Exploring the Digital Archive as a Thinking Space –

AI Aspects on Documentation, Access and Knowledge Discovery

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Abstract

Most digital archives still provide access through phonebook-like lists. But the digital archive is a *living (data) culture*. An artificial intelligence chatbot predicts that the digital archives of the future will improve the user experience. More than 20 years ago, however, the authors developed the media art archive platform netz-spannung.org (1998-2010) with *Knowledge Discovery* tools such as the *Semantic Map*, *Media Flow* or *Matrix*, which enable an *interactive* and *performative* engagement with the archive. This approach allows visitors to become active participants and co-creators of the archive's content rather than passive viewers. It is not primarily about finding familiar information, but about searching and browsing in unfamiliar contexts. The goal is to create a *participatory experience* that encourages visitors to become *data performers* in a walk-through *thinking space* and to acquire new knowledge without handing over their own thinking to the automated machine.

Keywords

Audio, data performer, interactive, interface, knowledge discovery, living data, mapping, participatory experience, performative, semantic, serendipity, thinking space, visual, walk-through.

Introduction

When asked about the future of digital archives, one AI responded that "they will be more accessible and user-friendly, with advanced search and organization tools. They may also include more multimedia content, such as video and audio recordings, and use virtual and augmented reality technologies to enhance the user experience". "It is also possible," continues the apparently retarded AI, "that digital archives of the future will be more integrated with other technologies, such as artificial intelligence, to make it easier for users to find and interact with the information they need." So much for ChatGPT in January 2023.

The authors are co-founders of ART+COM[1] (1987) in Berlin and have several years of experience of working with artificial intelligence. Their VR work *Home of the Brain* (1990-1991) juxtaposed the concepts of the antipodes of artificial intelligence-*Marvin Minsky* and *Joseph Weizenbaum*-with the concepts of digital culture of *Vilém Flusser* and *Paul Virilio*.

Figure 1. In memory and gratitude to *Peter Weibel*, who presents *Media Flow* (2006/08) at the ZKM as one of the "*groundbreaking*" *Knowledge Discovery Interfaces*. 2012 © Fleischmann & Strauss

To select these four thinkers, they listened to *Minsky's* provocative lectures and discussed them with *Sherry Turkle*. *Joseph Weizenbaum* accepted an invitation to the *Memoria Futura*[2] symposium at the *GMD*, then Germany's leading *IT* research institute, where discussions with online

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[1] In 1987, *Fleischmann & Strauss* joined forces with *Edouard Bannwart*, the principal founder of ART+COM. From this *think tank* in Berlin, they planned and carried out their first research projects in the field of *digital culture*. In 1992, they were invited as guest researchers and fellows to the GMD German Research Center for Information Technology in St. Augustin/Bonn and the KHM in Cologne. One year off turned into 22 years.

[2] The symposium *Memoria Futura* (1999) used a networked mixed reality situation to visualize a memory space of collective experience. The additional *i2TV* format of community television, comparable to today's *ZOOM*, was developed in the *MARS* lab under the direction of Monika Fleischmann.

participants (*i2TV*) in a *mixed reality* situation were held for the first time. [14] They exchanged letters with *Paul Virilio* and represented him at a symposium in Lisbon. *Vilém Flusser* looked forward to working with them, but sadly he died shortly afterwards.

In 1992, together with the *VisWiz*[3] research group, they began experimenting with AI algorithms, including neural networks and image alienation, on supercomputers such as *Thinking Machines' Connection Machine CM2*. In the mid-1990s, they expanded their work with the *MARS*[4] *lab*, first at the *GMD Institute for Media Communication*, and since 2006 at the *Fraunhofer Institute for Artificial Intelligence and Robotics*. In a walk-through thinking space, the authors exhibit their AI instruments as works of art that allow visitors to become data performers. But staging an online archive is not just staging something, but also staging someone who uses the archive.

The Performative Interface: Advanced Concepts of Presentation and Representation

The *digital archive* is not a rigid filing cabinet. Instead it should be a *networked*, *living* (data) *culture*. One of the first networked archives - *netzspannung.org* - had been in beta testing since 1999. The development of the underlying distributed technology and the creation of the first content took two years. It was launched in 2001 at the CAST01 [15] conference at GMD's *Birlinghoven Castle* in Sankt Augustin.

