Computer Graphics", January 2018, vol. 24, n<sup>o</sup> 1, pp. 1014–1024 [DOI : 10.1109/TVCG.2017.2743981], <https://hal.inria.fr/hal-01581203>
- [14] N. PEZZOTTI, J.-D. FEKETE, T. HÖLLT, B. LELIEVELDT, E. EISEMANN, A. VILANOVA. *Multiscale Visualization and Exploration of Large Bipartite Graphs*, in "Computer Graphics Forum", June 2018, vol. 37, n<sup>o</sup> 3, 12 p. , <https://hal.inria.fr/hal-01787046>
- [15] I. VIOLA, T. ISENBERG. *Pondering the Concept of Abstraction in (Illustrative) Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", September 2018, vol. 24, n<sup>o</sup> 9, pp. 2573–2588 [DOI : 10.1109/TVCG.2017.2747545], <https://hal.inria.fr/hal-01581177>
- [16] E. ZGRAGGEN, A. GALAKATOS, A. CROTTY, J.-D. FEKETE, T. KRASKA. *How Progressive Visualizations Affect Exploratory Analysis*, in "IEEE Transactions on Visualization and Computer Graphics", 2017, vol. 23, n<sup>o</sup> 8, pp. 1977–1987 [DOI : 10.1109/TVCG.2016.2607714], <https://hal.inria.fr/hal-01377896>

## Publications of the year

### Articles in International Peer-Reviewed Journals

- [17] T. BLASCHECK, L. BESANÇON, A. BEZERIANOS, B. LEE, P. ISENBERG. *Glanceable Visualization: Studies of Data Comparison Performance on Smartwatches*, in "IEEE Transactions on Visualization and Computer Graphics", January 2019, vol. 25, n<sup>o</sup> 1, <https://hal.inria.fr/hal-01851306>
- [18] N. BOUKHELIFA, M. BRYANT, N. BULATOVIĆ, I. ČUKIĆ, J.-D. FEKETE, M. KNEŽEVIĆ, J. LEHMANN, D. STUART, C. THIEL. *The CENDARI Infrastructure*, in "Journal on Computing and Cultural Heritage", April 2018, vol. 11, n<sup>o</sup> 2, pp. 1-20 [DOI : 10.1145/3092906], <https://hal.inria.fr/hal-01523102>
- [19] M. BREHMER, B. LEE, P. ISENBERG, E. K. CHOE. *Visualizing Ranges over Time on Mobile Phones: A Task-Based Crowdsourced Evaluation*, in "IEEE Transactions on Visualization and Computer Graphics", August 2018, vol. 25, pp. 1-11, <https://hal.inria.fr/hal-01857469>
- [20] S. BRUCKNER, T. ISENBERG, T. ROPINSKI, A. WIEBEL. *A Model of Spatial Directness in Interactive Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", 2018, To appear [DOI : 10.1109/TVCG.2018.2848906], <https://hal.inria.fr/hal-01813889>
- [21] E. DIMARA, G. BAILLY, A. BEZERIANOS, S. FRANCONERI. *Mitigating the Attraction Effect with Visualizations*, in "IEEE Transactions on Visualization and Computer Graphics", October 2018, 11 p. [DOI : 10.1109/TVCG.2018.2865233], <https://hal.inria.fr/hal-01845004>
- [22] E. DIMARA, A. BEZERIANOS, P. DRAGICEVIC. *Conceptual and Methodological Issues in Evaluating Multidimensional Visualizations for Decision Support*, in "IEEE Transactions on Visualization and Computer Graphics", 2018, vol. 24 [DOI : 10.1109/TVCG.2017.2745138], <https://hal.inria.fr/hal-01584729>
- [23] E. DIMARA, S. FRANCONERI, C. PLAISANT, A. BEZERIANOS, P. DRAGICEVIC. *A Task-based Taxonomy of Cognitive Biases for Information Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", 2019, <https://hal.sorbonne-universite.fr/hal-01868738>

