

# Dipl.-Ing. Dr.-Techn. Velitchko Filipov, BSc.

## Academic Resumé

Position:	Postdoctoral Researcher, TU Wien, Faculty of Informatics
Fields:	Computer Science, Human Computer Interaction, Visual Analytics, Network Analysis
Languages:	English (C2), German (C1), Bulgarian (Native)
LinkedIn:	<a href="https://www.linkedin.com/in/velitchko-filipov">in linkedin.com/in/velitchko-filipov</a> ↗
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Website:	<a href="https://velitchko.github.io">🌐 velitchko.github.io</a> ↗
ORCID:	<a href="https://orcid.org/0000-0001-9592-2179">ID 0000-0001-9592-2179</a> ↗
Scholar:	<a href="https://scholar.google.com/citations?user=2FYZ3QYAAAAJ">g scholar.google.com/citations?user=2FYZ3QYAAAAJ</a> ↗
Research Gate:	<a href="https://www.researchgate.net/profile/Velitchko-Filipov">R researchgate.net/profile/Velitchko-Filipov</a> ↗



## Research Profile

Postdoctoral researcher in visual analytics and complex networks, with a growing focus on integrating generative and agentic methods to support human decision-making. My work develops interactive frameworks that help navigate complex relational processes in temporal and spatial data. Drawing on human-centered computing and emerging AI methods, I aim to amplify human agency and interpretive depth in virtual and situated environments, particularly within interdisciplinary contexts.

## 1 Education

2024	<b>Ph.D. (Dr.-Techn.)</b> TU Wien <b>Field:</b> Visual Analytics, Faculty of Informatics <b>Dissertation:</b> “Networks in Time and Space: Visual Analytics of Dynamic Network Representations” <b>Advisor:</b> Prof. Silvia Miksch, <b>Reviewers:</b> Fabian Beck & Carolina Nobre	📍 Vienna, Austria
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2018	<b>M.Sc. (Dipl.-Ing.)</b> TU Wien <b>Field:</b> Human-Centered Computing, Faculty of Informatics <b>Thesis:</b> “Visual Exploration and Comparison of Multiple Resumes: Focus on Time and Space” <b>Advisor:</b> Prof. Silvia Miksch	📍 Vienna, Austria
2013	<b>B.Sc.</b> TU Wien <b>Field:</b> Media Informatics, Faculty of Informatics <b>Thesis:</b> “Social Interface and Interaction Design” <b>Advisor:</b> Dr. Peter Leitner	📍 Vienna, Austria

## 2 Employment & Further Training

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2024-Present	<b>Postdoctoral Researcher</b> Vienna, Austria <b>Responsibilities:</b> <ul style="list-style-type: none"> <li>• Co-PI &amp; work-package lead for <a href="#">ArtVis</a>↗ &amp; <a href="#">SANE</a>↗</li> <li>• Establish collaborations &amp; proposal writing</li> <li>• Teaching &amp; supervision</li> </ul>	📍 TU Wien↗
2017-2024	<b>PhD Student</b> Vienna, Austria <b>Responsibilities:</b> <ul style="list-style-type: none"> <li>• Research on visualization of dynamic networks [Fil24b]</li> <li>• Publish &amp; present research at top-tier visualization venues</li> <li>• Contribute to teaching, student supervision, &amp; academic service</li> </ul>	📍 TU Wien↗
2023-Present	<b>CTO</b> Remote <b>Responsibilities:</b> <ul style="list-style-type: none"> <li>• Translate research prototypes into deployable products</li> <li>• Technical strategy lead &amp; system architecture</li> <li>• Managing releases &amp; roadmap</li> </ul>	📍 <a href="#">iPal Network</a> ↗
2021-2023	<b>Developer</b> Remote <b>Responsibilities:</b> <ul style="list-style-type: none"> <li>• Data analysis &amp; visualization tools for large-scale blockchain data</li> <li>• Implement models for sentiment analysis</li> </ul>	📍 <a href="#">Trading Sentiment (iPal Network)</a> ↗
2015-2016	<b>Junior Web Developer</b> Vienna, Austria <b>Responsibilities:</b> <ul style="list-style-type: none"> <li>• Design &amp; implement interactive web-based applications</li> </ul>	📍 <a href="#">codeQ</a> ↗

2012-2014	<b>Junior Researcher</b> <i>Remote</i> <b>Responsibilities:</b> <ul style="list-style-type: none"><li>• Support applied research projects for volumetric rendering</li></ul>	✉ <a href="#">Crocotta R&amp;D Ltd (Urban Hawk)</a> ↗
2009	<b>Junior Web Designer</b> <i>Sofia, Bulgaria</i> <b>Responsibilities:</b> <ul style="list-style-type: none"><li>• Design and implement visual layouts and interactive web interfaces</li></ul>	✉ <a href="#">Bianor (WiserTechn)</a> ↗
2008	<b>Junior Web Designer</b> <i>Sofia, Bulgaria</i> <b>Responsibilities:</b> <ul style="list-style-type: none"><li>• Design layouts and interactive web interfaces</li></ul>	✉ <a href="#">Nextborn (WiserTech)</a> ↗