At about the same time, two other archives were founded in Germany with the aim of preserving *Media Art from the 1980s and 1990s*, at least descriptively, because it was in danger of being lost due to outdated software and hardware. *Oliver Grau* started the digital archive ADA, which he initially curated as a research collection focusing on the compilation of extensive documentary material as an expanded notion of documentation and developed further as a collaborative project with international media artists, researchers, institutions, and an editorial team. [7]

Dieter Daniels and *Rudolf Frieling* had created the *Media Art Net*, a self-contained digital network of artists' works curated by invited experts on media art topics. Their focus was on organizing data for specific information and a narrative approach to organizing thematic content. [8]

Monika Fleischmann and *Wolfgang Strauss*, the authors of *netzspannung.org*, took a different approach. They involved an editorial team, university partners, publishers, and community experts. To organize the growing database and gain new insights, they developed *Knowledge Discovery Interfaces*. The goal was to represent the relational network as a digital information space. Another focus was to enable

participants to search and find information in an online archive without prior knowledge or the help of an archivist. This seemed possible only with a *Performative Interface* as a *knowledge tool*. [9]

There are basically two types of access to electronically stored data: "*sharp*" searching and "*unsharp*" browsing. *Searching* requires prior knowledge. People must know what they are looking for. *Browsing,* on the other hand, is inspired by what is presented to the researcher. The basis of browsing is precisely "*not knowing,"* which becomes "*felt*" knowledge during the browsing process. The maxim of the industrial interface is "*what you see is what you get*". In contrast the authors *Performative Interface*, reverses this and reveals what is hidden: *what you get is what you did **not** see*. [2] This is where the *process of learning* begins.

The *Performative Interface* is a special feature that leaves room for improvisation and interpretation. [3] In particular, it is designed to encourage participants to respond to the evocative language of the interface. Wondering about something that becomes visible through one's actions creates a new space for thinking. The *Performative Interface* heralds a *paradigm shift*, namely the *symbiosis of natural and self-learning systems*. As a counter-model to the black box of *Artificial Intelligence* (AI), the authors pursue the concept of *Intelligence Augmentation* (IA), which emerges from a *symbiosis of self-learning systems* based on *natural* and *artificial intelligence*.

Netzspannung.org - a Junior "Mother of All Demos"

Research and development for building an archive for media art began in August 1998 with the project CAT - Communication, Art, Technology. A year earlier, in 1987, 120 international media artists participated in an *e-mail survey* on the characteristics of an *Internet platform for media art*. The authors' feasibility study was the program for its realization.

The platform *netzspannung.org* was envisioned as an online resource, producing and providing telelectures, pedagogy, scholarly essays, and media art documentation based on shared, distributed server systems. [5] The platform was developed in two years by the editorial and technical team. It had four curated content channels and an open community channel. It publishes a print magazine, the *netzspannung Journal*, organizes symposia such as *Memoria Futura*, conferences such as *CAST 01*, workshops such as "*I see what you hear*", the biennial student competition *Digital Sparks*, broadcasts of *Tele-Lectures* by renowned experts, a community profile system [10], and finally the archive itself. All in

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[3] The *VisWiz* research group was founded in 1992 by *Wolfgang Krueger* (formerly *ART+COM*) at *GMD - the German National Research Center for Information Technology* (1968-2001) and was headed by *Monika Fleischmann* after his death.

[4] *MARS* (Media Arts Research Science) was a department at the *GMD,* later *Fraunhofer Institute for Media Communication*, founded by *Monika Fleischmann* in 1996. It was presented as one of the top 15 labs for media arts and research at *ITAU Cultural* in *Sao Paulo* in 2002. https://idw-online.de/de/news51440

all, an art and science laboratory on its way to becoming a collaborative publishing and development house.

The *Digital Sparks* university competition was conducted online via the platform, while jury meetings and award ceremonies took place on site in partnership with festivals or events at Ars Electronica, EMAF, GMD's Schlosstag or the ZKM. [11] In collaboration with committed partners, the platform quickly compiled a comprehensive collection of media art educational materials with world-renowned speakers from a wide range of disciplines for example on the *Arts of Knowledge*[9].

