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Four Spaces
A digital media approach to the history of computer art

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Biographical Remark
Frieder Nake is a professor of computer science at the University of Bremen. His doctoral degree in mathematics is from the University of Stuttgart. Before coming to Bremen in 1972, he was a postdoctoral fellow at the University of Toronto and an Assistant Professor in Computer Science at the University of British Columbia in Vancouver. In the 1960s, he pioneered computer art. His work was recently exhibited under the title „Frieder Nake: Die präzisen Vergnügen“ (The Delights of Precision) at Kunsthalle Bremen (Nov. 2004 to Jan. 2005) and at ZKM Karlsruhe (Feb. to April 2005).

Abstract
The compArt project is creating an elaborate dynamic digital medium for computer art. It is based on a space metaphor. The concept here extends from the physical space of everyday experience to the semiotic spaces of art history, or mathematics. Digital art history should not only use the means any historic recording is using. It should creatively turn to its own media basis. We propose that artefacts, in the process of becoming works of art, exist in the artist’s studio, the gallery show room, and the cultural space of art criticism. Four subspaces of he compArt medium will be described (facts, works, art works, study).

Keywords
Computer art, digital art, algorithmic art, history of computer art, digital media, space metaphor, algorithmic sign

Introduction

Design of digital media is often considered a task in spatial design. But space and time are both useful concepts in understanding the world around us. As semiotic animals [1] we create layers of signs to cover up phenomena of the environment.

In spite of the apparent intangeability of information spaces, a new awareness is emphasizing location, extension, and body. Current analyses prefer space over time. [2]

We believe that we "enter" a space, stay there, and leave it behind. We also believe that time "passes by". Less naively, we would conclude that, instead of entering, we create space, and we create time rather than observing it passing by. Living is "generating" time and space.

This essay is on the early history of computer art. I will use the idea of space as means to organize data and processes relevant to that history. History is our product of combining temporal things of the past. We would, therefore, not usually expect spatial categories to be applied to it. But the connectivity of digital spaces allows for a new kind of representing events in contexts. That makes a spatial approach attractive.

A Google search generates results within (almost) no time. This comes at the expense of space: the search results are spread out in space, and we must wander around it in order to discover. The objective side of digital media may therefore be better understood from a space, than from a time perspective. This would constitute an interesting shift of awareness concerning the computer. the necessary, yet hidden, component of digital media is a computer as the kernel of digital media. Efficiency of time would be supplanted by observation of space. [3]

Computing has become quite ubiquitous. The media perspective has outscored the tool perspective of computing. Even if "space" appeared as a naive concept in dealing with media, it could be used metaphorically in their design. At the University of Bremen, we do so in developing an elaborate dynamic digital medium for computer art.

"Computer art" is here the generation of aesthetic objects with the aid of software on a digital computer. Its history has started in 1965. Three exhibitions took place that year, which are acknowledged as first public presentations of digital art: Georg Nees at the Studiengalerie of the University of Stuttgart (February 5-19, 1965); A. Michael Noll and Bela Julesz at Howard Wise Gallery, New York (April 6-24, 1965); Frieder Nake and Georg Nees at Galerie Wendelin Niedlich, Stuttgart (November 5-26, 1965). [4] More artists made their public appearance within the next few years. A small but lively crowd experimented with equipment that would today make shiver in pure disbelief.

About one generation's time has passed since then. This seems to be the amount of time against which a phenomenon must survive before it is accepted as of historical relevance. Paul Brown with the CACHE project is one of the most enthusiastic activists securing the origins of digital art. Others [5] play important roles, too. They seem to converge on one aspect.

In the rapidly changing field of digital arts, it may be irrelevant to identify similarities and differences of first beginnings. What should we hope to learn from those forgotten times? Technology was so terribly restricted that nothing could possibly be of any interest to an artist today. But inspite of the huge progress made on all "quantitative" counts, it seems likely that a few fundamental concerns of a "qualitative" nature emerge. The idea of algorithmic art – first conceived in the 1960s – is such a powerful principle. It is not only lasting till today but is gaining power as the digital arts spread. The new aesthetics, Lev Manovich says, is to be found in the engine of the new culture: in software.