### 3 Prizes, Awards, & Honors

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#### **Honorable Mention IEEE VIS 2025: Award** ↗

“Layers of Doubt: Typology of Temporal Uncertainty in Dynamic Diffusion Networks” [Bau+25]  
Authors: T. Baumgartl, **V. Filipov**, S. Rajendran, S. Miksch, D. Archambault, A. Arleo, T. Landesberger  
Awarded at IEEE VIS Uncertainty Visualization Workshop, 2<sup>nd</sup> of November 2025

#### **Best Full Paper EuroVis 2025: Award** ↗

“NODKANT: Exploring Constructive Network Physicalization” [Pah+25]  
Authors: D. Pahr, S. D. Bartolomeo, H. Ehlers, **V. Filipov**, C. Stoiber, W. Aigner, H.-Y. Wu, R. G. Raidou.  
Awarded at EuroVis, 3<sup>rd</sup> of June 2025

#### **Top Cited Article 2025: Award** ↗

“Are We There Yet? A Roadmap of Network Visualization from Surveys to Task Taxonomies” [FAM23]  
Authors: **V. Filipov**, A. Arleo, S. Miksch  
Wiley & Sons, 19<sup>th</sup> of March 2025

#### **Best Dissertation Nominee 2024: Entry** ↗

“Networks In Time and Space: Visual Analytics of Dynamic Network Representations” [Fil24b]  
Author: **V. Filipov**  
TU Wien Informatics Awards, 2<sup>nd</sup> of December 2024

#### **Best Paper VIS4DH 2019: Award** ↗

“Bridging the Gap between Visual Analytics and Digital Humanities: Beyond the Data-Users-Tasks Design Triangle” [Sch+19]  
Authors: V. Schetinger, K. Raminger, **V. Filipov**, N. Souratos, S. Zapke, S. Miksch  
Awarded at IEEE VIS 2019, Vancouver, Canada

#### **Graph Drawing Contest 2019: Award** ↗

“The Fabric of Heroes” [Fil+19a]  
Authors: **V. Filipov**, A. Arleo, D. Ceneda, S. Miksch  
Awarded at the 27<sup>th</sup> International Symposium on Graph Drawing and Network Visualization

#### **Graph Drawing Contest 2018: Award** ↗

“The Circle of Thrones” [Fil+18]  
Authors: **V. Filipov**, D. Ceneda, M. Koller, A. Arleo, S. Miksch  
Awarded at the 26<sup>th</sup> International Symposium on Graph Drawing and Network Visualization

## EPILOG - Best Master Thesis Nominee 2018: Entry<sup>↗</sup>

“Visual Exploration and Comparison of Multiple Resumes: Focus on Time and Space” [Fil17]

Author: **V. Filipov**

Presented at TU Wien, 18<sup>th</sup> of January 2018

## 4 Invited Talks & Events

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- **IEEE VIS TVCG Invited Paper:** “TimeLighting” [Fil+24]  
*IEEE VIS, Vienna, Austria, 2025*
- **BioMedVis:** “Networks in Motion” [Fil25]  
*Ludwig Boltzmann Institute, Vienna, Austria, 2025*
- **IEEE VIS TVCG Invited Paper:** “A Space and Time Odyssey” [Fil+23a]  
*IEEE VIS, Florida, US, 2024*
- **WinterGraph:** “Research Unit Introduction” [Fil24c]  
*(internal workshop), Kaprun, Austria 2024*
- **Shonan Seminar:** “Dynamic Perspectives” [Fil24a]  
*Material Sciences, Shonan, Japan, 2024*
- **EuroVis CGF Invited Paper:** “Are We There Yet?” [FAM23]  
*EuroVis, Leipzig, Germany, 2023*
- **AustroVIS:** “Chronicals of Artist Networks” [Fil+23c]  
*(internal workshop), AustroVIS, 2023*
- **Vienna Perspectives:** “Interactive Music Mapping Vienna” [Fil22]  
*Groove The City, Vienna, Austria, 2022*

## 5 Academic Cooperation & Funding

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**Total Funding Contributed/Managed:** **€2.0M** across 5 FWF projects

**SANE:** ViSual ANalytics for Event-based Diffusion on Networks (FWF WEAVE)

2024 – ongoing

**Principle Investigator:** Asst.Prof. Alessio Arleo

**Role:** co-PI & workpackage lead, Post-Doc. Senior Researcher

**Funding:** FWF 10.55776/I6635 (425,282 €)

**Responsibilities:**

- Supervising junior researchers
- Leading work packages
- Disseminating findings
- Project management