Figure 2. First sketch of *netzspannung.org*, 1998. Worldwide connected, 2006. Homepage, 2001. Streaming Hypermedia Telelecture 2004. *Otto's Mops* - i2tv, 2002. © Fleischmann & Strauss

The platform was first presented to the public at the *CAST01* conference at GMD's Birlinghoven Castle as an instrument for researching, reflecting on, and mediating electronic culture. [15] For this occasion, a *Mobile Streaming Unit*[10] (2001) was developed, a portable webcast studio with easy-to-use streaming software that enabled the MARS team to record lectures with prominent speakers and broadcast them to German universities and live on the Internet, such as the *Burda Academy's* "*Iconic Turn*"[11] series from the University of Munich. These events were recorded and stored long before the advent of *YouTube*.

A prototypical educational format was the *Hypermedia Tele-Lecture*. It consisted of linking two different online archives - *netzspannung.org* and *Media Art Net* - and making the resources available to the community. An exemplary *Tele-Lecture* on "*Sound and Vision*" (2004) was produced in collaboration with the art historian *Dieter Daniels*. [12] A first *netzspannung.org video* from 2004 shows the activities of the *MARS* team in this comprehensive archive project.[13] The number of hits had risen sharply, and in 2006 the platform recorded 150,000 visitors per month, which corresponds to the number of students at the Berlin University of the Arts at that time. More than 3,500 works by over 500 artists.

The knowledge productions of netzspannung.org were presented from 2007 to 2009 in the exhibitions "YOU_ser: The Century of the Consumer" and "The Celebration of the Consumer" at the ZKM Karlsruhe, as well as the 2012 solo exhibition "Inter-Facing the Archive", dedicated to knowledge discovery, curated by Peter Weibel.

At the request of the authors, netzspannung.org moved from the Fraunhofer to the ZKM as its new host in 2010. [12] Technically, the platform was under development from 1999 to 2001, with further update in 2004 and 2010, before being handed over to the ZKM in the same year.[14] Netzspannung.org is still accessible, outdated parts are to be restored. It is worth mentioning that the platform has been hosted and maintained by ZKM as a virtual server since 2012. But it also means that the archive itself is archived, virtualized. It's a frozen time capsule, still accessible but no longer active.

Faces of the Archive: Knowledge Discovery interfaces for browsing the Thinking Space

The authors developed *rhetorical figures of data presentation* to extend the experience of searching and finding in a growing archive, but above all to provide orientation and an overview of the content. The knowledge discovery interfaces are designed to allow participants to search for information and discover knowledge. They follow mental models such as the "*map*," the "*jukebox*," and the "*flow*" by linking artworks and lectures, artists, and scholars.

All developments were tested and discussed in workshops with other experts. This included the role of viewers and their use of the archive. In addition to the authors and the MARS team, *Annette Huennekens, Golo Foellmer, Christiane Paul, Alfred Rotert* and others took part in the workshops at the *GMD's Birlinghoven Castle*, e.g., on the topic of *Timelines, Clusters, Knowledge Maps*.[21] It was a learning

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[9] The *Arts of Knowledge* events organized by the *Zentrum für Literaturforschung*, Berlin. netzspannung.org/tele-lectures/series/en

[10] The Mobile Unit or Mobile Streaming Lab was developed at MARS by Predrag Peranović under the direction of Monika Fleischmann & Wolfgang Strauss, 2001. bit.ly/OnlineMediaLab

[11] *Iconic Turn - The New Image of the World*, 2003, www.hsozkult.de/event/id/event-52577,
Iconic-Turn Live-Streaming, 2003
www.nettime.org/Lists-Archives/rohrpost-0306/msg00170.html

[12] *Sound and vision in the avant-garde mainstream* by Dieter Daniels, a *Hypermedia Tele-Lecture* by Monika Fleischmann, Wolfgang Strauss and Fraunhofer MARS Lab 2004
http://netzspannung.org/tele-lectures/hypermedia-lectures/

[13] *netzspannung.org - Media Art Archive – Video* (2004) Monika Fleischmann & Wolfgang Strauss bit.ly/netzspannungVideo

[14] Media art portal "netzspannung.org" moves to ZKM, 2010. https://idw-online.de/de/news402889

[21] *Timelines, Clusters, Knowledge Maps*. Collaborative structures for networked knowledge spaces. Workshop by MARS Lab at

process for all involved at a time when there were hardly any role models.