What is still to be discovered, and fully to be acknowledged, is the character of digital art as “algorithmic sign”. In following Max Bense, I consider the work of art as a complex sign [6]. Digital works are semiotic creatures, too. Their semiotic existence is transformed into an algorithmic state when they get pushed through the computer interface. [7] This theoretical background is important for our project in Bremen. We hope to be able to provide valuable service to the digital art community in the following way.

The abstract space for computer art should eventually contain everything in the field. The space is a digital medium combining three types of activities:

- delivery: typically done by an artist, critic, or curator. Facts, events, processes are delivered as data to our server for inclusion in the medium.
- demand: typically carried out by a researcher, teacher, or everyday person wanting to learn something about computer art.
- deposit: carried out by media specialists on-site. They check and cross-check all data delivered to the server, before they grant certified entry into the data base.

Our maxim is to guarantee the correctness of data maintained in the space, to collect everything within well-defined boundaries, to be up to date to a defined point in time, and to provide joyful and pleasing modes of interaction. Currently, we are busy with design principles, and a series of bottom-up studies for the period into the 1970s.

The following sections describe the purpose and state of the subspaces of the compArt digital medium. An outlook on future work concludes the contribution.

General assumption

We assume the following simple, yet powerful, perspective on the world of art. Persons called artists produce works (artefacts). They want these to be more than pure “works” (i.e. results of work): they want them to be “works of art”. Often, they claim that to be the case. Subjectively, they are right. But everybody may declare what she has produced to be a work of art. In the end, only an abstract and complex network that we call “society” turns works into works of art. Briefly, the artist generates the work, society generates the work of art.

Such a starting position may sound odd. Its strongest proponent was Marcel Duchamp. The active artist is, of course, dreaming of that great piece of art she is making. But left alone, she has no chance. A gallerist must be willing to exhibit the work, a critic must write about it, an art magazine must provide space to reproduce the artist's work, teachers should start telling their students about it, art historians should mention it at least in passing, more art shows should include it, postcards should be printed, etc. Society must be ready and work hard if our artist's work is to become a work of art. Artistic production leads to the work, critical consumption leads to the art.

Our hypermedium for computer art takes up this basic idea. It is subdivided into three layers with four sub-spaces. The middle layer is occcupied by the space of works and the space of art. The top layer is the space of study, and the basic layer that of facts. We now look at those four spaces in turn.

The space of works

The artist produces her work in her studio. The traditional way of presenting it to the public is a gallery show. The gallery is the place for the transition from work to art. We decided to design the space of the works as virtual construction of a gallery.

To rebuild a gallery scenario as virtual reality can create a trap of kitsch. We nevertheless present the sites of major events of earliest computer art. The first candidate is the Studiengalerie of TH Stuttgart, the place of Nees' first show [8]. We have reconstructed it from verbal description, drawings, and photographs. It was a revelation when we found a floor plan. [9]

Second is the Howard Wise Gallery in New York, where A. Michael Noll and Bela Julesz first presented their works. The gallery no longer exists. It seems to be hard to get data of it, but we are working on it. Galerie Wendelin Niedlich in Stuttgart was site of the third show in 1965. We have completed a virtual reconstruction of its main room. [10]

A second group of historic places comprises the sites of breakthrough events: the Institute for Contemporary Arts in London, and the locations of the Tendencies 4 events in Zagreb 1968/69. They should be followed by more, notably the pavillons at the 35th Venice Biennale in the summer of 1970 where an experimental exposition was arranged.

