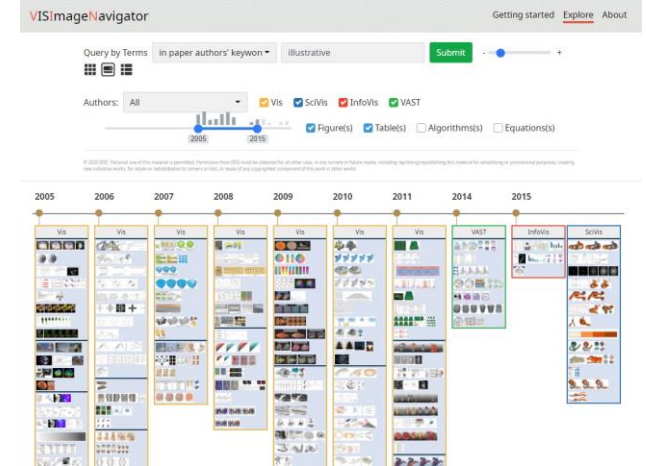
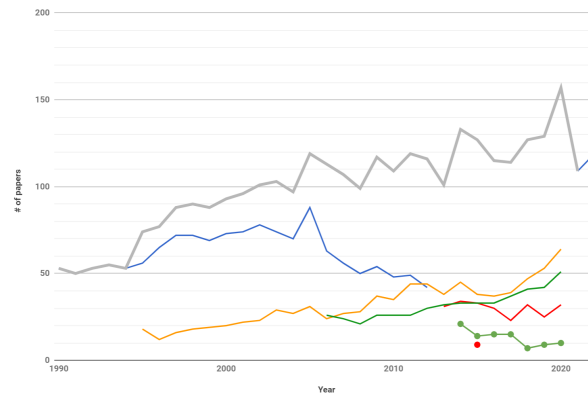


Papers included in the dataset



# Toward FAIR Visualization of Visualization Research

Tobias Isenberg



# FAIR Guiding Principles ...

- FAIR principles for scientific data management & stewardship [Wilkinson et al., 2016; doi: [10/bdd4](https://doi.org/10/bdd4)]
  - Findable
  - Accessible
  - Interoperable
  - Reproducible
- for both humans and machines



# ... for data and w.r.t. machines?

## Box 2 | The FAIR Guiding Principles

### To be Findable:

- F1. (meta)data are assigned a globally unique and persistent identifier
- F2. data are described with rich metadata (defined by R1 below)
- F3. metadata clearly and explicitly include the identifier of the data it describes
- F4. (meta)data are registered or indexed in a searchable resource

### To be Accessible:

- A1. (meta)data are retrievable by their identifier using a standardized communications protocol
  - A1.1 the protocol is open, free, and universally implementable
  - A1.2 the protocol allows for an authentication and authorization procedure, where necessary
- A2. metadata are accessible, even when the data are no longer available

### To be Interoperable:

- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
- I2. (meta)data use vocabularies that follow FAIR principles
- I3. (meta)data include qualified references to other (meta)data

### To be Reusable:

- R1. meta(data) are richly described with a plurality of accurate and relevant attributes
  - R1.1. (meta)data are released with a clear and accessible data usage license
  - R1.2. (meta)data are associated with detailed provenance
  - R1.3. (meta)data meet domain-relevant community standards

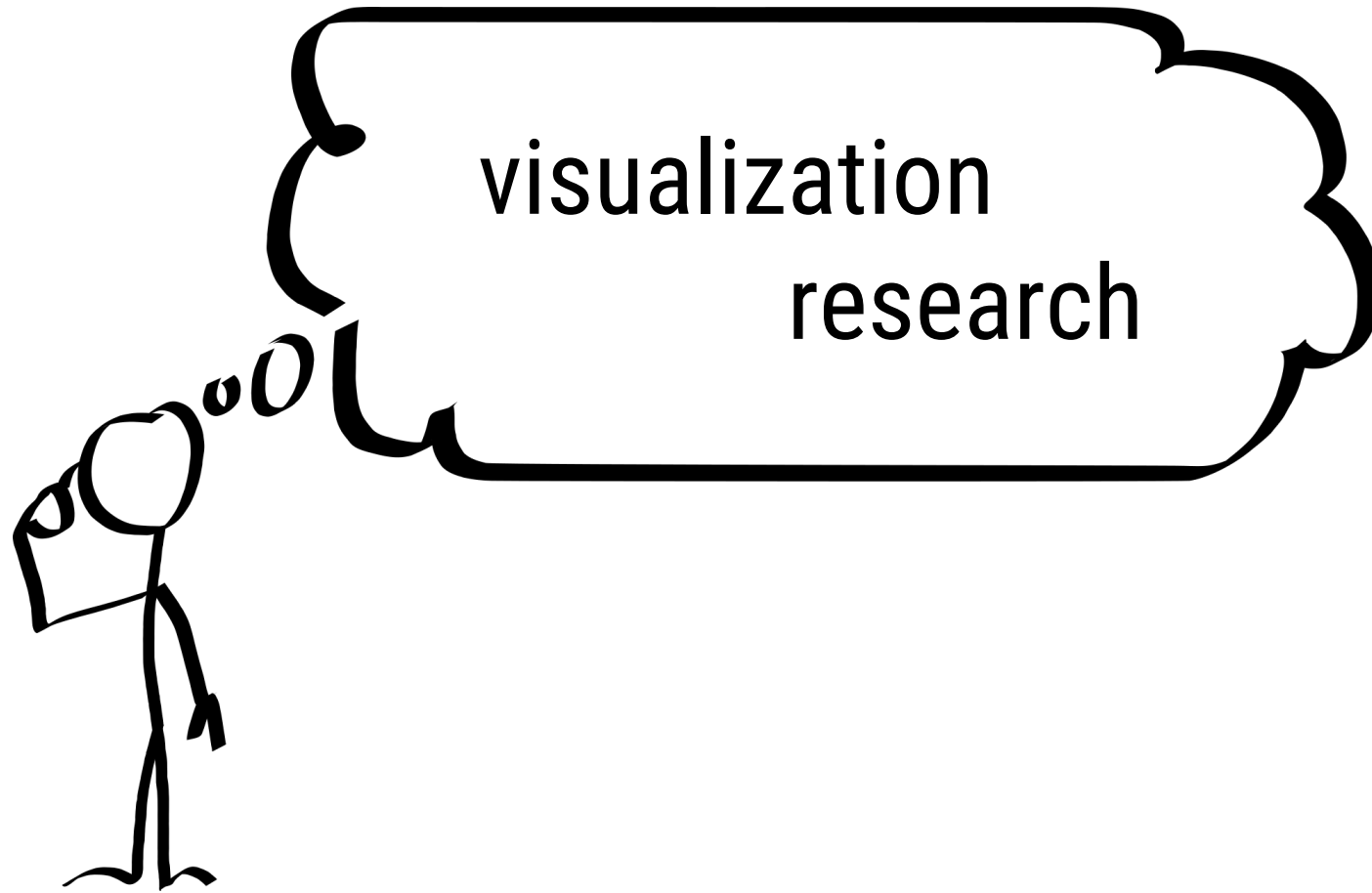
## ... for people who care about VIS research?

“A holistic approach to research data management **not only considers FAIRness of data**, but extends to ***all*** processes and artifacts used to obtain research results, including visualization and subjecting it to FAIR requirements.”





# Is visualization work findable?



# Is visualization work findable?

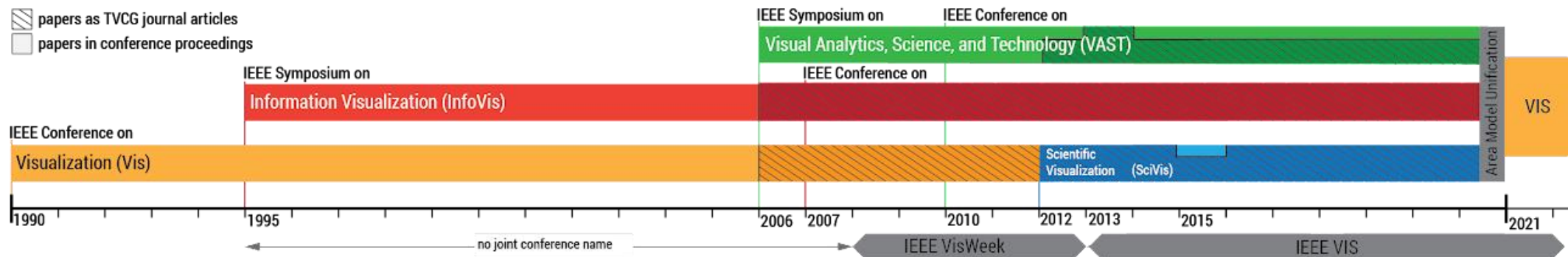
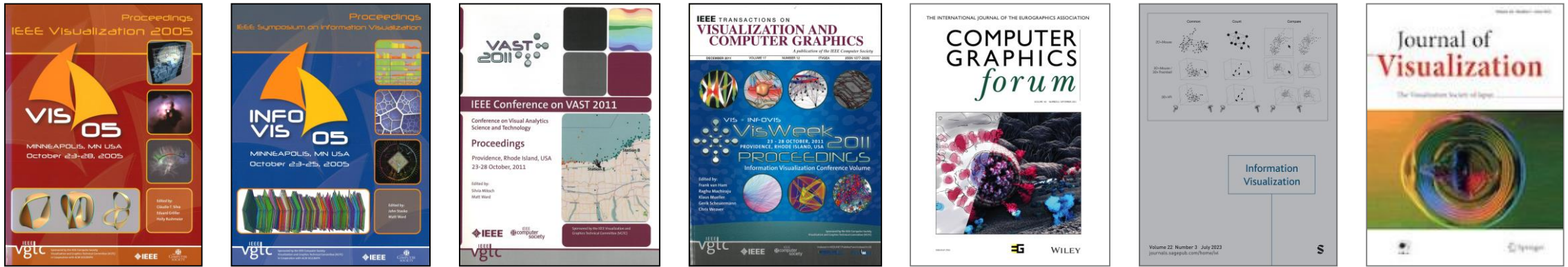


...

# Is visualization work findable?



# Is visualization work findable?



# vispubdata.org

**main contributors:** Petra Isenberg, John Stasko, Florian Heimerl, Steffen Koch, Tobias Isenberg, Natkamon Tovanich, Torsten Möller, Michael Sedlmair, Panpan Xu, Charles D. Stolper, Jian Chen; overview paper doi: [10/ggwwrv](https://doi.org/10.1109/VISUAL.1990.146359)