Thinking Space #1: The Semantic Map - a Radar System for Navigating the Data Cosmos

The *Semantic Map* (2001-02) locates archive entries and makes semantic relationships visible. [13] The self-organizing map uses semantic text analysis to reveal the relationships between text documents by generating keywords, identifying similarities, and grouping them into thematic clusters. The map shows in which conceptual environment a document is located and which other documents are most similar. The documents of an individual work appear as nodes in a network of thoughts, themes, and practices. The "*reader*" discovers information through differentiation and thus becomes a co-producer of meaning.
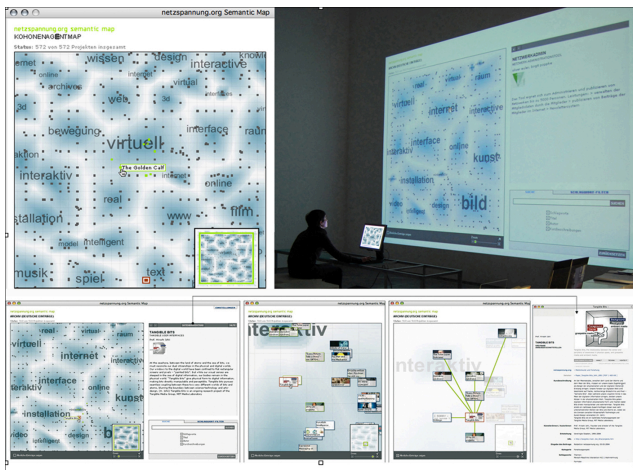

Figure 3. Semantic Map - Level of Detail, 2001-04. © Fleischmann & Strauss

The experience of browsing the *Semantic Map* is similar to walking through an exhibition, where the viewer sees more than just an isolated object. The *Semantic Map* represents the digital archive in a way that goes beyond the individual object and presents it as a *virtual cartography*. It aims to break down fixed categories and enable associative thinking. The *Semantic Map* is created using a *semi-automated artificial neural network* that changes its appearance with each new entry added to the database. The calculation iterates. Every new entry changes the map. This is an interface designer's nightmare, as it fails to place constants. But it allows the visualization of media art as a radar image of current events. *Roger Malina* describes the *Semantic Map* as a

visual system for the data cosmos. It has been shown internationally, including in the exhibition "*Resonance: Looking for Mr. McLuhan*"[23] at the *Pratt Manhattan Gallery* in New York City, curated by *Berta Sichel*.

The *Semantic Map* is an example of how humans and machines can work together in an *intelligence-amplifying* (IA) way, rather than being increasingly dominated by a black box of *artificial intelligence* (AI).

Some viewers were outraged that the map looked different every time they came back. Then they understood that's what it's all about. With each new project added to the archive, the size of each blue island and its position relative to each other changes, just as the relationships between them change as the archive grows. The S*emantic Map* is an invitation to active reflection on the new relationships.

Thinking Space #2: Navigating Databases with the Matrix Magnifier

The interface of *Matrix Magnifier*[25] (2005) follows the idea of a jukebox. It is based on the *Bubble Map* principle by *Ben Shneiderman*, who was inspired by the paintings of *Piet Mondrian* and their rhythmic lines. *Bubble Map* is a method of representing hierarchical data structures in the form of nested rectangles.
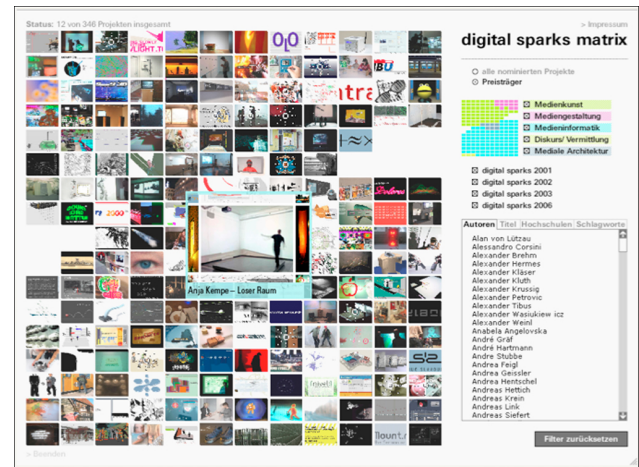