The virtual reconstruction of a gallery must compete with photographs as the main medium so far to transfer an impression of time and place. The goal of authentic pictures must minimize the kitsch factor that results from the discrepancy between the enormous effort for realistic visual appearance, and its futility. Historic places may also be used to display works in phantastically expanding environments. Exhibits would act as algorithmic interfaces to the space of data. Therefore they may change.

We define the task as the quest for virtual documents of historic interest used as database interface of inherent digital aesthetics. Photorealistic and non-photorealistic rendering should be combined in creative ways.

The space of art

Even if only virtual, we navigate the gallery in accord with our physical body experience. The work may become a work of art when it is put into appropriate contexts. Contexts transform physical works into mental artworks. The work of art is a mental construct, not a physical given. As such it is a sign.

Virtual navigation in the space of art should appear like mental navigation. No ground under the feet, but phantastic encounters of light when floating in empty spaces. Free navigation stands for putting-into-context. New experientience for the visitor.

We attempt to do this by reducing entities to simple geometric objects in a vector field of attraction and repulsion. Visitors observe the effect of the sum total of those forces. [11] The scene is in a state of permanent movement – a metaphor for the constant re-evalutation of works, artists, or styles.

To the visitor, the field of art appears as a look into a dark infinite space. Stars appear and go, as the visitor silently flows through that world. He gets himself into areas of strong attraction between objects, or in quiet areas.

This space of art is a visual metaphor for a very large dynamic data set. [12] We do not expect the one best way of visualization for it. Our approach emphasizes openness and renewed interpretation. „Find, don't search!“ is the motto for navigating the space of art. [13]

If searching requires symbolic formulation of a query and a powerful heuristic algorithm, finding depends on the leisure and aesthetic pleasure of diving into an unfathomed space with nothing much in mind but the expectation of unexpected discovery. Such a space must provide surprise and joy.

Both modes have their advantages. If I know fairly well what I need to find, the symbolic method of logical query is helpful. If I know only vaguely what I want, the iconic method of physical movement is preferable.

The space of study

We provide "virtual laboratories" making up the space of study. Virtual laboratories are dedicated to historic examples of computer art, but topics could be of more general nature as, e.g., color, randomness, or symmetry. The space of study will grow and shrink as topics appear and loose interest.

Manfred Mohr's algorithmic art uses features of the 6D-hypercube to algorithmically define paintings of hard colored polygonal areas. Though the picture looks random, the artist knows the very precise background.

With a simple software tool it is possible to explore part of the background. Applying our "deviceX" to Mohr's pictures, we transform geometry into topology – a step of abstraction. Areas and edges can be made to blink to help identify the path from the geometry panel to its topography equivalent.

Visual intuition of high-dimensional Euclidean space is nearly impossible. Manipulating aspects of it may, however, create an understanding beyond mathematics. Manipulation, combined with immediate visual feedback, may pave the way to partial insight. Observation of people using deviceX encourages us to continue along this line.

We have developed other virtual laboratories. [14] We expect the combination of historic data, their visualization, and aesthetic experiments to result in a new attitude towards art history – history created from exploration, rather than memorized as collections of data.

One aspect of art appreciation is "immediate" pleasure. We are emotionally, intellectually, or morally moved by the immediate impression of a work. There are many ways of indirect learning about the work, artist, or epoch. Any such knowledge influences our appreciation. We call that the "mediated" pleasure.

There is a third kind of appreciation. The various mediations leave the work itself untouched. It is treated as a distant object from which statements are inferred, i.e. signs are produced. But there is an approach that changes the work, and leaves it unchanged. How is that possible?

The artist's work is the canvass covered with paints, a piece of matter. It has no other purpose but to become the reason for sign production. We wrap the work into contexts: we appreciate it by involving it in semioses.

Signs, other than pure matter, may be changed but returned to their original form as if they had been left untouched. [15] We call this class of signs the "algorithmic sign". [16] It exists on the digital medium. It appears visibly on the surface of digital media and, at the same time, invisibly deep inside storage and processor. Metaphorically, we may dive into it, intrude it, and leave it again. But when we leave it, it snaps back to what it had been before.