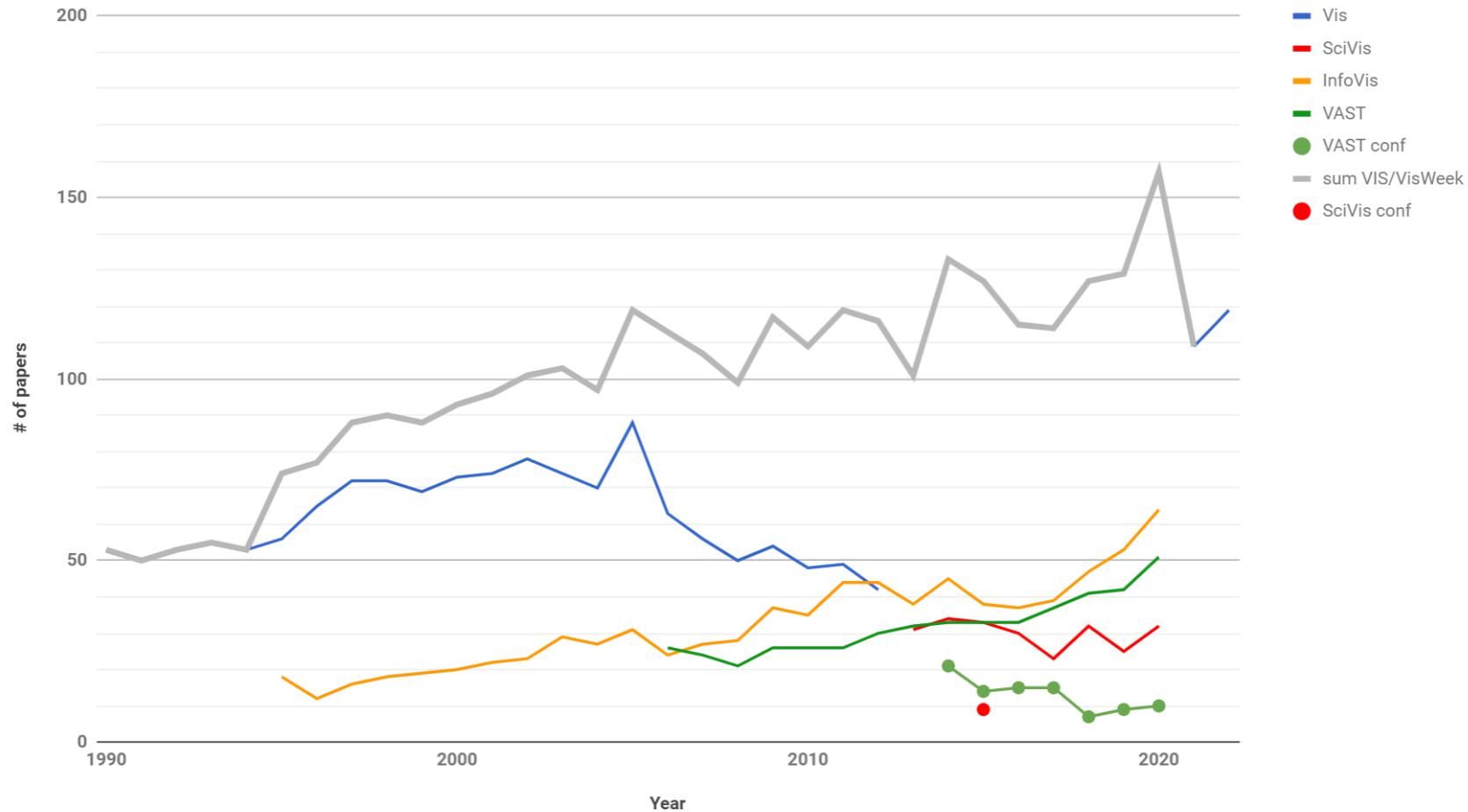
Vis	1990	Surface representations of two- and three-dimensional fluid	10.1109/VISUAL.1990.146359	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146359">http://dx.doi.org/10.1109/VISUAL.1990.146359</a>	6	13, 460	C	The use of critical po	James Helman;Lambertus Hessel	Stanford Univ., CA, USA c ;
Vis	1990	FAST: a multi-processed environment for visualization of co	10.1109/VISUAL.1990.146360	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146360">http://dx.doi.org/10.1109/VISUAL.1990.146360</a>	14	27, 461	C	The authors discuss	Gordon V. Bancroft;Fergus Merrit	Sterling Federal Syst. Inc., Pal
Vis	1990	The VIS-5D system for easy interactive visualization	10.1109/VISUAL.1990.146361	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146361">http://dx.doi.org/10.1109/VISUAL.1990.146361</a>	28	35, 462	C	The VIS-5D system	William L. Hibbard;David A. Sante	Space Sci. & Eng. Center, Wis
Vis	1990	A procedural interface for volume rendering	10.1109/VISUAL.1990.146362	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146362">http://dx.doi.org/10.1109/VISUAL.1990.146362</a>	36	44, 462	C	The author presents	James L. Montine	Alliant Comput. Syst., Littleton,
Vis	1990	Techniques for the interactive visualization of volumetric da	10.1109/VISUAL.1990.146363	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146363">http://dx.doi.org/10.1109/VISUAL.1990.146363</a>	45	50, 462	C	Some ideas and tec	Gregory M. Nielson;Bernd Hamar	Dept. of Comput. Sci., / 10.110
Vis	1990	Displaying voxel-based objects according to their qualitativ	10.1109/VISUAL.1990.146364	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146364">http://dx.doi.org/10.1109/VISUAL.1990.146364</a>	51	58, 463	C	The use of qualitative	Yaser Yacooob	Dept. of Comput. Sci., Marylan
Vis	1990	Interpreting a 3D object from a rough 2D line drawing	10.1109/VISUAL.1990.146365	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146365">http://dx.doi.org/10.1109/VISUAL.1990.146365</a>	59	66	C	Visualizing the third	Del Lamb;Amit Bandopadhay	Dept. of Comput. Sci., State Un
Vis	1990	Animation techniques for chain-coded objects	10.1109/VISUAL.1990.146366	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146366">http://dx.doi.org/10.1109/VISUAL.1990.146366</a>	67	73	C	The animation of two	Anthony J. Maeder	Dept. of Comput. Sci., Monash
Vis	1990	Extracting geometric models through constraint minimizati	10.1109/VISUAL.1990.146367	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146367">http://dx.doi.org/10.1109/VISUAL.1990.146367</a>	74	82, 464	C	The authors propose	James V. Miller;David E. Breen;Mi	Design. Res. Cente
Vis	1990	Wide-band relativistic Doppler effect visualization	10.1109/VISUAL.1990.146368	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146368">http://dx.doi.org/10.1109/VISUAL.1990.146368</a>	83	92, 465	C	The authors present	Ping-Kang Hsiung;Robert H. Thiba	Carnegie Mellon Univ., Pittsburg
Vis	1990	Dynamic meshing for visualization	10.1109/VISUAL.1990.146369	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146369">http://dx.doi.org/10.1109/VISUAL.1990.146369</a>	91	100, 465	C	The authors describe	James A. Stasko;A. K. Shih;Stefan	Bell Lab., Murray Hill, NJ, U
Vis	1990	Techniques for the interactive visualization of volumetric da	10.1109/VISUAL.1990.146370	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146370">http://dx.doi.org/10.1109/VISUAL.1990.146370</a>	94	103, 465	C	The authors discuss	Gregory M. Nielson;Bernd Hamar	Dept. of Comput. Sci., / 10.110
Vis	1990	Visualizing computer memory architectures	10.1109/VISUAL.1990.146371	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146371">http://dx.doi.org/10.1109/VISUAL.1990.146371</a>	107	113	C	The authors describe	Bowen Alpern;Larry Carter;Ted Se	IBM Thomas J. Watson Res. C
Vis	1990	A methodology for scientific data visualisation: choosing re	10.1109/VISUAL.1990.146372	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146372">http://dx.doi.org/10.1109/VISUAL.1990.146372</a>	114	123	C	A methodology for g	Philip K. Robertson	CSIRO, Canberra, ACT, Austral
Vis	1990	Moving image objects in scientific visualization	10.1109/VISUAL.1990.146373	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146373">http://dx.doi.org/10.1109/VISUAL.1990.146373</a>	130	140, 465	C	The idea of ind	G. David Kerlick	Elektronix Labs., Beaverton, OR
Vis	1990	Classifying visualization techniques	10.1109/VISUAL.1990.146374	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146374">http://dx.doi.org/10.1109/VISUAL.1990.146374</a>	139	143, 46	C	Progress in scienti	Stephen Wehrend;Clayton Lewis	Cognitive Sci. & Machine Intell
Vis	1990	A problem-oriented classification of visualization technique	10.1109/VISUAL.1990.146375	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146375">http://dx.doi.org/10.1109/VISUAL.1990.146375</a>	139	143, 46	C	Progress in scienti	Stephen Wehrend;Clayton Lewis	Colorado Univ., Boulder, CO, US
Vis	1990	Visualizing and three-dimensional image processing of p	10.1109/VISUAL.1990.146376	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146376">http://dx.doi.org/10.1109/VISUAL.1990.146376</a>	144	149, 46	C	The author applied	Nahum D. Gershon	MITRE Corp., McLean, VA, US
Vis	1990	Applying space subdivision techniques to volume rendering	10.1109/VISUAL.1990.146377	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146377">http://dx.doi.org/10.1109/VISUAL.1990.146377</a>	150	160, 47	C	We present a new	Kalnathi R. Subramanian;Donald	Dept. of Comput. Sci., State Un
Vis	1990	Volume rendering of hierarchical data	10.1109/VISUAL.1990.146378	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146378">http://dx.doi.org/10.1109/VISUAL.1990.146378</a>	160	170, 47	C	A hierarchical trian	Lori L. Scariatos;Theodosios Pavli	Grumman Data Syst., Woodbur
Vis	1990	Hierarchical triangulation using terrain features	10.1109/VISUAL.1990.146379	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146379">http://dx.doi.org/10.1109/VISUAL.1990.146379</a>	168	175	C	A hierarchical trian	Lori L. Scariatos;Theodosios Pavli	Grumman Data Syst., Woodbur
Vis	1990	Rendering and managing spherical data with sphere quad	10.1109/VISUAL.1990.146380	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146380">http://dx.doi.org/10.1109/VISUAL.1990.146380</a>	176	186	C	The sphere quadtree	Gyorgy Fekete	NASA, Goddard Space Flight C
Vis	1990	Methods for surface interrogation	10.1109/VISUAL.1990.146381	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146381">http://dx.doi.org/10.1109/VISUAL.1990.146381</a>	187	193, 47	C	The authors discuss	Hans Hagen;Thomas Schreiber;Er	Kaiserslautern Univ., Germany
Vis	1990	A three-dimensional/stereoscopic display and model contr	10.1109/VISUAL.1990.146382	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146382">http://dx.doi.org/10.1109/VISUAL.1990.146382</a>	194	201, 47	C	A forecasting system	Chieh-Cheng Yen;Keith W. Bedfor	Dept. of Civil Eng., Ohio State U
Vis	1990	Spline-based color sequences for univariate, bivariate and t	10.1109/VISUAL.1990.146383	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146383">http://dx.doi.org/10.1109/VISUAL.1990.146383</a>	202	208, 47	C	Alternative models th	Binh Pham	Dept. of Comput. Sci., Monash
Vis	1990	Interactive visualization of quaternion Julia sets	10.1109/VISUAL.1990.146384	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146384">http://dx.doi.org/10.1109/VISUAL.1990.146384</a>	209	218, 47	C	The first half of a two	John C. Hart;Louis H. Kauffman;D	Electron. Visualization Lab., Illi
Vis	1990	A journey into the fourth dimension	10.1109/VISUAL.1990.146385	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146385">http://dx.doi.org/10.1109/VISUAL.1990.146385</a>	219	229, 47	C	It is shown that by a	Yan Ke;E. S. Panduranga	Dept. of Comput. Sci., Saskatc
Vis	1990	Exploring N-dimensional databases	10.1109/VISUAL.1990.146386	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146386">http://dx.doi.org/10.1109/VISUAL.1990.146386</a>	230	237	C	The ability of researc	Jeffrey LeBlanc;Matthew O. Ward	Worcester Polytech. Inst., MA,
Vis	1990	Shape coding of multidimensional data on a microcompute	10.1109/VISUAL.1990.146387	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146387">http://dx.doi.org/10.1109/VISUAL.1990.146387</a>	238	246, 47	C	The author presents	Jeff Beddow	Microsimulations Res., Minneap
Vis	1990	Visualization of irregular multivariate data	10.1109/VISUAL.1990.146388	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146388">http://dx.doi.org/10.1109/VISUAL.1990.146388</a>	247	254, 47	C	The authors discuss	Thomas A. Foley;David A. Lane	Dept. of Comput. Sci., / 10.110
Vis	1990	Visualizing a scalar field on an N-dimensional lattice	10.1109/VISUAL.1990.146389	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146389">http://dx.doi.org/10.1109/VISUAL.1990.146389</a>	255	262, 47	C	A new hierarchical m	Ted Mihalisin;E. Grawlinks;John T	Dept. of Phys., Temple Univ., P
Vis	1990	Ray traced scalar fields with shaded polygonal output	10.1109/VISUAL.1990.146390	<a href="http://dx.doi.org/10.1109/VISUAL.1990.146390">http://dx.doi.org/10.1109/VISUAL.1990.146390</a>	263	272, 48	C	An algorithm for rend	Ray J. Meyers;Michael B. Stephen	Sandia Nat. Lab., Albuquerque,

- metadata on all IEEEVis papers from 1990–2016, now updated to 2021
- Google spreadsheet: can be commented, edited, and easily converted
- corrected and complete data: cleaned titles, de-duped authors, DOIs, ...

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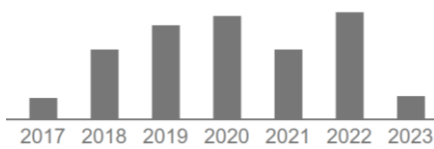




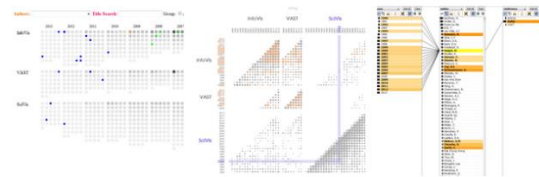
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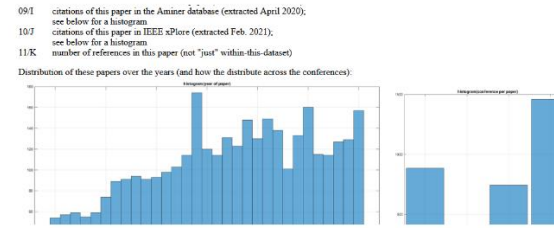


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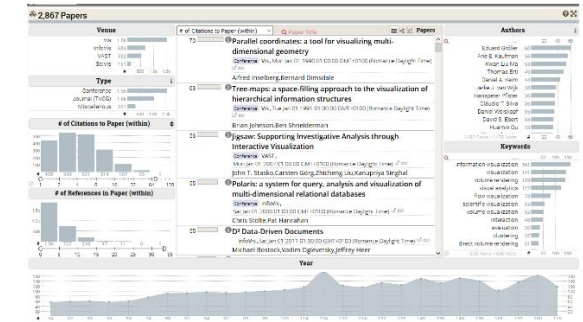


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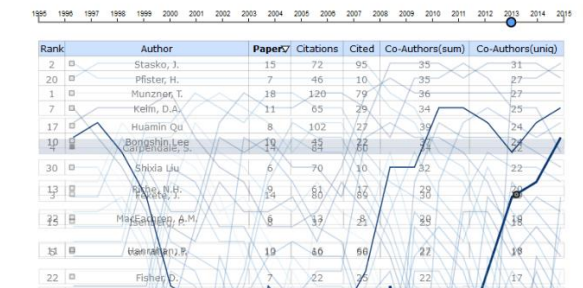
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Keshif - M. Adil Yalçın  
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KeyVis - Isenberg et al. ([link to paper.pdf](#))  
(data up to 2015)



A table - Chales Perin  
(data up to 2015)