Figure 4. Matrix Web-DVD Interface, 2006. © Fleischmann & Strauss

Each rectangle represents a different data element in the digital archive. The magnifying glass allows viewers to zoom in and see additional text, images, and video related to the project. A subtle crackling sound accompanies cursor movements and clicks as an object is selected and the image is magnified. The DVD was distributed to the participating

GMD's Birlinghoven Castle, Sankt Augustin, Germany. http://netzspannung.org/about/workshops/knowledgemaps/en

[23] *Semantic Map* in *Resonance: Looking for Mr. McLuhan*, NYC, 2011. https://resonancelookingformrmcluhan.wordpress.com/artists-2/monika-fleischman-wolfgag-strauss/

[25] Matrix Magnifier: Browser for exploring multimedia databases using gesture driven PointScreen technology by Wolfgang Strauss, Monika Fleischmann et al. Mensch und Computer 2006, (Ed.) HM Heinecke and H. Paul, München: Oldenbourg, pp. 411-418.

universities as a teaching tool. It had a first print run of 1000 copies. The *Matrix* DVD of the *Digital Sparks* competition entries is designed to work like an app for the database. It is viewed on a computer connected to the Internet and set up as a classroom learning environment. Combined with *PointScreen,* a *Minority Report*[26] interface, the *Matrix Magnifier* was exhibited as a contactless driven installation on the topic of *Knowledge Archives* (2008) at the Edith Russ House for Media Art in Oldenburg and in YOU_ser (2007-2009) at the ZKM Karlsruhe, curated by *Sabine Himmelsbach* and *Peter Weibel*, respectively.

The gesture-driven matrix, even more than the mouse-driven screen application, is the embodiment of the *serendipity* pattern of accidental discovery. It is the serendipitous observation of something not originally sought as a new and surprising discovery. Here we find a link to quantum chance through *serendipity*. Chance is the backbone of quantum technologies today in quantum entanglement. Serendipity becomes a parameter for the ability of an information system to find useful information despite an overabundance of data.

Figure 5. Touchless *PointScreen* with *Matrix*, 2006 © Fleischmann & Strauss. Inspired by *Theremin* creator Lev Thermen, 1917

PointScreen was also a preview of the post-pandemic interface. You want to avoid touching anything unnecessary. PointScreen captures the electrostatic aura of the visitor, reversing Walter Benjamin's question about the aura of a work of art. Now it is the electric aura of the human being that is of interest. *PointScreen* is a *biosensorial* interface that can measure the neuro-biological state of the human being.

Thinking Space #3: Media Flow – the Transformative Power of the Flow
Thoughts in flow, that's what the *Media Flow*[27] (2006) stands for. The interface displays parallel streams of images

and words running across the screen, allowing the viewer to easily access and browse a large collection of media, such as images and documents. Projects and people, as well as titles, authors, and keywords from the entire archive stream move before our eyes. The terms are spoken by computer voices using text-to-speech technology.

Figure 6. *Media Flow* Browser layers, 2007. © Fleischmann & Strauss

A large archive with thousands of documents is usually impossible to understand at a glance. With *Media Flow*, it is a matter of minutes. Zooming allows for flexible search and retrieval and brings related documents to the forefront. The reader selects individual terms like loose threads in a fabric, and guided by his or her own associations, new knowledge emerges.
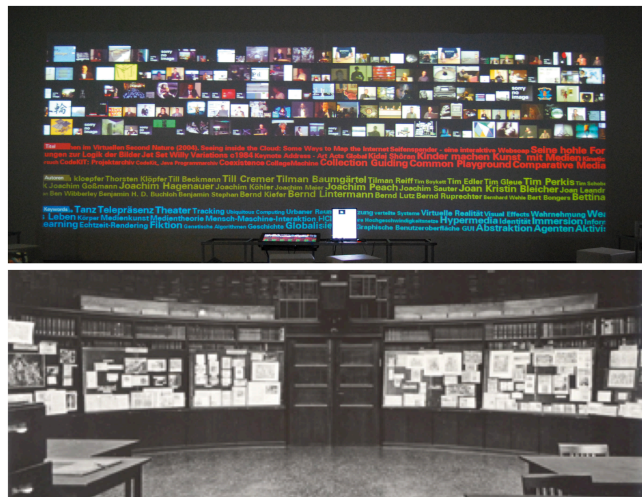