**Topics:** Dynamic Networks, Spatial Data, Temporal Data, Information Diffusion, Uncertainty

**ArtVis:** Dynamic Network Perspectives on Digital Art History (FWF)

2022 – ongoing

**Principle Investigator:** Prof. Silvia Miksch

**Role:** co-PI & workpackage lead, Post-Doc. Senior Researcher

**Funding:** FWF 10.55776/P35767 (410,779 €)

**Responsibilities:**

- Contributed to obtaining funding
- Supervising junior researchers
- Leading work packages

- Disseminating findings
- Project management

**Topics:** Dynamic Networks, Spatial Data, Temporal Data, Digital Humanities

**KnoVA:** Knowledge Assisted Visual Analytics (FWF)

2020 – 2022

**Principle Investigator:** Prof. Silvia Miksch

**Funding:** FWF 10.55776/P31419 (407,008 €)

**Role:** Pre-Doc. Junior Researcher

**Responsibilities:**

- Contributing to project goals
- Developing, designing, and evaluating visualization approaches
- Disseminating results through publications and presentations

**Topics:** Guidance, Knowledge Modeling, Health Care

**IMMV:** Interactive Music Mapping Vienna (FWF)

2017 – 2020

**Principle Investigator:** Prof. Susana Zapke

**Role:** Pre-Doc. Junior Researcher

**Funding:** FWF 10.55776/AR384 (415,338 €)

**Responsibilities:**

- Contributing to project goals
- Developing, designing, and evaluating visualization approaches
- Disseminating results through publications and presentations

**Topics:** Dynamic Networks, Spatial Data, Temporal Data, Digital Humanities

**PolyCube:** Towards Integrated Mental Models of Cultural Heritage Data (FWF)

2017 – 2019

**Principle Investigator:** Dr. Eva Mayr

**Funding:** FWF 10.55776/P28363 (342,895 €)

**Role:** Pre-Doc. Junior Researcher

**Responsibilities:**

- Contributing to project goals
- Developing, designing, and evaluating visualization approaches
- Disseminating results through publications and presentations

**Topics:** Spatial Data, Temporal Data, Set-typed Data, Digital Humanities, Uncertainty

## 6 Teaching Activity

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I support junior researchers and supervise students. I teach (Bachelor & Master) courses on information visualization and design.

### PhD Theses (co-supervision):

- (2024-ongoing) “Designing Dynamic, Uncertainty-Aware Glyphs for Visualizing Information Diffusion”. Sandhya Rajdendran  
Dynamic Networks, Spatial Data, Temporal Data, Information Diffusion
- (2023-ongoing) “Relationship Analysis in Cultural Heritage Data”. Michaela Tuscher  
Dynamic Networks, Spatial Data, Temporal Data, Digital Humanities
- (2022-ongoing) “Dynamics of modern artist groups around 1900: Collectivity, Connectivity, Conditions, Consequences”. Teressa Kamencek  
Dynamic Networks, Spatial Data, Temporal Data, Digital Humanities

### Master Theses (direct supervision):

- (2024) “Dynamic Network Analysis with Centrality Measures\*”. Luca Rauchenberger  
Dynamic Networks, Temporal Data, Digital Humanities
- (2023) “Utilizing Visual Analytics for Network Exploration in the Domain of Art History Research”. Adam Nedor  
Dynamic Networks, Temporal Data, Digital Humanities

#### **Bachelor Theses (direct supervision):**

- (2026) “Dynamic MetroMap Visualization for Information Diffusion”. Benedikt Gschmeidler.  
Dynamic Networks, Temporal Data, Information Diffusion
- (2026) “Schematic Representations of Information Diffusion”. Michael Matte  
Dynamic Networks, Temporal Data, Information Diffusion
- (2025) “Effective Methods for Visualizing Museum Artist Networks”. Oliver Kastner  
Dynamic Networks, Temporal Data, Digital Humanities
- (2025) “AdMaTiE: Visualizing Dynamic Adjacency Matrices in a Multiple-Coordinated-View System\*”. Nikolaus-Mathias Herl  
Dynamic Networks, Temporal Data  
\* Results of the thesis were published at Graph Drawing 2025 [HF24]
- (2024) “Temporal Motif Detection in Dynamic Networks”, Alexander Tashkov  
Dynamic Networks, Temporal Data, Guidance
- (2021) “PromNetworkVis: Dynamic Network Visualization to Patient-Reported Outcome Measures”. Mert Usul  
Dynamic Networks, Health Care, Knowledge Modeling
- (2019) “Visualization of Time-oriented Multivariate Survey Data”. Dominic Vallaster  
Temporal Data
- (2019) “EventQuery: Visual Querying & Pattern Matching in Time-Oriented Geospatial Data”. Christoph Gwihs  
Dynamic Networks, Spatial Data, Temporal Data
- (2018) “An Interactive Dashboard Approach for the Visual Analysis of Rocket Flight Data”. Thomas Khlebovitch  
Spatial Data, Temporal Data