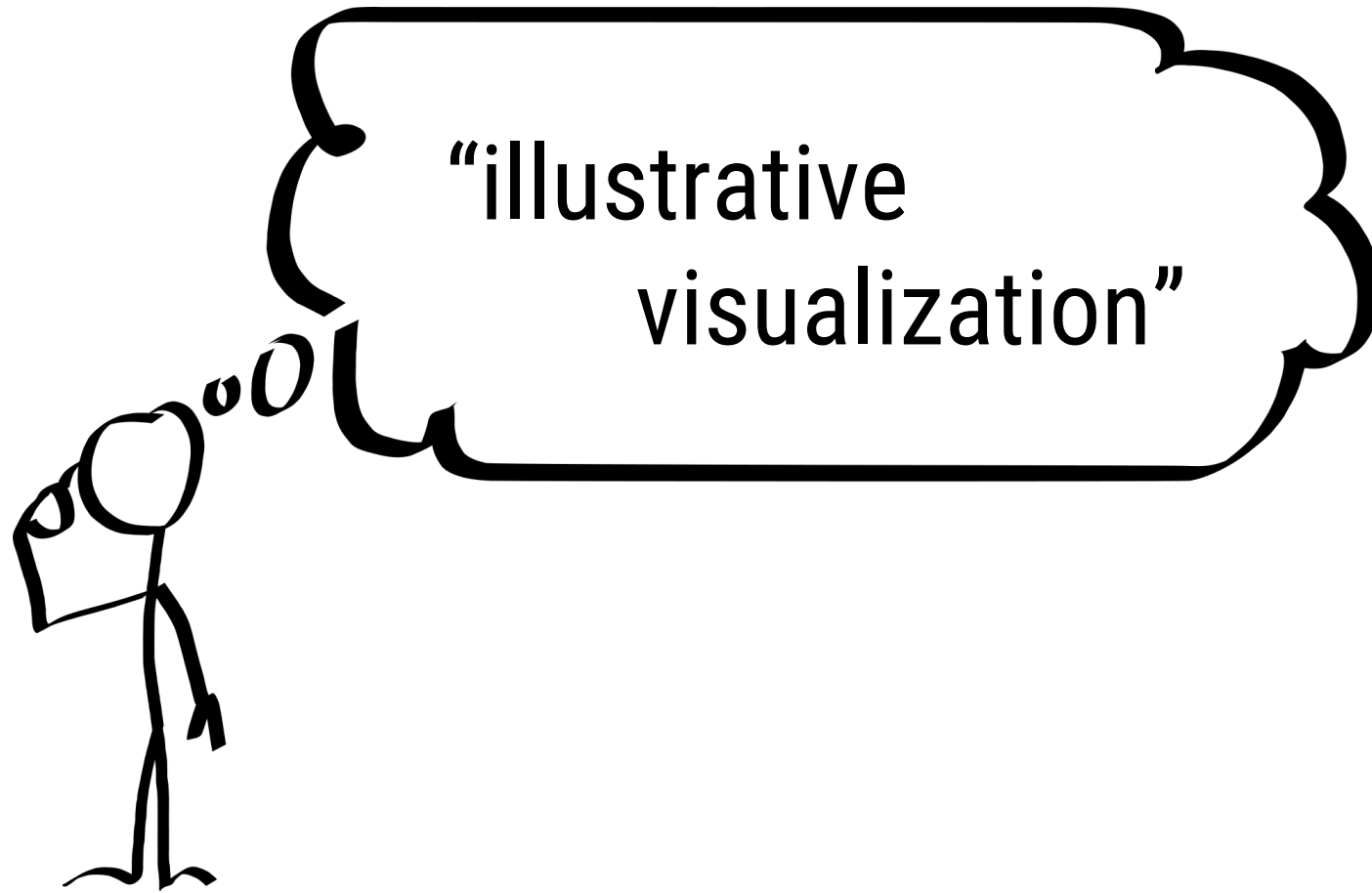


# vispubdata.org: challenges

- correcting paper titles
- de-duping & identifying authors uniquely (w/  dblp computer science bibliography)
- fixing DL mistakes/omissions (many!)
- scope
  - IEEE VIS main conference(s), full papers
  - EuroVis?
  - (TVCG/CG&A) journal presentations @ VIS?
- (continued) regular update?  **GitHub**?



# Is visualization work findable?



# Visualization as Seen Through its Research Paper Keywords

Petra Isenberg, *Member, IEEE*, Tobias Isenberg, *Senior Member, IEEE*, Michael Sedlmair, *Member, IEEE*, Jian Chen, *Member, IEEE*, and Torsten Möller, *Senior Member, IEEE*

**Abstract**—We present the results of a comprehensive multi-pass analysis of visualization paper keywords supplied by authors for their papers published in the IEEE Visualization conference series (now called IEEE VIS) between 1990–2015. From this analysis we derived a set of visualization topics that we discuss in the context of the current taxonomy that is used to categorize papers and assign reviewers in the IEEE VIS reviewing process. We point out missing and overemphasized topics in the current taxonomy and start a discussion on the importance of establishing common visualization terminology. Our analysis of research topics in visualization can, thus, serve as a starting point to (a) help create a common vocabulary to improve communication among different visualization sub-groups, (b) facilitate the process of understanding differences and commonalities of the various research sub-fields in visualization, (c) provide an understanding of emerging new research trends, (d) facilitate the crucial step of finding the right reviewers for research submissions, and (e) it can eventually lead to a comprehensive taxonomy of visualization research. One additional tangible outcome of our work is an online query tool (<http://keyvis.org/>) that allows visualization researchers to easily browse the 3 952 keywords used for IEEE VIS papers since 1990 to find related work or make informed keyword choices.

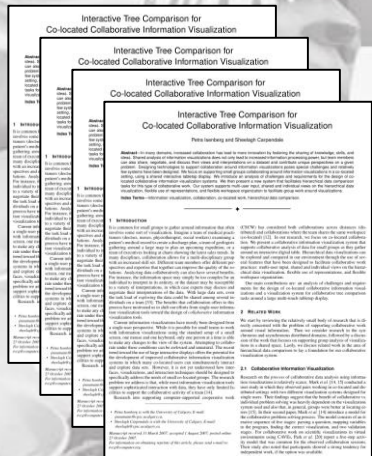
**Index Terms**—Keywords, data analysis, research themes, research topics, taxonomy, visualization history, theory.

## 1 MOTIVATION

One of the main reasons why visualization is such a fascinating field of research is its diversity. There is not only a diversity of applications but also a diversity of research methods being employed, a diversity of research contributions being made, as well as the diversity of its roots.

research an exciting field to be part of, they also create enormous challenges. There are different levels of appreciation for all aspects of visualization research, communication challenges between visualization researchers, and the challenge of communicating visualization as

# data – IEEE VIS conference 1990-2015



2431 papers

domain analysis
domain specific language
domain specific languages
domain-specific language
domain-specific languages
doppler effect
doppler radar
dot plots
double couple
drill-down
drr
drug design
drug discovery
dt-mri
dti
dti fiber tracts
dual energy ct
dual graph
dual meshes
dust

4319 unique  
keywords

## CLEANING

domain analysis
domain-specific languages
doppler effect
doppler radar
dot plots
double couple
drill-down
drug design
drug discovery
dual energy computed tomography image fusion
dual energy ct
dual graph
dual meshes
dust

3952 unique  
cleaned keywords

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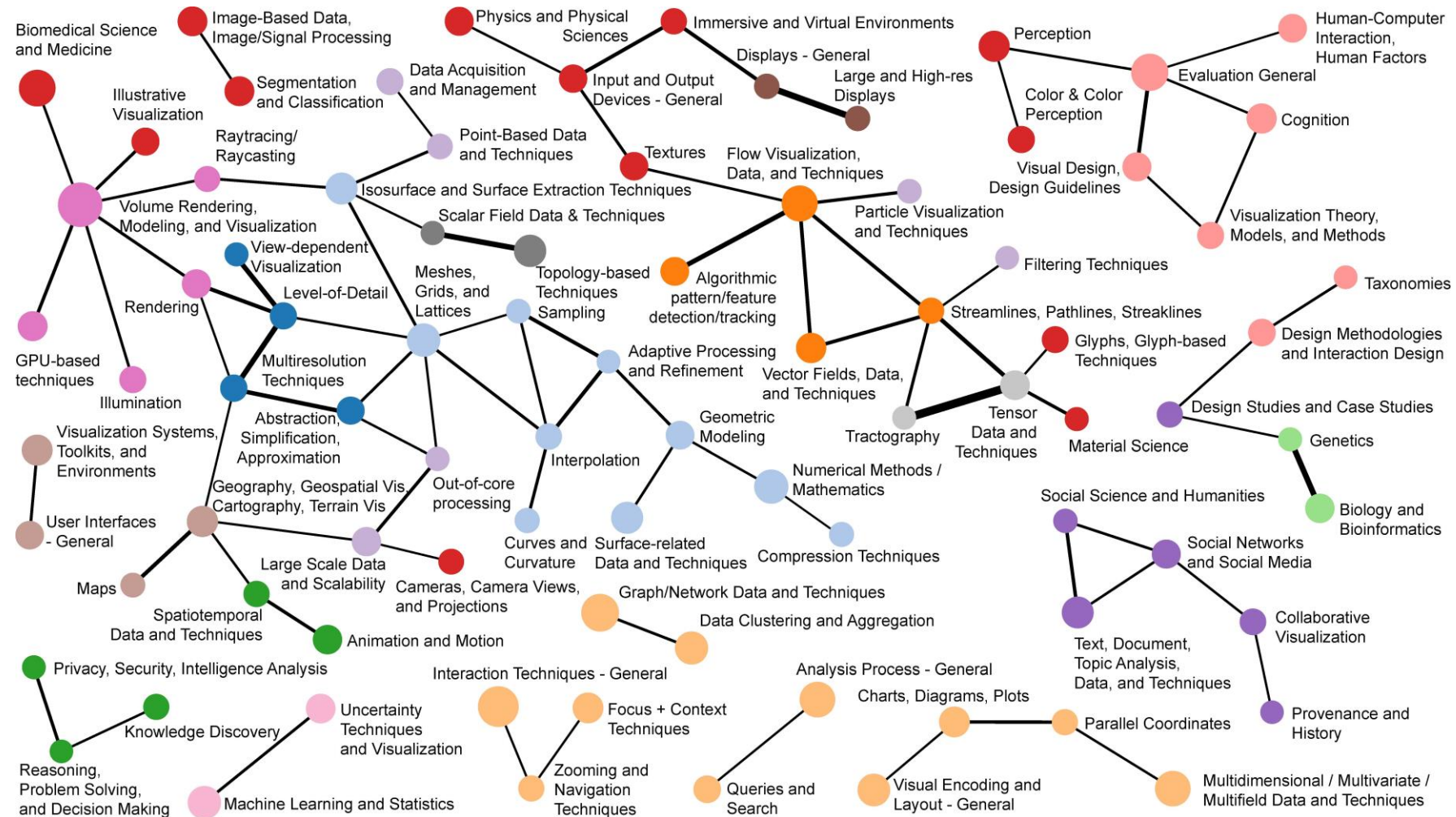
Sensor Networks	Applications
Time Critical Applications	Applications
Small, Mobile, and Ubiquitous Visualization	General Visualization/Analytics
Astronomy / Astrophysics	Applications
Genetics	Life Sciences
Internet, Web, Visualization for the Masses	Applications
Material Science	Applications
Microscopy	Life Sciences
Neurosciences and Brain Visualization	Life Sciences
Traffic	Applications
Social Networks and Social Media	Applications
Field Studies	Evaluation Methods + Types
Laboratory Studies	Evaluation Methods + Types
Evaluation Metrics and Benchmarks	Evaluation Methods + Types
Qualitative Evaluation	Evaluation Methods + Types
Quantitative Evaluation	Evaluation Methods + Types
Tasks, Task & Requirements Analysis	Evaluation Methods + Types
Usability Studies	Evaluation Methods + Types
Design Studies and Case Studies	Evaluation Methods + Types
Evaluation General	Evaluation Methods + Types

180 topics  
14 categories



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**contributors:** Petra Isenberg, Tobias Isenberg, Michael Sedlmair, Jian Chen, Torsten Möller; paper doi: [10/f92gps](https://doi.org/10/f92gps)



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Petra Isenberg  
Tobias Isenberg  
Michael Sedlmair  
Jian Chen  
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illustrative rendering

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illustrative parallel coordinates


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## illustrative visualization

found in **18** papers

co-occured with **50** author keywords

in a topic cluster with **15** author keywords



## illustrative visualization found in **18** VIS Papers

Conf.	Year	Title
InfoVis	2015	Acquired Codes of Meaning in Data Visualization and Infographics: Beyond Perceptual Primitives
SciVis	2015	Occlusion-free Blood Flow Animation with Wall Thickness Visualization
Vis	2011	Interactive Virtual Probing of 4D MRI Blood-Flow
Vis	2011	Hierarchical Event Selection for Video Storyboards with a Case Study on Snooker Video Visualization
Vis	2010	FI3D: Direct-Touch Interaction for the Exploration of 3D Scientific Visualization Spaces

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SciVis	2015	Occlusion-free Blood Flow Animation with Wall Thickness Visualization
Vis	2011	Interactive Virtual Probing of 4D MRI Blood-Flow
Vis	2011	Hierarchical Event Selection for Video Storyboards with a Case Study on Snooker Video Visualization
Vis	2010	FI3D: Direct-Touch Interaction for the Exploration of 3D Scientific Visualization Spaces
Vis	2010	Exploration of 4D MRI Blood Flow using Stylistic Visualization
Vis	2009	Volume Illustration of Muscle from Diffusion Tensor Images
Vis	2009	Hue-Preserving Color Blending
Vis	2008	Color Design for Illustrative Visualization
Vis	2007	Enhancing Depth-Perception with Flexible Volumetric Halos
Vis	2007	Semantic Layers for Illustrative Volume Rendering
Vis	2006	Exploded Views for Volume Data
Vis	2006	Feature Aligned Volume Manipulation for Illustration and Visualization
Vis	2006	Importance-Driven Focus of Attention
Vis	2006	Caricaturistic Visualization
Vis	2005	VolumeShop: an interactive system for direct volume illustration
Vis	2005	Visualization in the Einstein Year 2005: a case study on explanatory and illustrative visualization of relativity and astrophysics
Vis	2005	Dataset traversal with motion-controlled transfer functions

**illustrative visualization** co-occurs with **50** other keywords:

volume rendering 6x focus+context technique 4x volume visualization 3x flow visualization 2x phase-contrast cine mri 2x probing 2x  
3d navigation and exploration 1x 4d mri blood-flow 1x aneurysm 1x animation 1x astrophysics 1x blood flow 1x  
characteristic viewpoint estimation 1x color blending 1x color design 1x computer-assisted medical illustration 1x conjoint analysis 1x  
dataset traversal 1x design methodologies 1x diffusion tensor imaging 1x direct-touch interaction 1x evaluation 1x  
explanatory computer graphics 1x exploded views 1x general relativity 1x gpu computing 1x halos 1x illustrative manipulation 1x  
image compositing 1x interacting with volumetric datasets 1x mathematical visualization 1x medical visualization 1x  
multimedia visualization 1x multivalued images 1x muscle 1x perceptual transparency 1x solid texture synthesis 1x  
special relativity 1x taxonomy 1x terrain rendering 1x time-series data 1x transfer function 1x transparency 1x  
user study evaluation 1x visual design 1x visualization 1x volume deformation 1x volume manipulation 1x wall displays 1x