Figure 7. *Media Flow* installation, 2007 © Fleischmann & Strauss. Commemorating *Aby Warburg's Thinking Space*, 1925.

There is a surprising visual similarity between *Media Flow* and *Aby Warburg's Denkraum*, 1925 (Thinking Space) became apparent. It is the spatial installation of *Media Flow*

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[26] PointScreen - Minority Report Interface (2003).
bit.ly/PointScreenMinorityReportHCI

[27] Media Flow (2006 / 2008) by Fleischmann & Strauss, Video,
bit.ly/MediaFlow-Medienfluss

that transforms the digital archive into *a space of thought in motion*.

An important part of the exhibitions are encounters with students and their teachers, who can drop in and give ad hoc lectures using the media flow installation, as in ZKM, or teams of researchers getting to know each other while doing research, as in the exhibition "*WissensArchive*" in the Edith Russ Haus Oldenburg. Participants not only retrieve information from the database, but also process it directly and interact with the archive browser and other visitors.

Figure 8. *Media Flow* - Learning Environment 2007.
© Fleischmann & Strauss

The installations have been the subject of major solo exhibitions at ZKM Karlsruhe, Museum Weserburg in Bremen, Laznia[28] in Gdansk, Poland, and in Shenzen China between 2006 and 2011.

Looking at Aby Warburg's "Denkraum" – the archive as a space for thinking

Can *Aby Warburg's* way of thinking be considered a precursor of artistic positions dealing with digital information overload? The art historian *Daniel Becker* has discovered affinities between Warburg's picture atlas *Mnemosnye* and the online platform *netzspannung.org*, which aims to encourage the creation of new connections and relationships by browsing through the database.

In this respect, the work resembles the atlas in that connections and links lead to a genealogical process of knowledge formation. The participants are given a crucial position in this process: They can create their own new relationships.[29] *Becker* notes that the authors address the issue of information being consumed ad hoc and no longer reflected upon. "Yet Fleischmann and Strauss deal with precisely this problem in their works." Their work "consequently enriches the discourse around collections of knowledge, as the focus here is not – as with classic archive research that is connected with prior knowledge – on the targeted search, but rather on rummaging and finding. This affirmation of media-genuine 'surfing' in the sea of data of an online database registers in a long history of concepts about memorization, archiving, and data collection."[30]

It is not primarily a matter of finding known information, but of searching and browsing in unknown contexts. The database interface, in which the process of linking by the participant becomes relevant in a kind of contemplation, perhaps digitally updates *Aby Warburg's thought space*. A form of intelligence amplification takes place.

The performative interface creates a space where relationships can be actively experienced rather than merely represented. The authors see the interactivity of the performative interface as a contemporary strategy "to aesthetically intervene in the internationally operating media industries and to create a third space between the poles of fusion," as *Yvonne Spielmann[31]* puts it, a space of thinking. The performative interfaces introduce a participatory role for the viewer as a data performer, the viewer becomes a "theorist" through his or her action or reaction, demonstrating what the displayed material evokes in him or her. In this way, the archive becomes a thinking space, a place where thinking is done by doing, and connections are made by observing.

Conclusion

The knowledge discovery interfaces created by *Monika Fleischmann & Wolfgang Strauss* in the early 2000s were early manifestations of the emerging *Information Arts*[32] (2002), as described by Stephen Wilson in his book of the same name. Since then, other advanced interface solutions have emerged. But in 2009, a visitor to the *Ars Electronica Center* remarked that she "couldn't understand anything anymore" when navigating a cloud of millions of pieces of data. Much work remains to be done, and the question remains as to how AI should be used to further explore *the digital archive as a space for thinking*.