#### **Teaching (Bachelor & Master courses):**

- (VU) Information Visualization (6 ECTS, 194 participants 2025)
- (VO) Information Design and Visualization (3 ECTS, 48 participants 2023)
- (UE) Information Design and Visualization (1 ECTS, 48 participants 2023)
- (SE) Seminar on Human-Centered Computing, Information Visualization (3 ECTS, 43 participants 2025)
- (PR) Projects in Media and Human-Centered Computing (12 ECTS, 43 participants 2025)
- (PR) Projects: Visual Computing 1 & 2 (6 & 6 ECTS, 43 participants 2025)
- (PR) Bachelor & Master Theses (10 & 30 ECTS, 4 participants 2025)

## **7 Service to Academic Community**

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I actively contribute to the academic community through reviewing, organizing, and committee work:

### **Journal Reviewing**

- CGF, Computer Graphics Forum (Wiley & Sons)
- TVCG, Transactions on Visualization and Computer Graphics (IEEE)
- C&G, Computers & Graphics (Elsevier)

### **Conference Reviewing & Program Committees**

- Reviewer, ACM Symposium on Applied Computing – 2026
- Reviewer, IEEE VIS (Full and Short Paper Tracks) – 2024, 2025
- Reviewer, IEEE PacificVis (Conference and Journal Paper Tracks) – 2024, 2025, 2026
- Reviewer, Pacific Graphics (Full Paper Track) – 2025, 2026
- Reviewer, EuroVis (Full, Short, Education Paper Tracks) – 2024, 2025
- Reviewer, Graph Drawing & Network Visualization (Track 2) – 2024, 2025, 2026
- Program Committee, Track 2 @ Graph Drawing & Network Visualization – 2026
- Program Committee, Short Papers @ IEEE VIS – 2025
- Program Committee, EduVis Workshop @ IEEE VIS – 2025
- Program Committee, VIPRA Workshop @ EuroVis – 2024, BPM – 2025
- Program Committee @ Visual Analytics in Healthcare Workshop @ IEEE VIS – 2021, 2023, 2025

### **Workshop Organization and Chairing**

- Paper & Session Chair, Visual Analytics in Healthcare Full-day Workshop @ IEEE VIS – 2025
- Organizer & Co-Chair, VisGames Half-day Workshop @ EuroVis – 2025
- Organizer & Co-Chair, VisGames Full-day Workshop (Second Edition) @ EuroVis – 2026
- Organizer, README.md Tutorial On Reproducability in Visualization Research @ EuroVis – 2026
- Co-Organizer EduVis Workshop @ IEEE VIS – 2026

### **Local Organization**

- Local Organizer for EuroVis ↗ – 2026
- Organizer for AstroVis Workshop ↗ – 2026

### **Academic Service**

- Representative of the Scientific Staff Council for TU Wien, Faculty of Informatics – 2021, 2022, 2023, 2024, 2025, 2026

## Building Collaborations

I actively build interdisciplinary collaborations, particularly with art historians and scholars in the humanities, by engaging directly with researchers and their problems. My approach is grounded in openness, initiative, and sustained dialogue: reaching out, starting conversations, and exploring whether there is a shared research question worth pursuing. Rather than beginning from predefined solutions, I focus on understanding domain-specific challenges, constraints, and opportunities, and on identifying where visualization and analytics can meaningfully contribute.

This translates into interactive, hands-on, and co-design-oriented methods that support stakeholder engagement, requirements elicitation, and communication across disciplinary boundaries. I place particular emphasis on onboarding and the development of shared conceptual language to support knowledge exchange and continuity in interdisciplinary research settings.

This approach to collaboration has led to a diverse set of joint publications, successful project proposals, and ongoing interdisciplinary research partnerships.

## 8 Research Statement

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### Abstract

My research focuses on designing visualization and analytics approaches that support human reasoning about influence, relationships, and change in complex, heterogeneous, and multi-dimensional relational data. Much of my work is grounded in close collaboration with humanities scholars, such as art historians, musicologists, and cultural heritage researchers, who seek to understand how artistic styles, social relations, and ideas emerge and propagate over time. A central motivation of my interdisciplinary research is to better align computational methods with how domain experts interpret data: by tracing individual cases, situating findings in context, and questioning abstractions that obscure details. At the same time, visualization research often emphasizes aggregation, distant views, and statistical summaries, creating a tension between analytical power and interpretive depth.