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**contributors:** Petra Isenberg, Tobias Isenberg, Michael Sedlmair, Jian Chen, Torsten Möller; paper doi: [10/f92gps](https://doi.org/10/f92gps)

vis	2006	Feature Aligned volume manipulation for illustration and visualization
Vis	2006	Importance-Driven Focus of Attention
Vis	2006	Caricaturistic Visualization
Vis	2005	VolumeShop: an interactive system for direct volume illustration
Vis	2005	Visualization in the Einstein Year 2005: a case study on explanatory and illustrative visualization of relativity and astrophysics
Vis	2005	Dataset traversal with motion-controlled transfer functions

**illustrative visualization** co-occurs with **50** other keywords:


volume rendering 6x focus+context technique 4x volume visualization 3x flow visualization 2x phase-contrast cine mri 2x probing 2x  
3d navigation and exploration 1x 4d mri blood-flow 1x aneurysm 1x animation 1x astrophysics 1x blood flow 1x  
characteristic viewpoint estimation 1x color blending 1x color design 1x computer-assisted medical illustration 1x conjoint analysis 1x  
dataset traversal 1x design methodologies 1x diffusion tensor imaging 1x direct-touch interaction 1x evaluation 1x  
explanatory computer graphics 1x exploded views 1x general relativity 1x gpu computing 1x halos 1x illustrative manipulation 1x  
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multimedia visualization 1x multivalued images 1x muscle 1x perceptual transparency 1x solid texture synthesis 1x  
special relativity 1x taxonomy 1x terrain rendering 1x time-series data 1x transfer function 1x transparency 1x  
user study evaluation 1x visual design 1x visualization 1x volume deformation 1x volume manipulation 1x wall displays 1x  
wall thickness 1x

**illustrative visualization** is part of the topic cluster **Illustrative Visualization** containing **15** keywords

illustrative visualization 18x non-photorealistic rendering 1x illustrative rendering 6x illustration 2x silhouette enhancement 2x  
silhouettes 2x computer-assisted medical illustration 1x halos 1x illustrative manipulation 1x non-photorealistic techniques 1x  
pen-and-ink rendering 1x scientific illustration 1x style 1x stylized rendering 1x volume illustration 1x

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**contributors:** Petra Isenberg, Tobias Isenberg, Michael Sedlmair, Jian Chen, Torsten Möller; paper doi: [10/f92gps](https://doi.org/10.1145/1055558.1055567)



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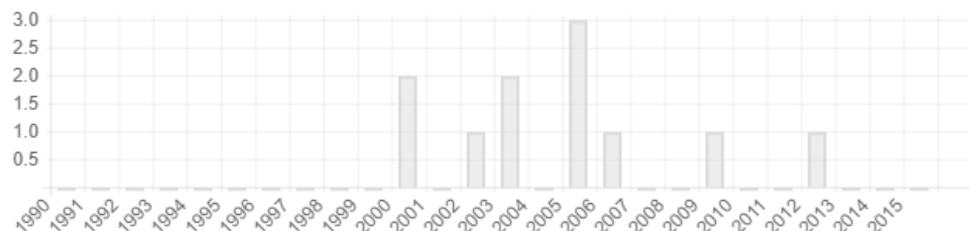
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## non-photorealistic rendering

found in **11** papers

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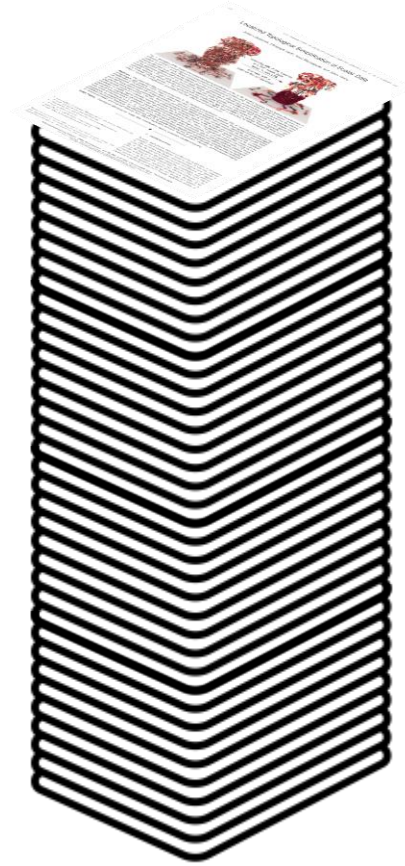
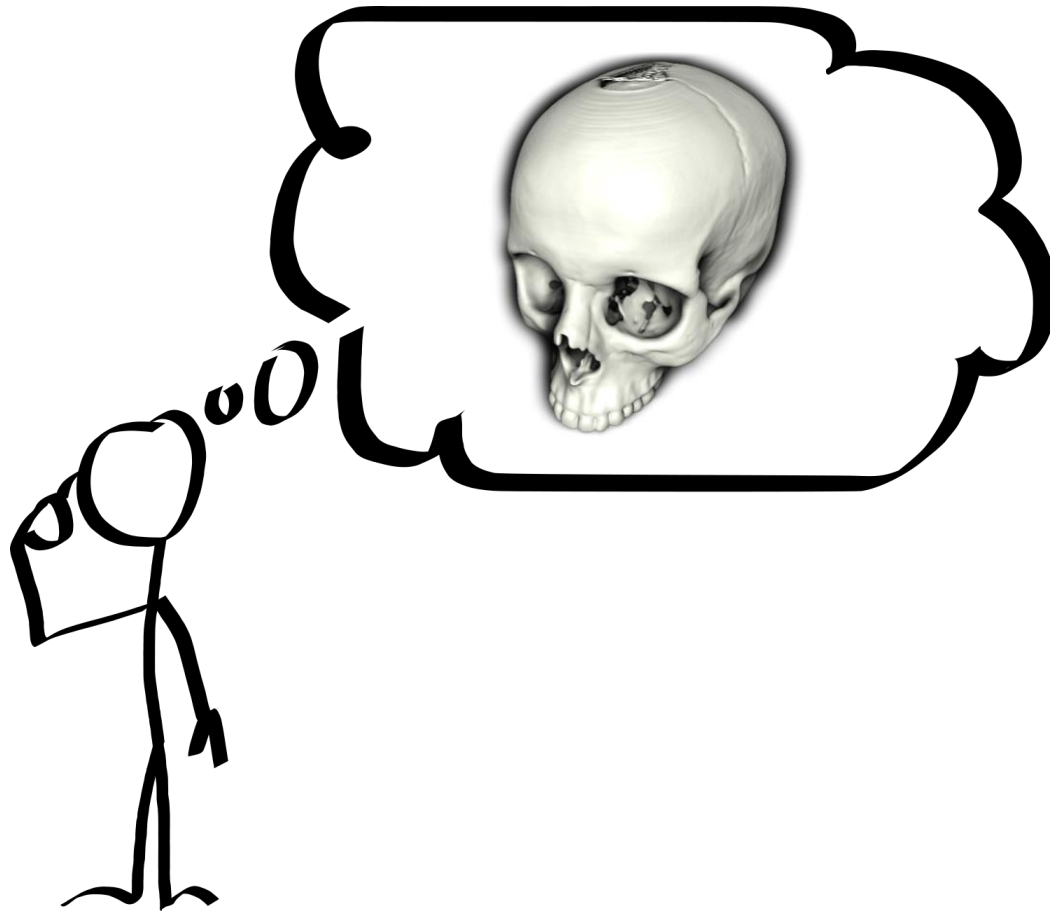
### non-photorealistic rendering found in **11** VIS Papers

Conf.	Year ▲	Title
InfoVis	2012	Sketchy Rendering for Information Visualization
Vis	2009	Multi-Scale Surface Descriptors
Vis	2006	Saliency-guided Enhancement for Volume Visualization
Vis	2005	Illustration and photography inspired visualization of flows and volumes
Vis	2005	Illustration-inspired techniques for visualizing time-varying data

# keyvis.org: challenges

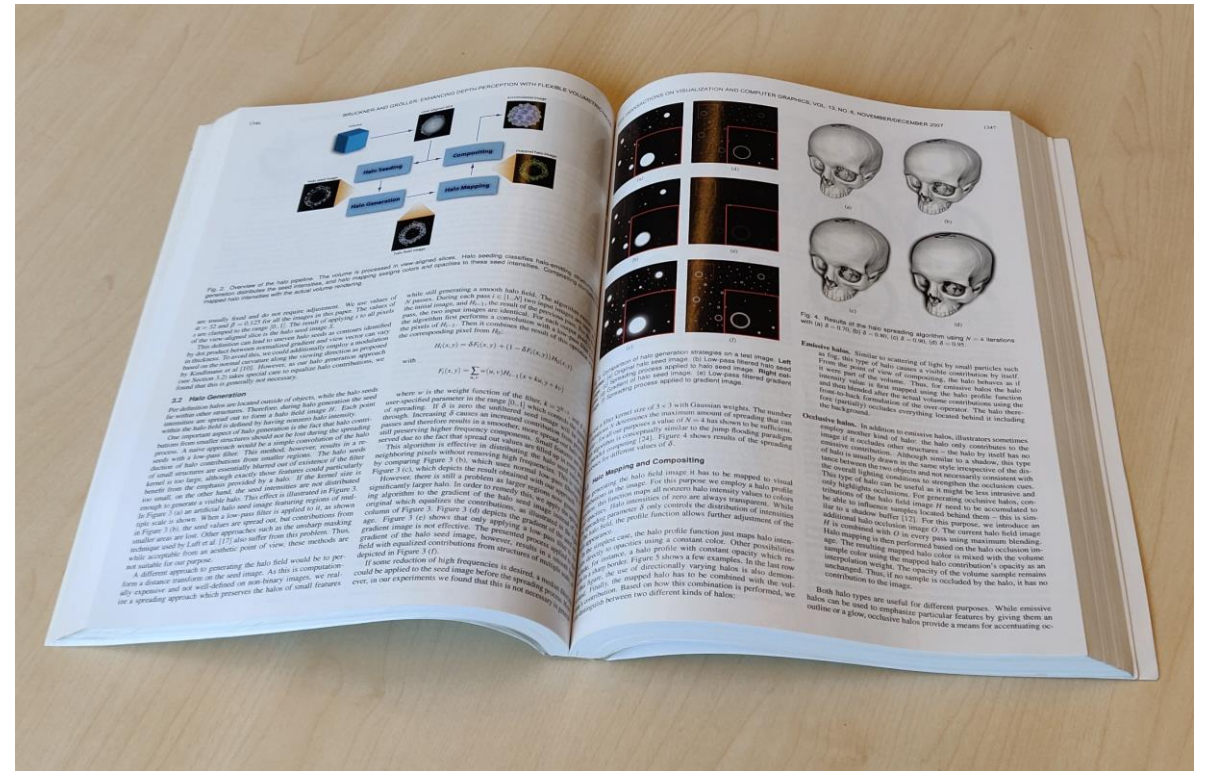
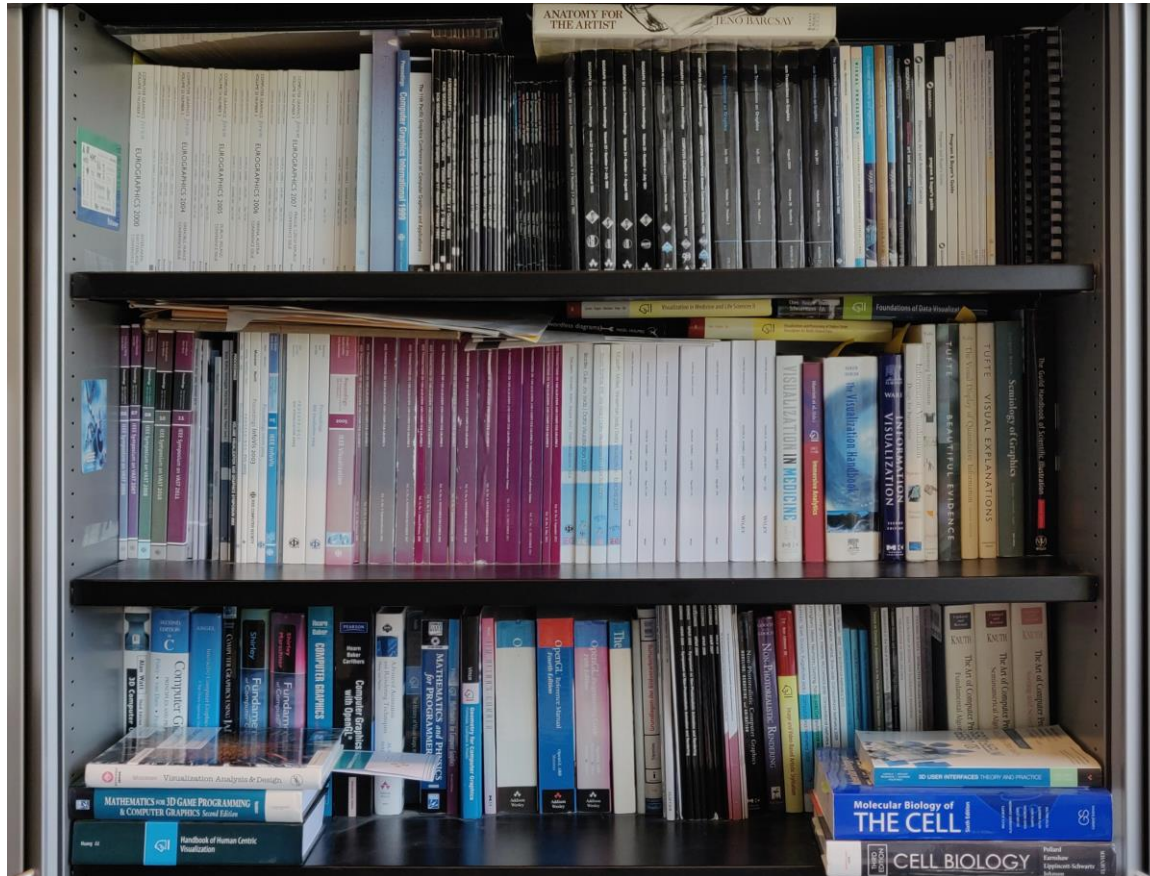
- data only up to 2015; regular update?
- even with a regular update
  - classification would need to be re-done for each update
  - clustering would change
  - topics may appear/disappear
  - huge amount of manual work
- raw data not really exported, only web tool
- private/personal initiative to keep it online