Nevertheless, the *Semantic Map* (2001/2004) was one of the first interfaces to show new patterns of *searching and finding* in the *Thinking Space*. Section *Thinking Space* #1

[28] Performing Data - Monika Fleischmann & Wolfgang Strauss, Katalog by Laznia Centrum, Gdansk, 2011. www.research-gate.net/publication/224904108_Fleischmann_Monika_Strauss_Wolfgang_Performing_Data

[29] Becker, Daniel. 2017-01-09 Atlas or oracle? The concept of the archive between Warburg and the online database. https://zkm.de/de/magazin/2017/01/atlas-oder-orakel

[30] cf. Becker, Daniel. 2017

[31] Yvonne Spielmann Hybridkultur, 2010. www.suhrkamp.de/buch/yvonne-spielmann-hybridkultur-t-9783518295724

[32] Other major writings of the time: Lev Manovich, "The Language of New Media" (2001), Oliver Grau, "Virtual Art: From Illusion to Immersion" (2003), Christiane Paul, "Digital Art" (2003), Roy Ascott, "Telematic Embrace" (2003), Edward A. Shanken, "Art and Electronic Media" (2009).

describes this process. The *Semantic Map* combines concepts of Artificial Intelligence AI and *Intelligence Amplification* (IA). Computer scientist *Frederick Brooks* argues "that intelligence amplifying systems can, at any given level of available systems technology, beat AI systems. That is, a machine and a mind can beat a mind-imitating machine working by itself."[33]

Based on elementary forms of *artificial intelligence*, such as an *artificial neural network* for *semantic text analysis* and *Kohonen mapping*, all presented archive interfaces are realized as two-dimensional interacting layers. Time-based *semantic surfaces* act like a skin of the archive. They were created with the above-mentioned technologies from a data volume of about 100 megabytes, which took days and weeks to compute and monitor due to the computing power available at that time. Therefore, the attempt to represent multidimensional structures was abandoned.

The authors work on the shift from the industrial to the performative interface. From "*what you see is what you get*" to "*what you get is what you did not see*". While the *Semantic Map* focuses on the interactivity between the participant and the networked information, the *Media Flow* application demonstrates media-mediated communication between participants, as described in *Thinking Space* #3.

AI methods can be used to better organize and classify content in the digital archive, making it more of an *interactive thinking space*. For example, *natural language processing algorithms* could automatically tag media files and categorize them based on content and context, as shown in the *Semantic Map*. This would make it easier to search and navigate the archive. It would help discover and explore unexpected connections and relationships.

Finally, as *thinking spaces* within the archive, AI could be used with virtual and augmented reality to create immersive, interactive experiences. An artificial neural network that automatically learns from training data would be implemented as a thinking space in the archive. For example, machine learning algorithms that can automatically learn from training data could be implemented to generate interactive, walk-through exhibits of the archives. Archivists could leave knowledge traces in the archive for other staff as they use it. Visitors would be surrounded by a 3D learning space. The archive would become a learning space not only for the learner, but also for the Media Flow interface. Both would evolve and "learn" through performative actions.

What's unique about ChatGPT's AI is its ability to combine natural and artificial intelligence. The interactivity of the operator plays a particularly important role in the quality of the survey. However, caution must be exercised in the use of information, given the proliferation of misinformation and fake news. It is also important to consider the need for diversity and inclusion in the development of AI, as well as the cultural attitudes and political leanings that go into programming and training AI. Another issue with AI is its energy consumption, which will contribute to the climate crisis, and the potential for AI-generated content to deceive and defraud creators and consumers. If humanity is to avoid a further acceleration of the climate crisis and a senseless plunge into the abyss, energy-efficient computing alternatives must be adopted. As a society, we need to decide whether we want to continue to automate, or whether we want to sharpen and strengthen our own intelligence and develop spaces for cross-disciplinary thinking.