- [24] P. DRAGICEVIC, Y. JANSEN. *Blinded with Science or Informed by Charts? A Replication Study*, in "IEEE Transactions on Visualization and Computer Graphics", January 2018, vol. 24, n<sup>o</sup> 1, pp. 781-790 [DOI : 10.1109/TVCG.2017.2744298], <https://hal.sorbonne-universite.fr/hal-01580259>
- [25] J. JO, J. SEO, J.-D. FEKETE. *PANENE: A Progressive Algorithm for Indexing and Querying Approximate k-Nearest Neighbors*, in "IEEE Transactions on Visualization and Computer Graphics", 2018 [DOI : 10.1109/TVCG.2018.2869149], <https://hal.inria.fr/hal-01855672>
- [26] J. JO, F. VERNIER, P. DRAGICEVIC, J.-D. FEKETE. *A Declarative Rendering Model for Multiclass Density Maps*, in "IEEE Transactions on Visualization and Computer Graphics", January 2019, vol. 25, n<sup>o</sup> 1, pp. 470-480 [DOI : 10.1109/TVCG.2018.2865141], <https://hal.inria.fr/hal-01848427>
- [27] K. LAWONN, I. VIOLA, B. PREIM, T. ISENBERG. *A Survey of Surface-Based Illustrative Rendering for Visualization*, in "Computer Graphics Forum", September 2018, vol. 37, n<sup>o</sup> 6, pp. 205–234 [DOI : 10.1111/CGF.13322], <https://hal.inria.fr/hal-01652236>
- [28] M. LE GOC, C. PERIN, S. FOLLMER, J.-D. FEKETE, P. DRAGICEVIC. *Dynamic Composite Data Physicization Using Wheeled Micro-Robots*, in "IEEE Transactions on Visualization and Computer Graphics", January 2019, vol. 25, n<sup>o</sup> 1, pp. 737-747 [DOI : 10.1109/TVCG.2018.2865159], <https://hal.inria.fr/hal-01848436>
- [29] H. MIAO, E. DE LLANO, T. ISENBERG, M. E. GRÖLLER, I. BARIŠIĆ, I. VIOLA. *DimSUM: Dimension and Scale Unifying Maps for Visual Abstraction of DNA Origami Structures*, in "Computer Graphics Forum", June 2018, vol. 37, n<sup>o</sup> 3, pp. 403-413 [DOI : 10.1111/CGF.13429], <https://hal.inria.fr/hal-01795734>
- [30] H. MIAO, E. DE LLANO, J. SORGER, Y. AHMADI, T. KEKIC, T. ISENBERG, M. E. GRÖLLER, I. BARIŠIĆ, I. VIOLA. *Multiscale Visualization and Scale-Adaptive Modification of DNA Nanostructures*, in "IEEE Transactions on Visualization and Computer Graphics", January 2018, vol. 24, n<sup>o</sup> 1, pp. 1014–1024 [DOI : 10.1109/TVCG.2017.2743981], <https://hal.inria.fr/hal-01581203>
- [31] H. MIAO, T. KLEIN, D. KOUŘIL, P. MINDEK, K. SCHATZ, M. E. GRÖLLER, B. KOZLÍKOVÁ, T. ISENBERG, I. VIOLA. *Multiscale Molecular Visualization*, in "Journal of Molecular Biology", 2018, To appear [DOI : 10.1016/J.JMB.2018.09.004], <https://hal.inria.fr/hal-01873724>
- [32] A. NEWMAN, Z. BYLINSKII, S. HAROZ, S. MADAN, F. DURAND, A. OLIVA. *Effects of title wording on memory of trends in line graphs*, in "Journal of Vision", 2018, vol. 18, n<sup>o</sup> 10, 837 p. , <https://hal.inria.fr/hal-01947467>
- [33] C. PERIN, J.-D. FEKETE, P. DRAGICEVIC. *Jacques Bertin's Legacy in Information Visualization and the Reorderable Matrix*, in "Cartography and Geographic Information Science", May 2018 [DOI : 10.1080/15230406.2018.1470942], <https://hal.inria.fr/hal-01786606>
- [34] N. PEZZOTTI, J.-D. FEKETE, T. HÖLLT, B. LELIEVELDT, E. EISEMANN, A. VILANOVA. *Multiscale Visualization and Exploration of Large Bipartite Graphs*, in "Computer Graphics Forum", June 2018, vol. 37, n<sup>o</sup> 3, 12 p. , <https://hal.inria.fr/hal-01787046>
- [35] I. VIOLA, T. ISENBERG. *Pondering the Concept of Abstraction in (Illustrative) Visualization*, in "IEEE Transactions on Visualization and Computer Graphics", September 2018, vol. 24, n<sup>o</sup> 9, pp. 2573–2588 [DOI : 10.1109/TVCG.2017.2747545], <https://hal.inria.fr/hal-01581177>