# Is visualization work findable?





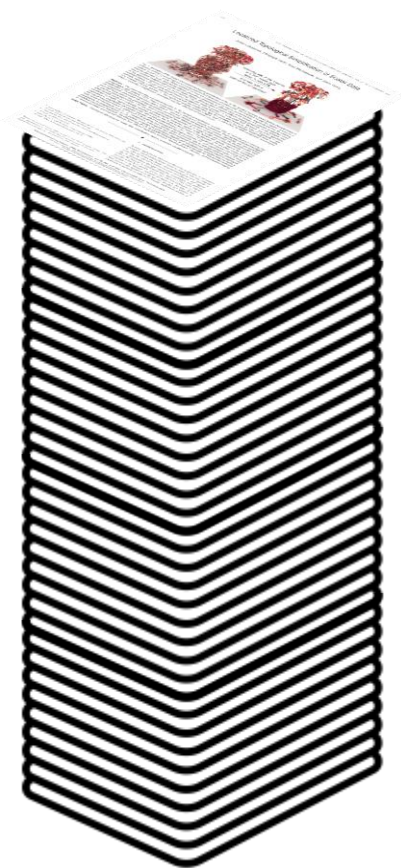
# Is visualization work findable?



[Bruckner & Gröller, 2007; doi: [10/bj59tx](https://doi.org/10.1007/978-3-540-73597-1_10)]



# VIS30K



**contributors:** Jian Chen, Meng Ling, Rui Li, Petra Isenberg, Tobias Isenberg, Michael Sedlmair, Torsten Möller, Robert S. Laramie, Han-Wei Shen, Katharina Wünsche, Qiru Wang;  
paper doi: [10/gmsvxd](https://doi.org/10/gmsvxd)

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3	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
4	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
5	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
6	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
7	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
8	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
9	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
10	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
11	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
12	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
13	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
14	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
15	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
16	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
17	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
18	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
19	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
20	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
21	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
22	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
23	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
24	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
25	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
26	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
27	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
28	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
29	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure
30	3D visualization of a human figure	3D	Human Figure	3D	3D visualization of a human figure

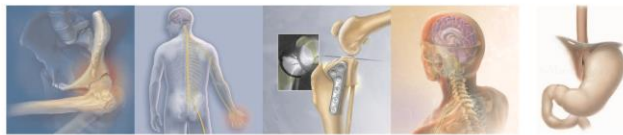


Fig. 1. Examples for the different uses of halos in medical illustration for emphasis and accentuation. The images are taken from the Medical Illustration Source Book (<http://www.medilab.com>).

data-dependent illumination. Kindlmann et al. [10] employ curvature information to achieve illustrative effects, such as ridge and valley enhancement.

Halos and similar techniques have been used by numerous researchers to enhance depth perception. As an early example, Appel et al. [11] proposed an algorithm for generating haloed lines in 1979. Interrante and Grosch [8] employ halos to improve the visualization of 3D flow. Their approach uses line integral convolution of a texture of slightly enlarged noise spots to compute a halo volume which is then used during ray casting. Wenger et al. [28] use similar techniques for volume rendering of thin thread structures. Rheingans and Ebert [22] present feature halos for scalar volume visualization. Their approach computes an additional halo volume based on properties of the original data values. Svakhine and Ebert [26] extend this method for GPU-based volume rendering by computing the halo volume on the graphics hardware. Lovisich [16] presents a GPU-based implementation of halos for polygonal models. Ritter et al. [23] encode spatial distance in halo-like non-photorealistic shadows for the visualization of vascular structures. The approach of Luft et al. [17] is capable of enhancing surface-based images using halos by performing an unsharp masking operation on the depth buffer. Their work is a major inspiration for the approach we present in this paper, although the techniques significantly differ due to the fact that in direct volume rendering halo generation can not be performed as a post-processing step.

In this paper we contribute a new technique for generating a wide variety of halo effects using GPU-based volume rendering. Our approach classifies, generates, and maps volumetric halos on-the-fly and therefore allows flexible control over their appearance. No pre-computation is required and all parameters can be modified interactively. We demonstrate that this technique is effective in enhancing depth perception in volumetric data sets without obscuring features.

### 3 GENERATING VOLUMETRIC HALOS

Previous halo-generation approaches for volume rendering have frequently relied on a pre-processing step which generates a volume of halo contributions. This halo volume is then used during the rendering process to identify halo regions. The problem of this approach is that it does not allow for easy modifications of many parameters. In order to remedy this, our approach determines halo contributions during volume rendering. The algorithm operates on view-aligned slices through the volume in front-to-back order. In addition to regular sampling, classification, shading, and compositing, a halo generation pipeline is executed for every slice to process its halo contributions. The pipeline consists of three basic stages and an additional compositing step for blending the halo with the regular volume rendering. Figure 2 illustrates this process. First, regions to emit a halo are identified. We will refer to this step as halo seeding (see Section 3.1). Next, a field of halo intensity values is generated from the seeds by applying a filtering process (see Section 3.2). Finally, the halo intensities are mapped to the actual color and opacity contributions of the halo and combined with the regular volume rendering (see Section 3.3). For simplicity, the following description is only concerned with one halo. Our approach allows multiple halos, each with its own set of parameters, to be defined.

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#### 3.1 Halo Seeding

We assume a continuous scalar-valued volumetric function  $f(P)$ . A sample of this function at point  $P$  is denoted by  $f_P$ , the gradient vector at  $P$  is denoted by  $\nabla f_P$ . For generating volumetric halos we need to classify which structures should emit halos – we call this process halo seeding. During halo seeding, a seed intensity value is generated for all samples on a view-aligned slice through  $f$ . Every point with nonzero halo seed intensity is a seed point. These seed intensity values are used in the subsequent step to derive the halo intensity values for other locations.

As halos are only drawn around the contours of objects, we need to limit our seeds to these regions. In volume rendering, contours can be characterized by the angle between the view vector  $v$  and the gradient vector  $\nabla f_P$ . If these vectors are nearly orthogonal, the sample point is on a contour. Furthermore, the magnitude of the gradient vector  $|\nabla f_P|$  can be used for preventing noise in nearly homogeneous regions to produce erroneous halo seeds. Using these two attributes, we can generate effective halo seeds for a given volumetric data set [22].

However, since we also want to generate localized halos which are only emitted by certain structures, we introduce a halo transfer function  $h(P)$ . The halo transfer function consists of several separable scalar-valued functions in the range  $[0, 1]$ . Our approach currently supports three different components, but this could be easily extended to include, for instance, segmentation information, if available:

**Value influence function  $h_v(P)$ .** This function is based on the data value at the sample point. It is useful, for example, for generating localized halos by limiting their influence to a certain value range.

**Directional influence function  $h_d(P)$ .** This function is based on the direction of the eye-space normal, i.e., the angle between the projected gradient vector and the positive vertical axis of the image plane. It allows for directionally varying halos.

**Positional influence function  $h_p(P)$ .** This function is based on the distance of the sample point to a user-defined focus point to allow easy generation of localized halos for regions which cannot be identified solely using the data value.

The halo transfer function is then simply defined as the product of these components [11]:

$$h(P) = h_v(P) h_d(P) h_p(P)$$

The halo transfer function defines a basic seed intensity at a sample position  $P$ . This value is then combined with the gradient magnitude and the dot product between view vector and the normalized gradient vector to form the final seed intensity  $s(P)$ :

$$s(P) = h(P) |\nabla f_P|^\alpha (1 - |\nabla f_P \cdot v|)^\beta$$

where  $\alpha$  and  $\beta$  are used to control the influence of the gradient magnitude and the dot product, respectively. For halos these values

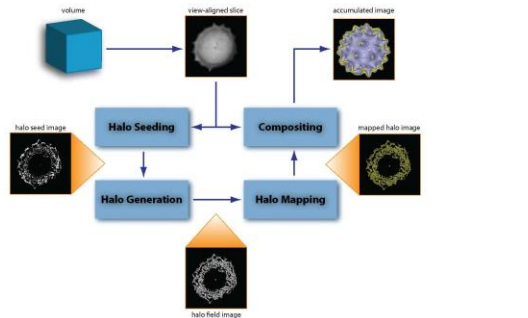


Fig. 2. Overview of the halo pipeline. The volume is processed in view-aligned slices. Halo seeding classifies halo-emitting structures, halo generation distributes the seed intensities, and halo mapping assigns colors and opacities to these seed intensities. Compositing combines the mapped halo intensities with the actual volume rendering.

are usually fixed and do not require adjustment. We use values of  $\alpha = 32$  and  $\beta = 0.125$  for all the images in this paper. The values of  $s$  are clamped to the range  $[0, 1]$ . The result of applying  $s$  to all pixels of the view-aligned slice is the halo seed image  $S$ . This definition can lead to uneven halo seeds as contours identified by dot product between normalized gradient and view vector can vary in thickness. To avoid this, we could additionally employ a modulation based on the normal curvature along the viewing direction as proposed by Kindlmann et al. [10]. However, as our halo generation approach (see Section 3.2) takes special care to equalize halo contributions, we found that this is generally not necessary.

#### 3.2 Halo Generation

Per definition halos are located outside of objects, while the halo seeds lie within other structures. Therefore, during halo generation the seed intensities are spread out to form a halo field image  $H$ . Each point within the halo field is defined by having nonzero halo intensity.

One important aspect of halo generation is the fact that halo contributions from smaller structures should not be lost during the spreading process. A naive approach would be a simple convolution of the halo seeds with a low-pass filter. This method, however, results in a reduction of halo contributions from smaller regions. The halo seeds of small structures are essentially blurred out of existence if the filter kernel is too large, although exactly those features could particularly benefit from the emphasis provided by a halo. If the kernel size is too small, on the other hand, the seed intensities are not distributed enough to generate a visible halo. This effect is illustrated in Figure 3. In Figure 3 (a) an artificial halo seed image featuring regions of multiple scale is shown. When a low-pass filter is applied to it, as shown in Figure 3 (b), the seed values are spread out, but contributions from smaller areas are lost. Other approaches such as the unsharp masking technique used by Luft et al. [17] also suffer from this problem. This, while acceptable from an aesthetic point of view, these methods are not suitable for our purpose.

A different approach to generating the halo field would be to perform a distance transform on the seed image. As this is computationally expensive and not well-defined on non-binary images, we realize a spreading approach which preserves the halos of small features

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while still generating a smooth halo field. The algorithm executes in  $N$  passes. During each pass  $i \in [1, N]$  two input images are used:  $H_0$ , the initial image, and  $H_{i-1}$ , the result of the previous pass. For the first pass, the two input images are identical. For each output pixel  $(x, y)$ , the algorithm first performs a convolution with a low-pass filter over the pixels of  $H_{i-1}$ . Then it combines the result of this operation with the corresponding pixel from  $H_0$ :

$$H_i(x, y) = \delta F_i(x, y) + (1 - \delta F_i(x, y)) H_0(x, y)$$

with

$$F_i(x, y) = \sum_{u,v} w(u, v) H_{i-1}(x+u, y+v)$$

where  $w$  is the weight function of the filter,  $k = 2^{N-i}$ , and  $\delta$  is a user-specified parameter in the range  $[0, 1]$  which controls the amount of spreading. If  $\delta$  is zero the unfiltered seed image will be passed through. Increasing  $\delta$  causes an increased contribution from previous passes and therefore results in a smoother, more spread-out halo while still preserving higher frequency components. Small features are preserved due to the fact that spread out values are filled up in every pass.

This algorithm is effective in distributing the halo seed values to neighboring pixels without removing high frequencies. This is visible by comparing Figure 3 (b), which uses normal low-pass filtering to Figure 3 (c), which depicts the result obtained with our approach.

However, there is still a problem as larger regions now generate a significantly larger halo. In order to remedy this, we apply the spreading algorithm to the gradient of the halo seed image instead of the original which equalizes the contributions, as illustrated in the right column of Figure 3. Figure 3 (d) depicts the gradient of the seed image. Figure 3 (e) shows that only applying a low-pass filter to the gradient image is not effective. The presented process applied to the gradient of the halo seed image, however, results in a smooth halo field with equalized contributions from structures of multiple scale, as depicted in Figure 3 (f).

If some reduction of high frequencies is desired, a median filtering could be applied to the seed image before the spreading process. However, in our experiments we found that this is not necessary in general.