The algorithmic sign is the mode of existence of computer artefacts in general, and of works of computer art in particular. In the digital domain, semiotic processes may appear

as if they were characterized by "unchanging change". It guarantees that we may take the work apart without altering it. The space of study allows for exactly this kind of mediated encounter. The work appears as interface to its construction.

The space of facts

Everything that appears in one of the spaces of works, art, or study consists of a fact and an appearance. The fact is what remains constant in all its various perceivable appearances.

The facts make up the world of computer art. This view is highly problematic, but we are safe with an extensional view of the space of facts as implementation of a relational data base.

Central to the data base schema are the entities of work, artist, and exhibition, plus a few more. The data base will eventually be the most precious part of the space for computer art. [17] When you search the WWW, you will be surprised about the discrepancies and blatant errors you find. Our goal is to achieve 95%, and more, of completeness, correctness, and consistency.

Completeness is to a large extent a matter of definition and exclusion. What do we define to belong to computer art? To start, we collect data from 1965 to 1970, but extend this into the 1970s. We prefer a pragmatic approach. Only humans can decide. They change their former decisions under the influence of growing insight. Therefore, we prefer a social process of collecting „facts". Selected artists will be asked to enter their data by submitting them via the Internet. Others will later add theirs, and the dynamics of the process will emerge.

We will set up a local organization to cross-check all arriving data before release. Cases may take considerable amounts of time. Categories of validity may become adviceable, as e.g.: certified, plausibly reliable, communicated.

The software system itself will play an important role. The interface must be intuitively clear for artists to participate. The interface must aesthetically appeal to them. It must allow for unexpected requests, proposals, complaints, or errors. We are working on this and hope to come up with an attractive solution. But it will remain a matter of subjective judgement.

Conclusion

I have presented an overview of the compArt approach to the early history of (visual) computer art. Its features are (i) a spatial metaphor as design background for an elaborate hypermedium, (ii) trust in social networks and their distributed potential to generate reliable sediments of data, (iii) gradual bottom-up development of software combined with top-down projection of theory.

Up to this point, our efforts have gained general support by the University of Bremen. We have relied on, and tremendously gained from, students in their project and thesis work. Steps have meanwhile been taken to ally with specialists of art history at the Kunsthalle Bremen. We are optimistic that even under current circumstances a concentrated financial support will be possible.

Acknowledgement

I am indebted to a large number of co-workers and students who have discussed concepts with me, and have contributed to first implementations. I am glad to acknowledge the help

by many friends from the earliest times of computer art, too many to include here. I restrict the list of names to only those who have actively contributed to the current state of the compArt medium. They are Hermann Cordes, Lars Fehr, Andreas Genz, Leif Genzmer, Sven Goeckels, Pablo García González, Susanne Grabowski, Oliver Graf, Eva-Sophie Katterfeldt, Jörn Ketelsen, Matthias Krauß, Yan Lin-Olthoff, Tim Wendisch. I mention only one of all my arts friends: Manfred Mohr. He continues to be, a great source of inspiration. Behind the scene is Paul Brown.

Notes

[1] The German mathematician, Felix Hausdorff, used the pseudonym Paul Mongré when he identified the human as the semiotic animal. The concept is being discussed in semiotic circles.

[2] A beautiful recent book celebrates space as a human product. Contributions by architects, artists, writers, philosophers, sociologists are collected in Tom Fecht and Dietmar Kamper (eds.): "Umzug ins Offene. Vier Versuche über den Raum." Vienna, New York: Springer Verlag 2000 (mostly in German)

[3] This is clearly an exaggeration. The development of computer programming is the permanent dialectics of time (efficiency of algorithms) and space (organization of data structures).