Building on this foundation, my current research investigates how human-centered and generative approaches can augment analytical workflows by positioning intelligent systems as active collaborators rather than passive tools. I am particularly interested in how structured, context-aware generative methods can support domain experts in exploring relational phenomena, such as influences and diffusion of ideas in networks, while preserving human agency in interpretation and decision-making. In parallel, I explore situated and embodied analytics through physicalization and tangible interaction, examining how learning, reasoning, and collaborative sensemaking can be enhanced when analysis moves beyond the desktop into physical and social contexts. Across these directions, my work is guided by a common goal: **develop visualization and analytics methods that amplify human agency** by aligning computational power with how people think, reason, and collaborate.

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### Current Research Activities.

Dynamic Networks, Spatial Data, Temporal Data, Digital Humanities, Information Diffusion

I began with a practical problem in human resources and recruitment: “How do you compare multiple resumés efficiently?”. This led to CV3↗ [Fil+19b; FFM18; Fil17], a system for visual exploration and comparison of curriculum vitae that handles temporal and spatial dimensions of career trajectories. The project taught me the importance of comparison as an analytical task [JE12; Gle+11], and it introduced me to the challenges of visualizing biographical and event-based data [Bre+17]. From there, I moved into humanities collaborations. The Interactive Music Mapping Vienna↗ project, with the Music and Arts University of the City of Vienna, explored the lives and relationships of musicians in early 20th century Vienna [Fil+21; Fil+19c], connecting people, places, events, and themes through an event-based network visualization. Concurrently, I contributed to the PolyCube↗ project, which investigated how to visualize cultural heritage data collections across multiple coordinated space-time-cubes while maintaining visual coherence and supporting synoptic insights [Win+20]. These projects illustrated a fundamental challenge: humanists don’t just want to see patterns in the aggregate (e.g., overall trends, derived statistics), they want to understand specific individuals, trace influences, and situate findings within historical and socio-political contexts. This made differences between distant (examining large-scale patterns) and close (interpreting individual cases or artifacts) reading become clear to me [Jän+15; Mor13]. We can build powerful abstractions and overviews, but if they don’t let people zoom into the details that matter to them, the visualization approaches don’t get used.

Building on these experiences, we established a collaboration with art historians at the University of Vienna that became the basis for the ArtVis↗ project. The project is still ongoing and we’re investigating exhibition networks of early 20th century artists to understand how artistic styles and movements spread through co-exhibition activity. These topics are central to current art historical research [Tus+25; Lin16; Sch+14]. Our system visualizes dynamic networks of artists, venues, and exhibitions across time and space. Art history students actively work with it in seminars to explore questions about influence, canonization, and artist networks. We continue to refine it in response to feature requests and student feed-

back. This iterative, in-use development process has shaped how I think about collaborating with domain experts and conducting research. The project demonstrates successful dissemination of visualization research into another discipline, where it is actively adopted and used in research and teaching.

Throughout my doctoral studies I have investigated how we can effectively represent time in networks. I started this with an exploratory study in 2021 [FAM21] comparing structural representations like node-link diagrams and adjacency matrices [HFM07; GFC04] with different temporal encodings. The results were interesting enough that I pursued the question further. I submitted an extended version to Graph Drawing in 2022 [Fil+23b], which was then invited for a journal extension in IEEE TVCG in 2023 [Fil+23a], and culminated in an invited presentation at IEEE VIS 2024. In parallel, I conducted a comprehensive survey of the broader field of network visualization, covering structural and temporal visualization approaches, interaction techniques, and task taxonomies. I synthesized these insights into a survey representing a practical resource for researchers, which was recognized as one of Wiley's top-cited articles in 2025 [FAM23]. This multi-year process taught me about persistence and the value of really opening up a problem rather than moving on after a single publication. The results challenged some assumptions in the literature which is what sparked this interest. As networks grow in size and complexity [Lan+11], it becomes increasingly difficult to identify which actors or events play a pivotal role in shaping outcomes. This piqued my interest in the concept of information diffusion in dynamic networks that we are tackling within the SANE project. Diffusion is a powerful abstraction [KKT03; KM27] and presents a method to treat influence as something that propagates through a network, we can quantify the relative importance of nodes, edges, or events in a principled way. However, this concept is underexplored in cultural contexts. “How do artistic styles diffuse through exhibition networks?” “What role do specific actors or venues play in spreading or blocking certain movements?” I’m currently writing a research proposal to model artistic influence as probabilistic diffusion over dynamic networks, adapting techniques from epidemiology [PV01; KM27]. The idea is to treat exhibitions as transmission events [Bon+12] and use diffusion models to simulate how styles propagate through the network over time.