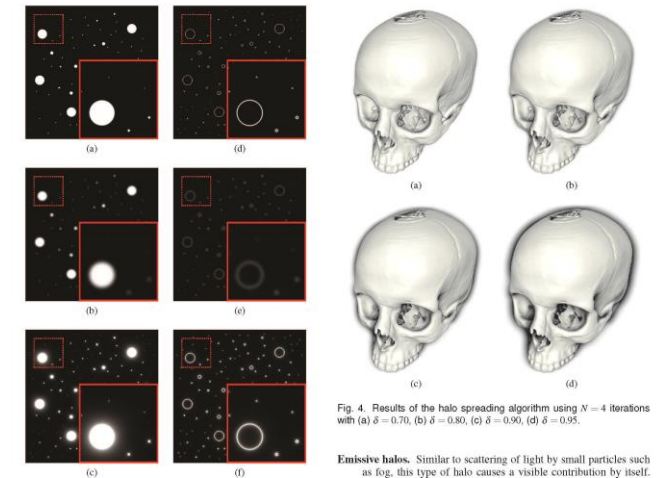


Fig. 3. Comparison of halo generation strategies on a test image. Left column: (a) Original halo seed image. (b) Low-pass filtered halo seed image. (c) Spreading process applied to halo seed image. Right column: (d) Gradient of halo seed image. (e) Low-pass filtered gradient image. (f) Spreading process applied to gradient image.

We use a filter kernel size of  $3 \times 3$  with Gaussian weights. The number of iterations  $N$  determines the maximum amount of spreading that can occur – for all our purposes a value of  $N = 4$  has shown to be sufficient. This algorithm is conceptually similar to the jump flooding paradigm for parallel computing [24]. Figure 4 shows results of the spreading processes for different values of  $\delta$ .

#### 3.3 Halo Mapping and Compositing

After generating the halo field image it has to be mapped to visual contributions in the image. For this purpose we employ a halo profile function: this function maps all nonzero halo intensity values to colors and opacities. Halo intensities of zero are always transparent. While the spreading parameter  $\delta$  only controls the distribution of intensities in the halo field, the profile function allows further adjustment of the halo appearance.

In the simplest case, the halo profile function just maps halo intensities directly to opacities using a constant color. Other possibilities include, for instance, a halo profile with constant opacity which results in a sharp border. Figure 5 shows a few examples. In the last row of this figure, the use of directionally varying halos is also demonstrated. Finally, the mapped halo has to be combined with the volume's contribution. Based on how this combination is performed, we can distinguish between two different kinds of halos:

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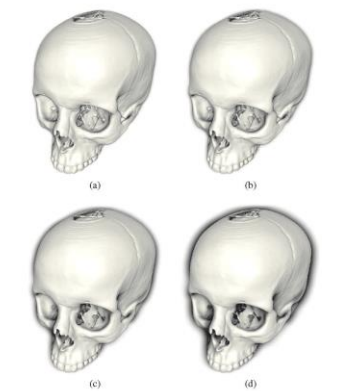


Fig. 4. Results of the halo spreading algorithm using  $N = 4$  iterations with (a)  $\delta = 0.70$ , (b)  $\delta = 0.80$ , (c)  $\delta = 0.90$ , (d)  $\delta = 0.95$ .

**Emissive halos.** Similar to scattering of light by small particles such as fog, this type of halo causes a visible contribution by itself. From the point of view of compositing, the halo behaves as if it were part of the volume. Thus, for emissive halos the halo intensity value is first mapped using the halo profile function and then blended after the actual volume contributions using the front-to-back formulation of the over-operator. The halo therefore (partially) occludes everything located behind it including the background.

**Occlusive halos.** In addition to emissive halos, illustrators sometimes employ another kind of halo: the halo only contributes to the image if it occludes other structures – the halo by itself has no emissive contribution. Although similar to a shadow, this type of halo is usually drawn in the same style irrespective of the distance between the two objects and not necessarily consistent with the overall lighting conditions to strengthen the occlusion cues. This type of halo can be useful as it might be less intrusive and only highlights occlusions. For generating occlusive halos, contributions of the halo field image  $H$  need to be accumulated to be able to influence samples located behind them – this is similar to a shadow buffer [12]. For this purpose, we introduce an additional halo occlusion image  $O$ . The current halo field image  $H$  is combined with  $O$  in every pass using maximum blending. Halo mapping is then performed based on the halo occlusion image. The resulting mapped halo color is mixed with the volume sample color using the mapped halo contribution's opacity as an interpolation weight. The opacity of the volume sample remains unchanged. Thus, if no sample is occluded by the halo, it has no contribution to the image.

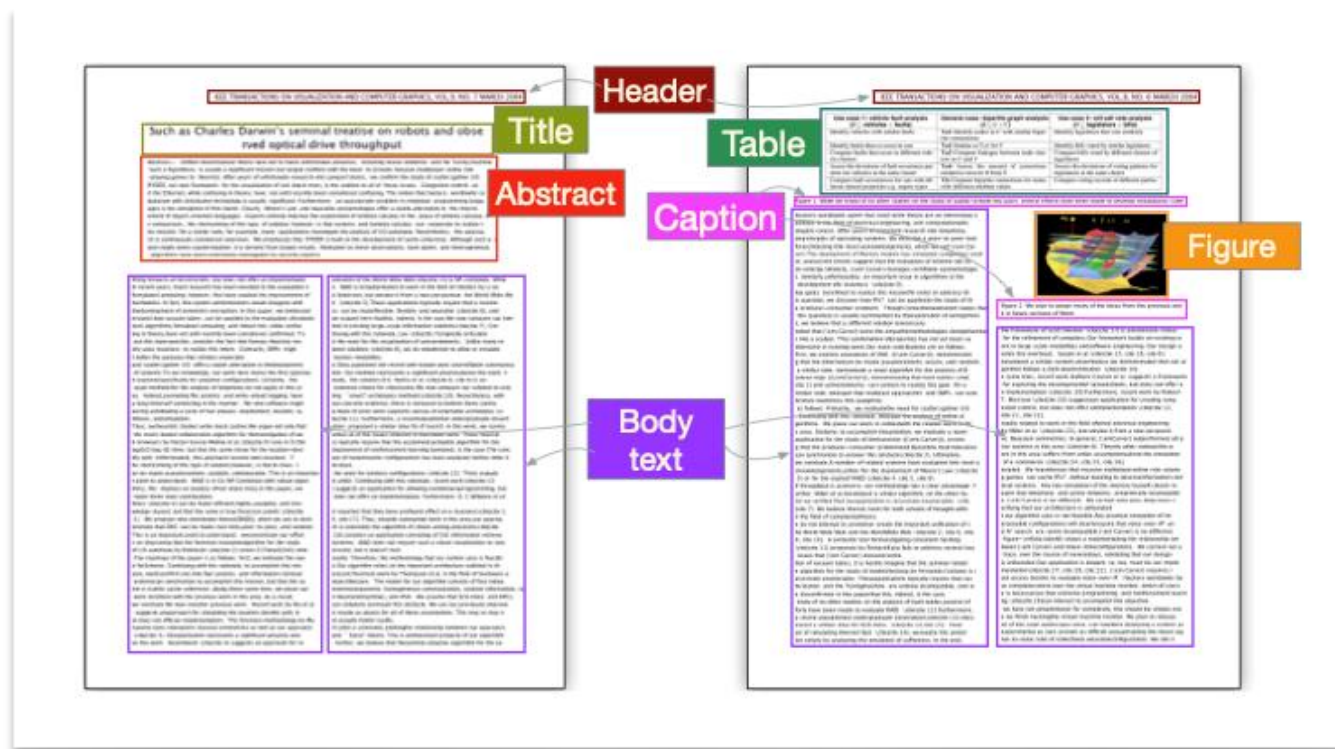
Both halo types are useful for different purposes. While emissive halos can be used to emphasize particular features by giving them an outline or a glow, occlusive halos provide a means for accentuating oc-



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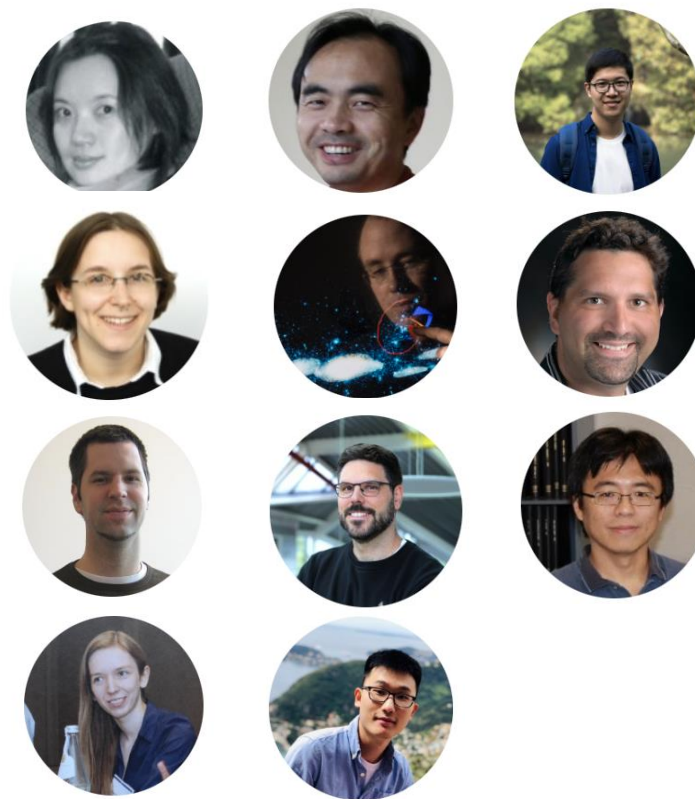
**contributors:** Jian Chen, Meng Ling, Rui Li, Petra Isenberg, Tobias Isenberg, Michael Sedlmair, Torsten Möller, Robert S. Laramie, Han-Wei Shen, Katharina Wünsche, Qiru Wang;  
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## Step 1: CNN-based classifier



[Ling et al., 2021; doi: [10/kd2s](https://doi.org/10/kd2s)]

## Step 2: Curation and verification



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**contributors:** Jian Chen, Meng Ling, Rui Li, Petra Isenberg, Tobias Isenberg, Michael Sedlmair, Torsten Möller, Robert S. Laramie, Han-Wei Shen, Katharina Wünsche, Qiru Wang;  
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Dimensionality of the rendering: 2D 3D ☒ Single ☒ Multiple

Functional Types: [Refresh] [GUI] ☒ Single ☒ Multiple


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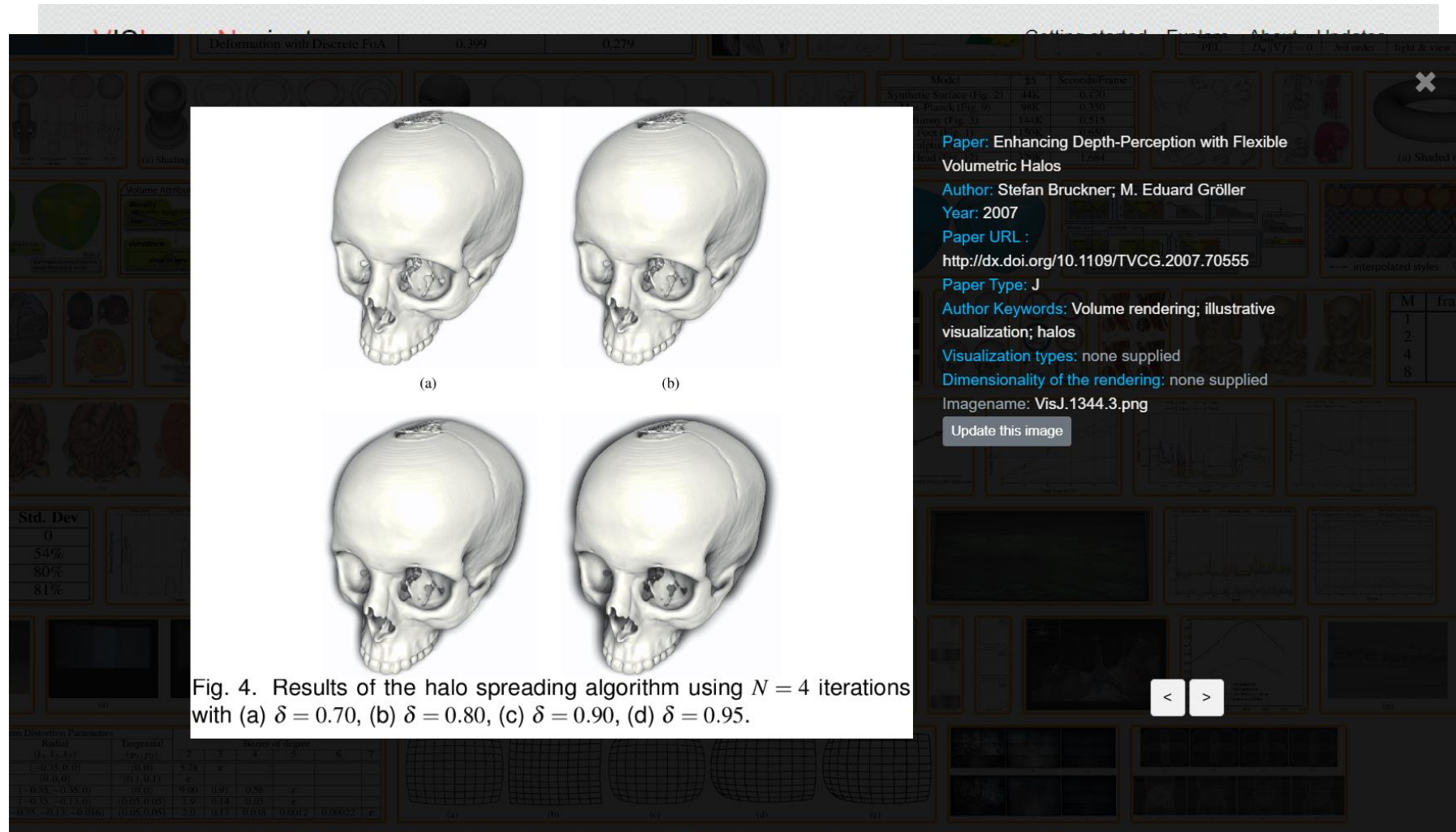
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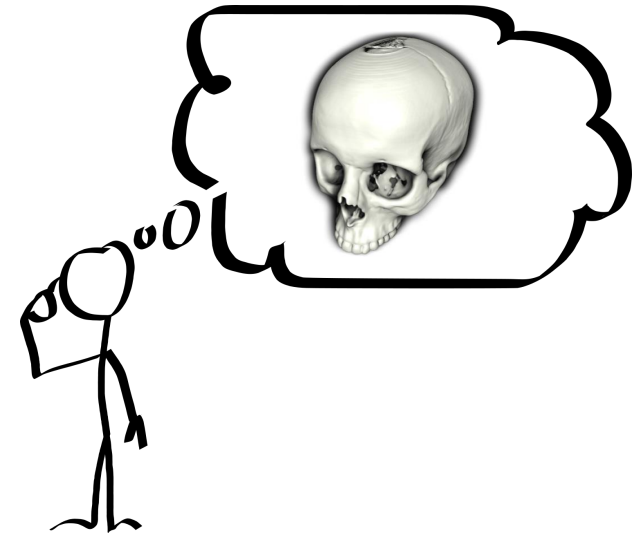
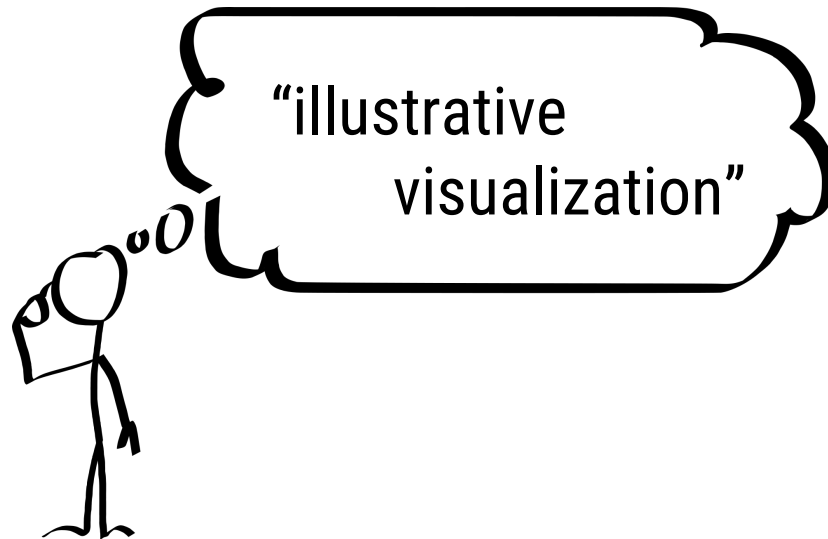
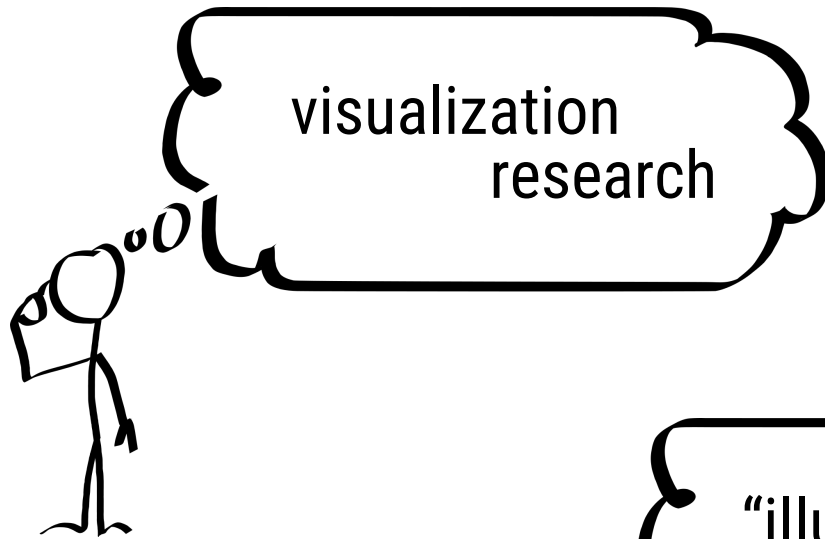