### International Conferences with Proceedings

- [36] B. BACH, C. PERIN, Q. REN, P. DRAGICEVIC. *Ways of Visualizing Data on Curves*, in "TransImage 2018 - 5th Biennial Transdisciplinary Imaging Conference", Edinburgh, United Kingdom, April 2018, pp. 1-14 [DOI : 10.6084/M9.FIGSHARE.6104705], <https://hal.inria.fr/hal-01818137>
- [37] L. BATTLE, M. ANGELINI, C. BINNIG, T. CATARCI, P. EICHMANN, J.-D. FEKETE, G. SANTUCCI, M. SEDLMAIR, W. WILLET. *Evaluating Visual Data Analysis Systems: A Discussion Report*, in "HILDA'18: Workshop on Human-In-the-Loop Data Analytics", Houston, TX, United States, June 2018 [DOI : 10.1145/3209900.3209901], <https://hal.inria.fr/hal-01786507>
- [38] L. BESANÇON, A. SEMMO, D. J. BIAU, B. FRACHET, V. PINEAU, E. H. SARIALI, R. TAOUACHI, T. ISENBERG, P. DRAGICEVIC. *Reducing Affective Responses to Surgical Images through Color Manipulation and Stylization*, in "Proceedings of the Joint Symposium on Computational Aesthetics, Sketch-Based Interfaces and Modeling, and Non-Photorealistic Animation and Rendering", Victoria, Canada, ACM, August 2018, pp. 4:1-4:13 [DOI : 10.1145/3229147.3229158], <https://hal.inria.fr/hal-01795744>
- [39] T. BLASCHECK, A. BEZERIANOS, L. BESANÇON, B. LEE, P. ISENBERG. *Preparing for Perceptual Studies: Position and Orientation of Wrist-worn Smartwatches for Reading Tasks*, in "Proceedings of the Workshop on Data Visualization on Mobile Devices held at ACM CHI", Montréal, Canada, April 2018, <https://hal.inria.fr/hal-01744246>
- [40] T. BLASCHECK, M. BURCH, T. MEISEL, T. SCHNEIDER, S. MUMIN. *Exploring Eye Movements with Node-Link Graph Layouts*, in "Eye Tracking for Spatial Research, Proceedings of the 3rd International Workshop", Zürich, Switzerland, P. KIEFER, I. GIANNOPOULOS, F. GÖBEL, M. RAUBAL, A. T. DUCHOWSKI (editors), January 2018 [DOI : 10.3929/ETHZ-B-00022279], <https://hal.inria.fr/hal-01766812>
- [41] S. HAROZ. *Open Practices in Visualization Research*, in "Evaluation and Beyond - Methodological Approaches for Visualization", Berlin, Germany, October 2018 [DOI : 10.31219/OSF.IO/8AG3W], <https://hal.inria.fr/hal-01947432>
- [42] R. KOSARA, S. HAROZ. *Skipping the Replication Crisis in Visualization: Threats to Study Validity and How to Address Them*, in "Evaluation and Beyond - Methodological Approaches for Visualization", Berlin, Germany, October 2018 [DOI : 10.31219/OSF.IO/F8QEY], <https://hal.inria.fr/hal-01947436>
- [43] B. PREIM, T. ROPINSKI, P. ISENBERG. *A Critical Analysis of the Evaluation Practice in Medical Visualization*, in "Eurographics 8th EG Workshop on Visual Computing for Biology and Medicine", Granada, Spain, VCBM 2018, September 2018 [DOI : 10.2312/vcbm.20181228], <https://hal.inria.fr/hal-01893153>
- [44] M. TREFZGER, T. BLASCHECK, M. RASCHKE, S. HAUSMANN, T. SCHLEGEL. *A Visual Comparison of Gaze Behavior from Pedestrians and Cyclists*, in "ETRA 2018 - Symposium on Eye Tracking Research and Applications", Warsaw, Poland, ACM, June 2018 [DOI : 10.1145/3204493.3204553], <https://hal.inria.fr/hal-01766815>
- [45] C. WACHARAMANOTHAM, S. GUHA, M. KAY, P. DRAGICEVIC, S. HAROZ. *Special Interest Group on Transparent Statistics Guidelines*, in "CHI 2018 - Conference on Human Factors in Computing Systems", Montreal QC, France, ACM Press, April 2018, pp. 1-4 [DOI : 10.1145/3170427.3185374], <https://hal.inria.fr/hal-01818141>