### Planned Research Activities.

Dynamic Networks, Information Diffusion, Digital Humanities, Embodied Cognition, Artificial Intelligence (AI)

Research Question
<p><i>“How can human-centered computing and generative methods empower people’s agency and capabilities to explore, interpret, and reason about complex relational and dynamic processes?”</i></p>

This question guides my research vision. Networks, cultural datasets, and relational systems are all growing in size and complexity and it is increasingly difficult to identify key actors, trace influences, and make sense of emergent patterns. My goal is to develop approaches that reveal these structures but also amplify human agency, enabling researchers, domain experts, learners, and practitioners to engage meaningfully with data, uncover insights that were previously inaccessible, and explore questions that could not be answered before. Currently, my projects reflect different aspects of this vision. The ongoing art history collaboration (ArtVis) and the project on information diffusion (SANE) demonstrate how domain-grounded approaches can support interpretation and reasoning about influence in networks and behavioral changes over time. Complementing these, my work on physicalization [Ehl+25; Pah+25; PEF25] examines how embodied engagement with data supports learning, reasoning, and interaction with complex information. These insights motivate three interconnected research directions:

**I. Agentic Visual Analysis** – focuses on the methodological foundations of collaboratively working with agentic AI when both developing as well as actively using visual analytics techniques to analyze complex and heterogeneous relational data. I envision agentic visual analysis as a collaborative

setting in which humans work with autonomous agentic AI systems that actively participate in problem formulation, system development, and analysis. Models and their capabilities are advancing at such a rapid pace and I believe we need to fundamentally rethink their role in visualization and human-centered computing research. This direction goes beyond adding existing generative AI models for well-known problems and more into the direction of providing structure and context to guide what these models generate and how they can collaborate and work with people. The main contributions would be model-agnostic frameworks, design patterns, taxonomies, and structured workflows that others can use when integrating generative AI into visual analytics systems. The next step I see in this direction is to develop methods that ensure generative models align with human-centered analytical practices, augmenting rather than replacing human analytical and creative capabilities [Dha+25].

For example, when a researcher asks how a phenomenon spreads through a network, an agentic system should understand the problem formulation and which views, analytical techniques, and interactions are appropriate by drawing on integrated domain knowledge and established visualization and network analysis methods. This requires moving beyond simple generic chart generation or understanding toward systems that work with and support domain-specific workflows and reasoning practices. This work builds on principles from human-AI interaction [Shn20; Ame+19] to address unresolved challenges of interpretation and sense-making in visual analytics contexts [Cen+17; Kei+08]. Finally, the rigorous evaluation of human-AI interaction and model behavior is essential to build trust in these agents and ensure that their contributions are transparent. Methods to assess the quality of AI lack standardization and do not validate their explainability with humans [Suh+25] underscoring the need for guidelines and best practices. At the same time, most fields of research employing various types of AI face reproducibility challenges stemming from these rapidly changing and evolving models, undocumented workflows and highlight the importance of reproducible analysis pipelines [KMS24]. Addressing these issues is critical for ensuring agentic visual analysis methods are reliable, interpretable, and replicable.

## **II. Situated & Embodied Analytics – extending my work on physicalization, I am interested in how collaborative analysis [Ise+11] can move fluidly across time, space, and devices. I want to explore how people can work together in (or across) physical spaces with distributed interfaces and physical artifacts, particularly, when they need to reason about complex data and problems.**

Recently, we explored how physicalization can provide a foundation for thinking about tangible and embodied cognition [ACD09; Wil02]. In HoloGraphs [PEF25], we explored how dynamic networks can be represented as layered physical artifacts that preserve temporal structure while providing intuitive physical affordances. People were enabled to remove, overlay, separate, and order timeslices. Our approach supported reasoning and comparison through physical and tangible manipulation. The ways in which people interacted with HoloGraphs align closely with core comparative visualization strategies such as juxtaposition and superposition [JE12; Gle+11] and space-time-cube operations [Bac+17], but are realized as natural, embodied actions rather than explicit interface commands. Following up with NODKANT [Pah+25], we demonstrated the cognitive value of embodied interaction with networks. People who physically construct their own network representations can extract significantly more insights during construction and retain more information over longer periods of time. Building on this, we developed BattleGraphs [Ehl+25], a competitive network physicalization game in which two players independently construct networks and compete in network analysis tasks. Deploying the game in workshop scenarios allowed us to observe how tangible network construction supports both strategy formation and collaborative reflection.

Across HoloGraphs, NODKANT, and BattleGraphs [Ehl+25; Pah+25; PEF25], physicalization emerges as a means to surface interaction techniques grounded in intuitive human comparison and reasoning, providing guidance for the design of human-centered interactive systems. Building on these insights, we can start exploring how visual and analytical views can be distributed across physical space, tangible computing, and devices to support collaborative sense making and human-centered system design. This perspective aligns with work on visualization beyond the desktop [Jan+15; JD13] and frames physicalization as a means to study how people naturally coordinate, compare, and reason about data together

when interfaces are embedded in shared environments. Games and playful activities, such as the ones we explore in the **VisGames**<sup>↗</sup> workshop, represent another form of situated engagement where learning and collaboration happen through embodied, interactive play rather than traditional interfaces.