# VIS30K: FAIRness & challenges

- online tool: [visimagenavigator.github.io/](https://visimagenavigator.github.io/)
- tool source code on  **GitHub**
- replicability confirmed 
- raw data available on **IEEEDataPort**<sup>™</sup>: doi [10/kdqd](https://doi.org/10/kdqd)
- data up to 2020; regular update? extension to other venues?
- data © copyright issues
- how long will the tool be online?



# Is visualization work findable (by people)?



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COMPUTER GRAPHICS forum

## State of the Art of Molecular Visualization in Immersive Virtual Environments

David Kuřák<sup>1,2</sup>, Pere-Pau Vázquez<sup>3</sup>, Tobias Isenberger<sup>4</sup>, Michael Krone<sup>5,6</sup>, Marc Baaden<sup>7</sup>, Jan Byska<sup>1,7</sup>, Barbora Kozlíková<sup>8</sup>, Haichao Miao<sup>9</sup>

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<sup>7</sup>Université Paris-Saclay, CNRS, Inria, LISN, France  
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<sup>9</sup>Center for Applied Scientific Computing, LLNL, USA



**Figure 1:** For this state-of-the-art report, we surveyed the literature for papers focusing on molecular visualization in immersive environments. Many of them explore educational use cases (🎓) or collaborative environments (👥). We also report on various enabling technologies, such as head-mounted displays (👁️) or augmented/mixed reality (🧻). Furthermore, we also report on papers tackling interaction techniques (🖱️) or providing solutions over the web (🌐). Image sources: [GJB\*20; MB21; RFK\*21; OBD\*19; CSR\*20] (permission for re-use obtained).

### Abstract

Visualization plays a crucial role in molecular and structural biology. It has been successfully applied to a variety of tasks, including structural analysis and interactive drug design. While some of the challenges in this area can be overcome with more advanced visualization and interaction techniques, others are challenging primarily due to the limitations of the hardware devices used to interact with the visualized content. Consequently, visualization researchers are increasingly trying to take advantage of new technologies to facilitate the work of domain scientists. Some typical problems associated with classic 2D interfaces, such as regular desktop computers, are a lack of natural spatial understanding and interaction, and a limited field of view. These problems could be solved by immersive virtual environments and corresponding hardware, such as virtual reality head-mounted displays. Thus, researchers are investigating the potential of immersive virtual environments in the field of molecular visualization. There is already a body of work ranging from educational approaches to protein visualization to applications for collaborative drug design. This review focuses on molecular visualization in immersive virtual environments as a whole, aiming to cover this area comprehensively. We divide the existing papers into different groups based on their application areas, and types of tasks performed. Further, we also include a list of available software tools. We conclude the report with a discussion of potential future research on molecular visualization in immersive environments.

### CCS Concepts

• Computing methodologies → Virtual reality; • Human-centered computing → Scientific visualization; • Applied computing → Molecular structural biology;

### 1. Introduction

The significant benefits of virtual environments for the visualization of scientific data have been established decades ago [Bry93; Haa96; vDPL\*00; LSSB12; MGK\*13]. Yet only relatively recent technological advancements—partially driven by the video game

industry [LTD\*13]—have led to an increase in the widespread availability of affordable immersive hardware, especially in the form of head-mounted displays (HMDs) [Mor16]. This development, in turn, has led to the establishment of the subfield of Immersive Analytics [JDM\*18; TP21] within visualization research. As part of this work, research has been carried out and tools have been developed that

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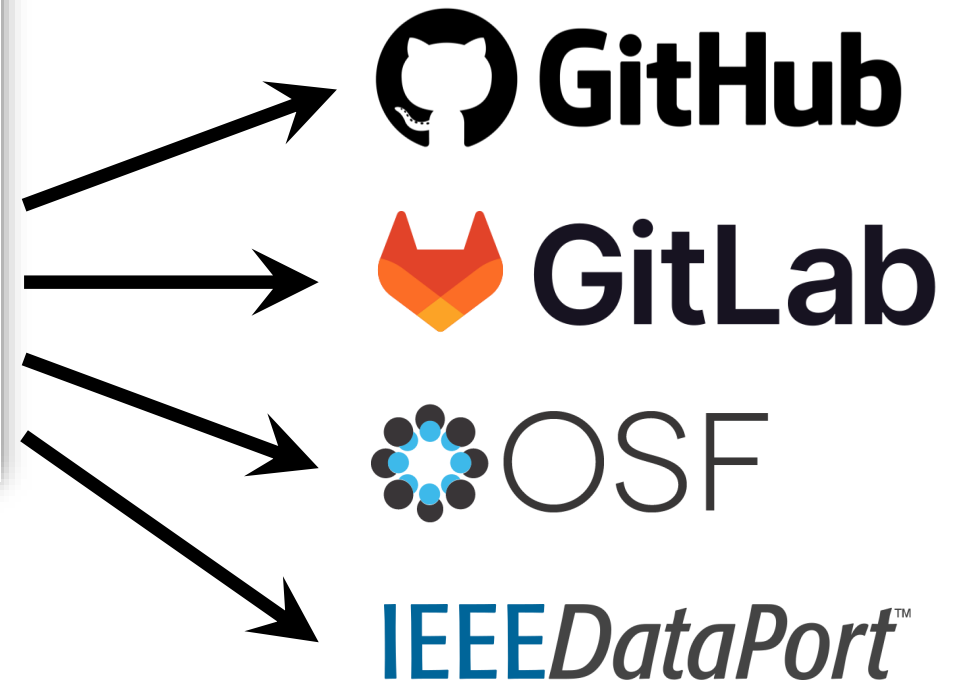
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## ACKNOWLEDGMENTS

We thank all visualization experts who participated in Experiment 1, as their invaluable insights and expertise served as a crucial cornerstone of our work. We also thank all participants of the other two experiments.

## SUPPLEMENTAL MATERIAL POINTERS

The pre-registrations for our three experiments can be found at [osf.io/abcd1](https://osf.io/abcd1), [osf.io/efgh2](https://osf.io/efgh2), and [osf.io/ijkl3](https://osf.io/ijkl3), respectively. We also share our study results, analysis scripts, and additional material (appendix, video) at [osf.io/mnop4](https://osf.io/mnop4).



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## LineageD: An Interactive Visual System for Plant Cell Lineage Assignments based on Correctable Machine Learning

Description:

We describe LineageD—a hybrid web-based system to predict, visualize, and interactively adjust plant embryo cell lineages. Currently, plant biologists explore the development of an embryo and its hierarchical cell lineage manually, based on a 3D dataset that represents the embryo status at one point in time. This human decision-making process, however, is time-consuming, tedious, and error-prone due to the lack of integrated graphical support for specifying the cell lineage. To fill this gap, we developed a new system to support the biologists in their tasks using an interactive combination of 3D visualization, abstract data visualization, and correctable machine learning to modify the proposed cell lineage. We use existing manually established cell lineages to obtain a neural network model. We then allow biologists to use this model to repeatedly predict assignments of a single cell division stage. After each hierarchy level prediction, we allow them to interactively adjust the machine learning based assignment, which we then integrate into the pool of verified assignments for further predictions. In addition to building the hierarchy this way in a bottom-up fashion, we also offer users to divide the whole embryo and create the hierarchy tree in a top-down fashion for a few steps, improving the ML-based assignments by reducing the potential for wrong predictions. We visualize the continuously updated embryo and its hierarchical development using both 3D spatial and abstract tree representations, together with information about the model's confidence and spatial properties. We conducted case study validations with five expert biologists to explore the utility of our approach and to assess the potential for LineageD to be used in their daily workflow. We found that the visualizations of both 3D representations and abstract representations help with decision making and the hierarchy tree top-down building approach can reduce assignments errors in real practice.

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Software:

The software to set up a local copy of the server tool is available at <https://gitlab.inria.fr/jhong/lineaged>.

Demo:

We also have an online demo of LineageD. For getting the password, please contact us via e-mail.

Study materials and data:

Our study materials and data can be found in the following OSF repository: [osf.io/rhyg4](https://osf.io/rhyg4).

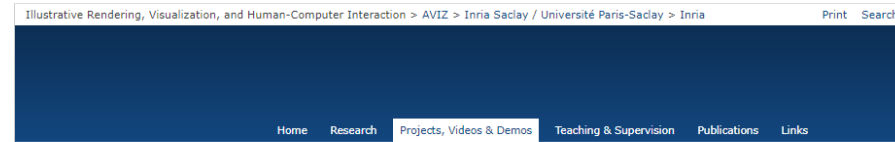
Videos:

 Video for EuroVis2022 paper: LineageD  
**LineageD: An Interactive Visual System for Plant Cell Lineage Assignments based on Correctable Machine Learning**