### Conferences without Proceedings

- [46] T. BLASCHECK, L. BESANÇON, A. BEZERIANOS, B. LEE, P. ISENBERG. *Visualization perception on smartwatches*, in "Journée Visu 2018", Palaiseau, France, May 2018, <https://hal.inria.fr/hal-01844726>
- [47] A. HOLCOMBE, C. LUDOWICI, S. HAROZ. *Is there a reproducibility crisis around here? Maybe not, but we still need to change*, in "Vision Sciences Society", St. Pete Beach, Florida, United States, 2019, <https://hal.inria.fr/hal-01944513>
- [48] P. VALDIVIA, P. BUONO, C. PLAISANT, N. DUFOURNAUD, J.-D. FEKETE. *Using Dynamic Hypergraphs to Reveal the Evolution of the Business Network of a 17th Century French Woman Merchant*, in "VIS 2018 - 3rd Workshop on Visualization for the Digital Humanities", Berlin, Germany, October 2018, <https://hal.inria.fr/hal-01855675>

### Scientific Books (or Scientific Book chapters)

- [49] W. BÜSCHEL, J. CHEN, R. DACHSELT, S. M. DRUCKER, T. DWYER, C. GÖRG, T. ISENBERG, A. KERREN, C. NORTH, W. STUERZLINGER. *Interaction for Immersive Analytics*, in "Immersive Analytics", Springer, 2018, pp. 95 - 138 [DOI : 10.1007/978-3-030-01388-2\_4], <https://hal.inria.fr/hal-01907526>
- [50] T. DWYER, K. MARRIOTT, T. ISENBERG, K. KLEIN, N. RICHE, F. SCHREIBER, W. STUERZLINGER, B. THOMAS. *Immersive Analytics: An Introduction*, in "Immersive Analytics", Springer, 2018, pp. 1 - 23 [DOI : 10.1007/978-3-030-01388-2\_1], <https://hal.inria.fr/hal-01907533>
- [51] B. THOMAS, G. WELCH, P. DRAGICEVIC, N. ELMQVIST, P. IRANI, Y. JANSEN, D. SCHMALSTIEG, A. TABARD, N. ELSAYED, R. SMITH, W. WILLETT. *Situated Analytics*, in "Immersive Analytics", Lecture Notes in Computer Science, Springer, October 2018, vol. 11190, pp. 185-220 [DOI : 10.1007/978-3-030-01388-2\_7], <https://hal.inria.fr/hal-01947243>

### Books or Proceedings Editing

- [52] E. LUTTON, P. LEGRAND, P. PARREND, N. MONMARCHÉ, M. SCHOENAUER (editors). *Artificial Evolution, 13th International Conference, Evolution Artificielle, EA 2017, Paris, France, October 25-27, 2017, Revised Selected Papers*, Artificial Evolution, Springer, March 2018, vol. LNCS - Lecture Notes in Computer Science, n<sup>o</sup> 10764 [DOI : 10.1007/978-3-319-78133-4], <https://hal.inria.fr/hal-01910443>

### Research Reports

- [53] R. CHANG, J.-D. FEKETE, J. FREIRE, C. SCHEIDEGGER. *Connecting Visualization and Data Management Research (Dagstuhl Seminar 17461)*, Dagstuhl, 2018, n<sup>o</sup> 2018/8670, pp. 46–58 [DOI : 10.4230/DAGREP.7.11.46], <https://hal.inria.fr/hal-01756799>

### Scientific Popularization

- [54] X. WANG, L. BESANÇON, M. AMMI, T. ISENBERG. *Navigation Tactile 3D Augmentée Sur Mobiles*, in "Journée Visu 2018", Palaiseau, France, May 2018, <https://hal.inria.fr/hal-01854463>