### **III. Reciprocal Interdisciplinary Research** – is a hot topic discussed in literature and workshop settings. Transferable methods for interdisciplinary research are still considered an open challenge and are non-trivial, particularly, at the intersection of computer sciences and humanities [Sch+19].

A persistent challenge in the visualization and human-computer interaction community is that there exist a plethora of existing tools and approaches, their adoption rates, however, remain low and are rarely utilized outside of the case studies that are described in the associated papers. This divide is especially expressed in disciplines such as digital humanities, where the developed approaches and methods often clash with the interpretive nature of the research practices in the field. We treat interdisciplinary work as unidirectional: visualization builds solutions for other domains. What we usually do not consider is the reverse, how other domains can contribute to visualization research? This asymmetry is a missed opportunity. Domains like art history have developed sophisticated methods for dealing with ambiguity, context, and interpretation over centuries. These aren't problems visualization has solved, we often abstract them away. What if close reading techniques informed how we design detail views? What if historiographic methods for evaluating sources shaped how we represent data provenance and uncertainty?

In the **ArtVis**<sup>↗</sup> project we pursue this bidirectional exchange [Hal+20]. Art historians use the system and their interpretive practices actively shape what we build. When they critique our abstraction and aggregation approaches that erase individual agency, they highlight something fundamental about networks and influence that our standard methods miss. Additionally, games and playful activities emerge as a new direction to facilitate interdisciplinary collaboration. Part of the **VisGames**<sup>↗</sup> workshop also aims to explore visualization games as a way to study how people collaboratively reason about data across disciplinary boundaries. By externalizing reasoning through play, these approaches support communication and help bridge epistemic gaps between different analytical traditions [Sto+25]. In order to understand various disciplines and research methods, we need to actively engage with the problems rather than treating them as convenient application areas and case studies we could use. This involves developing frameworks to establish productive collaborations, negotiating between different epistemic cultures, building solutions that respect domain expertise and augment their capabilities with state of the art computational methods [Mul02; SG89]. This direction matters because reciprocal interdisciplinary research produces knowledge neither field could generate alone.

Taken together, these directions address complementary facets of the research question. **I. Agentic Visual Analysis** focuses on enhancing human agency in analytical workflows through structured human-AI collaboration; **II. Situated & Embodied Analytics** emphasizes reasoning grounded in physical and social interaction; and **III. Reciprocal Interdisciplinary Research** establishes bidirectional exchange between visualization methods and domain practices, enabling mutual shaping of analytical methods and domain reasoning. Collectively, these directions aim to amplify human agency in exploring, interpreting, and reasoning about complex relational and dynamic systems.

## References

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## 9 Teaching & Mentoring Statement

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My teaching philosophy is about getting our hands dirty together. I find that knowledge is **constructed, questioned, and worked with** rather than passively absorbed. My approach is grounded in active learning and constructivist pedagogy: students learn by doing, by failing, by making decisions under uncertainty, and by engaging directly with problems that are not always easy to answer.

I teach **information visualization and design** at both bachelor and master levels, and across these contexts I try to move beyond presenting encoding principles or interaction techniques. I encourage students to build visualizations, critique them, break them intentionally, and defend their choices. I've supervised 10 completed theses (8 bachelor, 2 master) and currently guide 2 more bachelor students while supporting junior PhD researchers. What connects these experiences is an approach built around questions rather than answers. I provide structure and scaffolding but leave space for students to construct their own research and understanding.

**Constructivist learning theory** tells us that knowledge isn't transferred, but built through scaffolded engagement with authentic problems. When I teach visualization courses, I do not just present the "rules" and "guidelines". We explore datasets together, try different encodings, observe what fails, and reason about why. One of my favorite moments in class comes when we wrap up the topic of design guidelines by intentionally breaking every one of them. Students see for themselves how choices shape results, which helps them build a deep understanding of why some approaches succeed and others do not. They understand why some things work, because they've seen the alternatives we made. Their feedback about this is also quite positive.

Teaching requires flexibility and attentiveness. I teach classes of varying sizes, and I'm aware that a 100+ student lecture demands different strategies compared to a smaller group of 10 students. But I believe it is important to create opportunities for students to actively engage with the material, whether through in-class problem-solving, peer discussion, hands-on prototyping, or reflective exercises. Given the opportunity of shaping courses and curricula, I want to open with informal sessions where students articulate what they want to learn. At the end, we revisit those goals and reflect on what was achieved. I want to **actively involve and co-create the learning environment** with the students, make a space for diverse voices and goals.

There are three things I try to help students develop, and I think they matter beyond any specific course or project.