Acknowledgements

References

Books
[1] Monika Fleischmann and Wolfgang Strauss, *CAST01//Living in mixed realities* (FhG – ZPS, Birlinghoven Castle), Proceedings 2001, netzspannung.org/version1/cast01/proceedings/index.html

Edited Books
[2] Monika Fleischmann and Wolfgang Strauss, "New Media Arts – the Thinking Space for Digitality." In *Creating Digitality*, ed Anthony Brooks (Springer 2023, to come)
[3] Monika Fleischmann and Wolfgang Strauss, „Staging of the Thinking Space: From Immersion to Performative Presence", in *Paradoxes of Interactivity*, eds Uwe Seifert, Jin Hyun Kim, and Anthony Moore (Transcript, 2008), 266-281. bit.ly/CreatingPerformativePresence
[4] Monika Fleischmann and Wolfgang Strauss, "On the development of netzspannung.org - An Online Archive and Transfer Instrument for Communicating Digital Art and Culture", in *Present Continuous Past(s)*, eds Ursula Frohne, Mona Schieren, and JF. Guiton (Springer, Vienna 2005) bit.ly/Netzspannung

Journal article (online)
[5] Monika Fleischmann, Andrea Helbach, "CAT - Communication, Art, Technology: History of a project - step by step." The CAT feasibility study is the program for developing the Internet platform netzspannung.org, netzspannung journal 2001

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[33] Brooks, Frederick P. Jr. "The Computer Scientist as Toolsmith II." *Communications of the ACM*, vol. 39, no. 3, 1996, p.64.

http://cat1.netzspannung.org/version1/journal/issue0/cat-history/index_en.html
[6] Wolfgang Strauss, Nina Zschocke, "Explore Information / Create Knowledge", netzspannung.org/media-art/explore-information/ 30.08.2004.

Websites
[7] ADA digitalartarchive.at
[8] MediaArtNet www.mediaartnet.org
[9] netzspannung.org/about/en
[10] Netzkollektor netzspannung.org/netzkollektor/en, Digest#4 Artistic Works netzspannung.org/netzkollektor/digest/04/en
[11] Digital Sparks Student Media Project Competition and Talent Scout. netzspannung.org/digital-sparks/en
[12] netzspannung.org - Plattform für interaktive Medienkunst und die Lehre mit Neuen Medien. zkm.de/de/projekt/netzspannungorg
[13] Semantic Map Wolfgang Strauss, Monika Fleischmann et al. 2001 bit.ly/Semantic-Map

Proceedings Paper Published
[14] Jasminko Novak, Monika Fleischmann, Wolfgang Strauss et al., "From Memoria Futura to i2TV: A Technological Framework and Two Models for New Forms of Cultural Participation and Production in Mixed Realities". ICHIM (1), page 27-41. Archives & Museum Informatics, Pittsburgh, PA, USA, (2001) bit.ly/MemoriaFutura-i2TV
[15] Monika Fleischmann, Wolfgang Strauss et al, "Netzspannung. org - an internet media lab for knowledge discovery in mixed realities". Paper based on a talk presented at Birlinghoven Castle at the launch of netzspannung.org as part of the conference CAST01//Living in Mixed Realities, page 121-129. Sankt Augustin, Germany (2001) bit.ly/KnowledgeDiscoveryLab

Authors Biographies

Monika Fleischmann (*1950 in Karlsruhe) and Wolfgang Strauss (*1951 near Nuremberg) are a German artist duo who have been working with digital media as a combination of art and technology since the mid-1980s. They founded their ARTWORK studio in 1987 and co-founded the ART+COM Institute for interdisciplinary research in Berlin; established the MARS - Media Art & Research Studies Lab at GMD Institute for Media Communication and Fraunhofer Institute for AI and Robotics. Their pioneering work began with "Berlin-Cyber City" (1989) and working with maps of the city as part of the research project "New Media in Urban Space" was the impetus for further ART+COM projects, that led to the dispute with Google Earth depicted (not entirely accurate) in the Netflix series "The Billion Dollar Code". They have received numerous awards for their pioneering work, including the Golden Nica of Ars Electronica (1992) and the SIGGRAPH Lifetime Achievement Award in Digital Art (2018). Their focus is on the "Virtual Denkraum" and the power of images in shaping our perception of the world, with a specific interest on 'performative interface' as a tool for knowledge discovery and creation through interactivity.