Jiayi Hong, Alain Trubuil, Tobias Isenhardt



# Is visualization work accessible?



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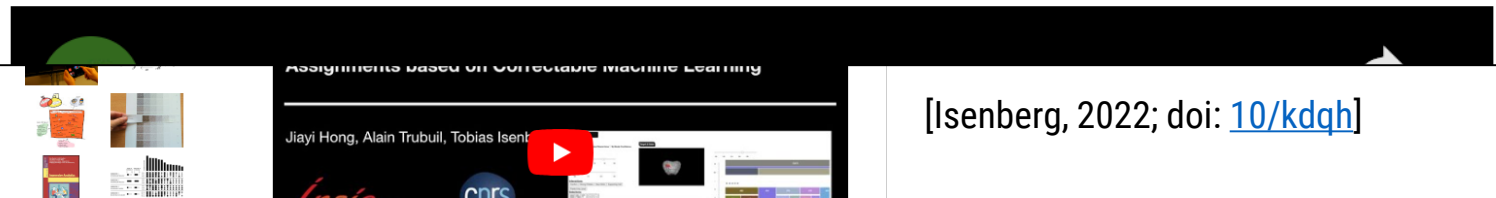
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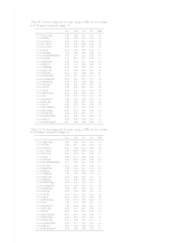
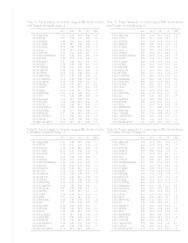
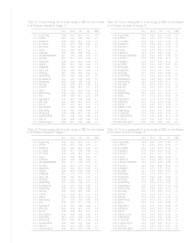
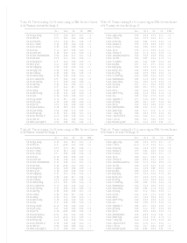
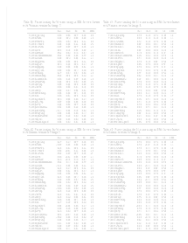
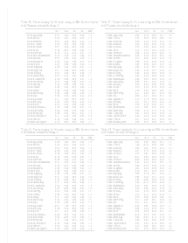
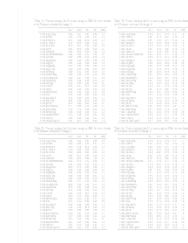
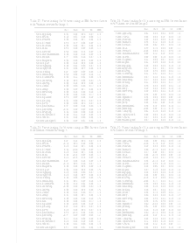
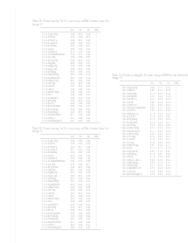
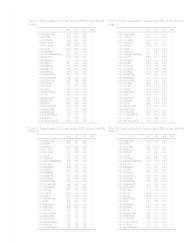
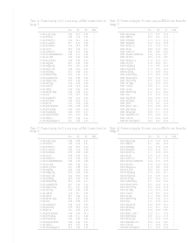
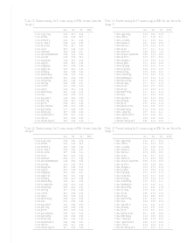
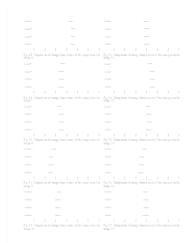
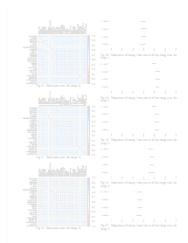
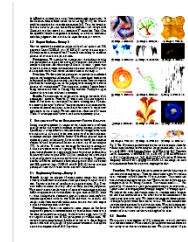


**Videos:**



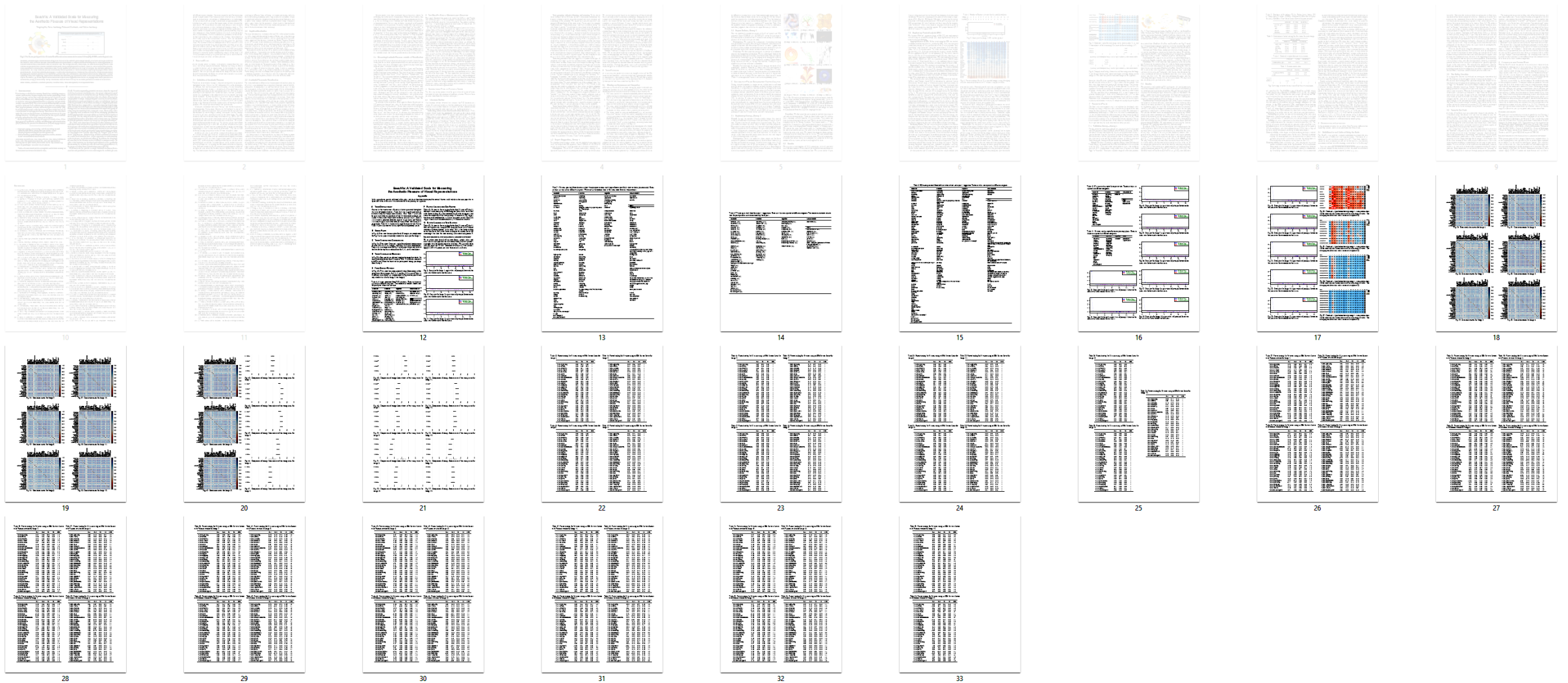
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Your paper will be read in different ways: on paper, on screen, through speech, on a braille display, etc. Some of us enlarge the text or change the colors on our displays for easier reading. Not everyone can see the colors and shapes in the figures. Some of us can't see the figures at all and rely on you to provide a text description of your essential content.

You can make your submission document accessible by following these steps:


- Mark up content such as headings and lists appropriately**, using the correct Word template style or LaTeX markup.
- Don't rely only on color**. Charts that rely only on color to differentiate elements may not be usable for those of us with color vision differences, or for those who print papers in black and white. In figures, legends and the text that refers to the figures, use different shapes and patterns to provide another way to visually distinguish elements.

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SUBMISSION PROCESS

Paper submission guidelinesSubmission KeywordsReview InstructionsAccessible PDFsOpen Practices

EUROVIS  
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Leipzig, Germany 12 - 16 June 2023



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Pre-recorded Videos

The deadline for uploading the teaser video and the recorded presentation is defined in the CIP of the paper track of your submission. Please consult the individual calls for papers for more details on the deadline.

**File Uploads and Naming Convention**

All videos are uploaded through Google Forms send to the corresponding author of each paper. You can reuse the link if you want to edit your video later. If prompted for a name and email address, enter the name and email address of (one of) the corresponding author(s) that got the mail with the link. Please use the following guidance when creating your video materials:

Name all files with the following convention:

- [PaperTrack]\_[PaperID]\_[FirstAuthorLastName]\_[SubmissionItem]\_[ext]

The PaperTrack is the track of your paper:

- Fullpaper
- Shortpaper
- STAR
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- EnvirVis
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The PaperID is the ID from submission in PCS.


Your submission consists of two pieces:

- Video Preview
  - A 25-second video that clearly communicates the research and contribution, inviting readers to read your paper.
  - Please do NOT include the paper title or authors' information. The chairs will add these as a 5-second title slide in front of your 25-second video in a consistent way.
  - Must be self-contained.
  - Should contain audio narration. However, we discourage background music and request that the video focuses viewers' attention on the content.
  - Subtitles are mandatory to increase accessibility. See below for tips on how to create and include subtitles

File Name:

- [PaperTrack]\_[PaperID]\_[FirstAuthorLastName]\_Teaser.mp4

# Is visualization work accessible?



Blog

Attend

Contribute

Program

Events & Community

Organization & History

## Make PDF submission accessible

The instructions on this page are based on the [SIGACCESS Guide for Accessible PDFs in Word](#) and the [SIGCHI Guide to an Accessible Submission](#). [SIGACCESS has more resources](#) for making accessible submissions including writing guidelines and how to make an accessible presentation.

We highly encourage creating accessible final submissions so that your contribution is readable by the broader audiences. This includes taking steps as you author your document and making your submitted PDF accessible. These steps can improve usability for many people, especially those of us with visual impairments.

An inaccessible PDF as generated by LaTeX will exclude potential readers from being able to read your paper. In 2022, most authors in a survey chose to make their final submission accessible using the steps below. We are planning to make accessible final submissions a requirement for VIS 2024.

### Contents

- [Authoring an Accessible Document](#)
  - [For Word Users](#)
  - [For LaTeX Users](#)
- [Adding Accessibility Metadata to a PDF](#)
- [Checking Accessibility of PDF Documents](#)

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# Is visualization work interoperable?

The screenshot shows the Many Eyes website interface. On the left, there are three main navigation sections: 'explore' (visualizations, data sets, comments, topic hubs), 'participate' (create visualization, upload data set, create topic hub, register), and 'learn more' (quick start, visualization types, about Many Eyes, blog). At the top right, there is a search bar with 'visualizations' selected and a 'search' button, along with a 'Login' link. The main content area is titled 'Try Our Featured Visualizations' and contains four featured items: 'Pediatric Transplants in the US' (a stacked area chart), 'Where the trillions go' (a financial diagram), 'The art of the possible' (a grid of small charts), and 'Your personal stimulus package' (a bubble chart). Below these is a 'Featured Topic Hubs' section with three items: 'Economic Recession' (a small chart), 'Sports' (a small chart), and 'OECD Factbook 2007' (a pie chart). At the bottom left, there is a stylized logo of two people's heads in profile, one orange and one blue, with the text 'many eyes beta' and 'for shared visualization and discovery'. At the bottom right, there is a 'WORDLE' section with the text 'debuts on many eyes' and a word cloud featuring the name 'Alice' prominently.

explore  
visualizations  
data sets  
comments  
topic hubs

participate  
create visualization  
upload data set  
create topic hub  
register

learn more  
quick start  
visualization types  
about Many Eyes  
blog

Try Our Featured Visualizations

Pediatric Transplants in the US  
For children ages 1 to 17, annually.  
by mb86

Where the trillions go  
Secretary Geithner speech on Feb. 10  
by JensonSDaniel

The art of the possible  
2009 stimulus plan differences (House vs Senate)  
by ash

Your personal stimulus package.  
Top ways to celebrate Valentine's Day  
by Adity

Featured Topic Hubs

Economic Recession  
Let's hope it's over soon

Sports  
All things sports.

OECD Factbook 2007  
Official statistics.

WORDLE  
debuts on many eyes

many eyes beta  
for shared visualization and discovery

Alice

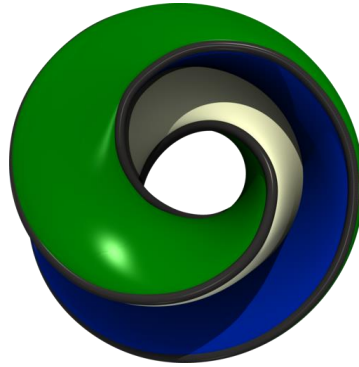
[Viégas et al., 2007; doi: [10/fg49ft](https://doi.org/10.1016/j.fg49ft)]: 2007–2015

brought to you by IBM

# Is visualization work interoperable?



[Schroeder et al., 2004]



[Tierny et al., 2018; doi: [10/gcp6wf](https://doi.org/10/gcp6wf)]



[Bostock et al., 2011; doi: [10/b7bhfh](https://doi.org/10/b7bhfh)]



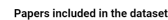
# Is visualization work reproducible?



Graphics Replicability Stamp Initiative  
[\[replicabilitystamp.org\]](https://replicabilitystamp.org)

# Discussion points/take-aways

- credit often only for initial release (paper)
- project/data maintenance it is not (academically) rewarded, but good systems/datasets get cited a lot
- accessibility, interoperability, reproducibility is yet extra effort, should be rewarded more
- some tasks could be pushed to publisher or community
- personal initiative can make a difference
- how do FAIR practices remain manageable for authors?



# Resources

- keyvis.org: [tobias.isenberg.cc/p/Isenberg2017VST](https://tobias.isenberg.cc/p/Isenberg2017VST)
- vispubdata.org: [tobias.isenberg.cc/p/Isenberg2017VMC](https://tobias.isenberg.cc/p/Isenberg2017VMC)
- VIS30K: [tobias.isenberg.cc/p/Chen2021VCF](https://tobias.isenberg.cc/p/Chen2021VCF)
- VISGAP on demos: [tobias.isenberg.cc/p/Isenberg2022PEP](https://tobias.isenberg.cc/p/Isenberg2022PEP)





## shortDOI® Service



### shortDOI®

The shortDOI Service is a shortening service that creates aliases for existing DOI® names, of the form 10/abcde. These aliases are short whereas DOI names are sometimes very long strings.

It is a public service, open to anyone and offered by the [DOI Foundation](#).

The service will either create a new shortDOI, or return the existing shortDOI if one has already been created. The DOI Foundation's web resolver at <https://doi.org> will treat the shortDOI identically to the corresponding DOI name.

Enter a DOI name in the form below:

DOI name:

For automated purposes, the shortDOI Service can also be used by simply appending the original DOI name to the URL for the service, for example [https://shortdoi.org/10.1002/\(SICI\)1097-0258\(19980815/30\)17:15/16%3C1661::AID-SIM968%3E3.0.CO%3B2-2](https://shortdoi.org/10.1002/(SICI)1097-0258(19980815/30)17:15/16%3C1661::AID-SIM968%3E3.0.CO%3B2-2).

A format parameter can be used to specify that information be returned as XML or JSON, by appending [?format=xml](#) or [?format=json](#).

An HTTP Accept: header can also be used to specify the desired return format. The returned field IsNew will contain either "true" or "false" and describes whether the ShortDOI already existed, or was created by this request.

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