- First, **critical reflection**. Question everything: your visualizations, your assumptions, the "best practices" you read in papers, and my feedback too. To me questioning, is the foundation of research and science and I reflect this in my teaching. The most interesting work emerges when we challenge what's taken for granted, when we ask whether a design actually answers the question it claims to answer, or whether a technique is appropriate for the context at hand. I try to encourage students to push back, to interrogate claims, and to develop their own critical lens. This curiosity-driven questioning often sparks creative ideas and opens unexpected directions.
- Second, **decisiveness**. Make a decision. Commit to a direction and iterate. Students, especially early-career researchers, often paralyze themselves with choice: which framework, which dataset, which venue, which design. The goal isn't perfection, but to gather enough information, choose a direction thoughtfully, and experiment. If the choice is wrong, we can adjust and change the approach. If it's right, we can build on it and improve. Making informed decisions turns ideas into something tangible we can learn from.
- Third, **movement**. Prototype early. Fail fast. Don't sit on an idea too long. Progress requires motion, not just in projects, but in thinking, in research trajectories, in career development. Without movement, ideas stagnate. I believe progress is all about doing small incremental steps towards your goals. Therefore, I encourage students to get their hands dirty quickly, to build something tangible, to test ideas rather than over-theorize them. Experimenting is, at its core, a way to explore creatively and discover surprising

solutions. This is how we discover what we don't know, and how we keep momentum even when the path forward is unclear.

I think about these things in my own research too, and students see me question my own designs, pivot when something isn't working, and keep projects moving even when progress feels slow. My approach to supervision is more about mentoring than managing. My theses supervisions span topics from dynamic network analysis to geospatial event querying to medical data visualization, reflecting the breadth of students' interests and the flexibility I try to afford them. I prefer to sit down together, plan, then schedule regularly check-ins to adapt and adjust if necessary. I am aware that some students need more structure whereas others thrive with autonomy, some are confident and direct, whereas others need encouragement and support. **I try to meet students where they are.** This extends to my work with junior researchers as well, I collaborate closely with four PhD students. We **tackle problems together**, challenge each other's assumptions, and iterate rapidly. Some of the best things have come from these sessions because we asked the right (and wrong) questions. Along the way, I often learn from them too. Like anyone, I have blind spots in my research, and when discussions raise questions I haven't thought about, it helps me see problems from fresh perspectives. **Together we explore unexpected ideas** and creative approaches that enrich my own research and broaden how I think about problems.

In teaching, **failure** is usually the thing students fear most. To me failure is normal, necessary, and generative. I'm transparent about my own failures: rejected papers, visualizations that didn't work, projects that stalled. In class, I want students to see that setbacks are part of the process. So we deliberately test ideas that may fail, analyze why they do not work, and discuss the lessons these experiences reveal. This hands-on approach helps students internalize learning in a tangible way. I find this to be incredibly important for students who are already marginalized or lack confidence. I'm aware that students come from different backgrounds, cultures, genders, ages, and levels of experience. As someone who has spent most of my life abroad, I know what it feels like to be on the outside. I try to create inclusive spaces where diverse perspectives are not just tolerated but valued. I make all materials transparent and accessible and I encourage students to ask questions immediately, rather than waiting for email or office hours. I believe this is how we can build trust and create environments where people feel heard and included.

Computer science is rapidly developing and paradigm shifts happen all the time. Students today are navigating technological changes, complex ethical questions, and interdisciplinary research contexts that didn't exist a decade ago. We need to adapt our **teaching methods to match the complexity and pace of the field**, to equip students not just with knowledge but with the capacity to question, decide, and move. I see teaching as research in its own right: an iterative process of hypothesis, experimentation, and refinement. Every semester, I incorporate student feedback and adjust content, structure, and methods. I pay attention to what works and what doesn't.

Ultimately, I believe the most impactful thing I can do as an educator is to help students become **independent, critical, and confident thinkers** who can navigate uncertainty and complexity. I want them to leave my courses not just with technical skills, but with the capacity to ask hard and critical questions, know how to approach problems, make bold decisions, and keep moving even when the path isn't clear.

**Open Science:** My publications are open access ([Google Scholar](#)↗; [Web of Science](#)↗; [ResearchGate](#)↗). Implementations as well as results and analysis are open-sourced ([GitHub](#)↗ and [GitLab](#)↗). I actively promote reproducibility, replicability, and transparency in academic research ([GRSI](#)↗), providing all materials linked to my publications on [OSF](#)↗.

Publications: 45

Citations: 210

h-index: 8

i10-index: 8

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## Publication List

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- [Bau+25] T. Baumgartl, **V. Filipov**, S. Rajendran, S. Miksch, D. Archambault, A. Arleo, T. Landesberger. “Layers of Doubt: Typology of Temporal Uncertainty in Dynamic Diffusion Networks”. In: Short Paper. 2025.
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