### Other Publications

- [55] M. ALIPOUR, P. DRAGICEVIC, T. ISEBERG, P. ISEBERG. *Situated Visualizations of Office Noise to Promote Personal Health*, October 2018, pp. 1-2, InfoVis 2018 - IEEE Conference on Information Visualization, Poster, <https://hal.inria.fr/hal-01857354>
- [56] E. DE LLANO, H. MIAO, T. ISEBERG, M. E. GRÖLLER, I. VIOLA, I. BARIŠIĆ. *A Preview to Adenita: Modeling and Visualization of DNA Nanostructures*, June 2018, Posters at the 3rd Functional DNA Nanotechnology Workshop, Poster, <https://hal.inria.fr/hal-01813901>
- [57] P. ISEBERG, C. KINKELDEY, J.-D. FEKETE. *Visual Analytics for Monitoring and Exploration of Blockchain Data With a Focus on the Bitcoin Blockchain*, 2018, HCI for Blockchain: A CHI 2018 workshop on Studying, Critiquing, Designing and Envisioning Distributed Ledger Technologies, <https://hal.inria.fr/hal-01950934>
- [58] C. TURKAY, N. PEZZOTTI, C. BINNIG, H. STROBELT, B. HAMMER, D. A. KEIM, J.-D. FEKETE, T. PALPANAS, Y. WANG, F. RUSU. *Progressive Data Science: Potential and Challenges*, December 2018, <https://arxiv.org/abs/1812.08032> - working paper or preprint, <https://hal.inria.fr/hal-01961871>

## References in notes

- [59] S. K. CARD, J. D. MACKINLAY, B. SHNEIDERMAN (editors). *Readings in information visualization: using vision to think*, Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, 1999
- [60] J. BERTIN. *Sémiologie graphique : Les diagrammes - Les réseaux - Les cartes*, Les réimpressions, Editions de l'Ecole des Hautes Etudes en Sciences, Paris, France, 1967
- [61] A. BEZERIANOS, P. DRAGICEVIC, R. BALAKRISHNAN. *Mnemonic rendering: an image-based approach for exposing hidden changes in dynamic displays*, in "UIST '06: Proceedings of the 19th annual ACM symposium on User interface software and technology", New York, NY, USA, ACM, 2006, pp. 159–168, <http://doi.acm.org/10.1145/1166253.1166279>
- [62] J.-D. FEKETE, C. PLAISANT. *Interactive Information Visualization of a Million Items*, in "Proc. IEEE Symposium on Information Visualization 2002 (InfoVis 2002)", Boston, USA, IEEE Press, October 2002, pp. 117-124
- [63] J.-D. FEKETE, C. PLAISANT. *Les leçons tirées des deux compétitions de visualisation d'information*, in "Proceedings of IHM 2004", Namur, Belgium, International Conference Proceedings Series, ACM Press, September 2004, pp. 7-12
- [64] J. J. GIBSON. *The Ecological Approach to Visual Perception*, Lawrence Erlbaum Associates, New Jersey, USA, 1979
- [65] Y. GUIARD, Y. DU, J.-D. FEKETE, M. BEAUDOUIN-LAFON, C. APPERT, O. CHAPUIS. *Shakespeare's Complete Works as a Benchmark for Evaluating Multiscale Document-Navigation Techniques*, in "Proceedings of BEyond time and errors: novel evaluation methods for Information Visualization (BELIV'06)", Venice, Italy, ACM Press, May 2006, pp. 65-70
- [66] N. HENRY RICHE, J.-D. FEKETE. *Evaluating Visual Table Data Understanding*, in "Proceedings of BEyond time and errors: novel evaluation methods for Information Visualization (BELIV'06)", Venice, Italy, ACM Press, May 2006, 6 p.



- 
- [67] B. LEE, C. PLAISANT, C. SIMS PARR, J.-D. FEKETE, N. HENRY RICHE. *Task taxonomy for graph visualization*, in "BELIV '06: Proceedings of the 2006 AVI workshop on BEyond time and errors", New York, NY, USA, ACM, 2006, pp. 1–5, <http://doi.acm.org/10.1145/1168149.1168168>
- [68] C. PLAISANT, J.-D. FEKETE, G. GRINSTEIN. *Promoting Insight-Based Evaluation of Visualizations: From Contest to Benchmark Repository*, in "IEEE Transactions on Visualization and Computer Graphics", 2008, vol. 14, n<sup>o</sup> 1, pp. 120–134, <http://doi.ieeecomputersociety.org/10.1109/TVCG.2007.70412>
- [69] A. TRIESMAN. *Preattentive Processing in Vision*, in "Computer Vision, Graphics, and Image Processing", August 1985, vol. 31, n<sup>o</sup> 2, pp. 156-177
- [70] E. TUFTE. *The Visual Display of Quantitative Information*, Graphics Press, 1983
- [71] J. W. TUKEY. *Exploratory Data Analysis*, Addison-Wesley, 1977