[4] The picture changes slightly, when we closely look at the time when these researcher-artists started their experiments in algorithmic art: Noll in 1962, Nake in 1963, Nees in 1964. All these dates refer to "digital" art and computers. Ben F. Laposky had started to work with analogue equipment in 1952. Herbert W. Franke followed in Austria in 1959, and Kurd Alsleben in Hamburg around 1960.

[5] Without attempting any completeness, I only name Annick Bureaud, Herbert W. Franke, Roger Malina, Mary Ann Spalter.

[6] An early source for this, though in German, is: Frieder Nake: "Ästhetik als Informationsverarbeitung". Vienna, New York: Springer Verlag 1974

[7] Peter Weibel acknowledges the importance of the paradigm of algorithm in the exhibition, „The Algorithmic Revolution" (ZKM Karlsruhe 2004/05).

[8] Until late into the 1960s, the University of Stuttgart was a Technische Hochschule (TH), comparable to an Institute of Technology in the US.

[9] Oliver Graf together with Leif Arne Genzmer and Eva-Sophie Katterfeldt have contributed this work as part of their B.Sc. (Digital Media) project. Thanks for help go to Karl Herrmann, Elisabeth Walther, and the Südwestdeutsches Archiv für Architektur und Ingenieurbau in Karlruhe.

[10] Yan Lin-Olthoff completed her B.Sc. in Digital Media with this project. Wendelin Niedlich himself critically reviewed it.

[11] Sven Goeckels implemented the first prototype as part of his thesis work in computer science. Hermann Cordes is working on an improvement.

[12] Jock Mackinlay & Ben Shneiderman (eds.): "Readings in information visualization". San Mateo, CA: Morgan Kaufmann 1997

[13] I don't search, I find, Picasso is reported to have said.

[14] deviceX was designed and implemented by Matthias Krauß. Jörn Ketelsen and Hermann Cordes have contributed further examples of study experiments. Susanne Grabowski has conducted several design classes with students using some of the implementations.

[15] This sloppy formulation mistakes the whole sign relation for one of its components, its syntactics. Only the syntactics of the sign returns to original form.

[16] Unfortunalety, currently only a German reference can be given: Frieder Nake: Das algorithmische Zeichen. In: W. Bauknecht, W. Brauer, Th. Mück (eds.): "Informatik 2001. Tagungsband der GI/OCG Jahrestagung 2001". Bd. II, 736-742

[17] Pablo García González has developed most of the data base schema, and has implemented a first prototype. Lars Fehr and Tim Wendisch are continuing this work.

Figures

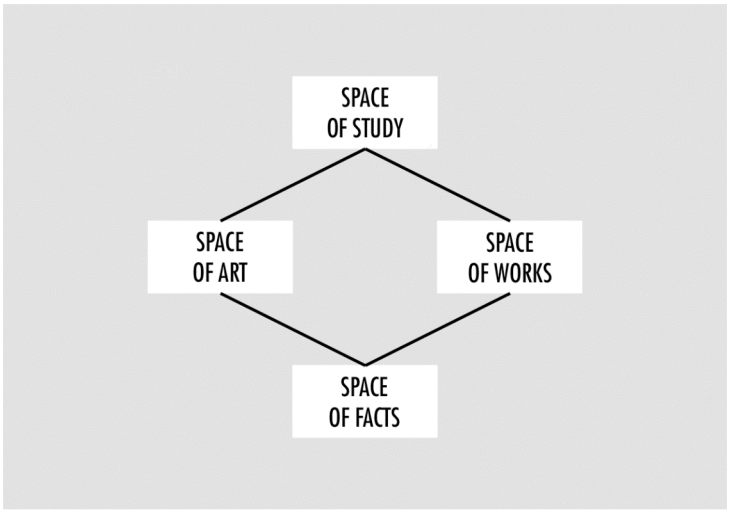

Fig. 1. Schema of the space for computer art

Fig. 2. Space of works: view of virtual reconstruction of Galerie Wendelin Niedlich Stuttgart in the 1960s (from Yan Lin-Olthoff's thesis)

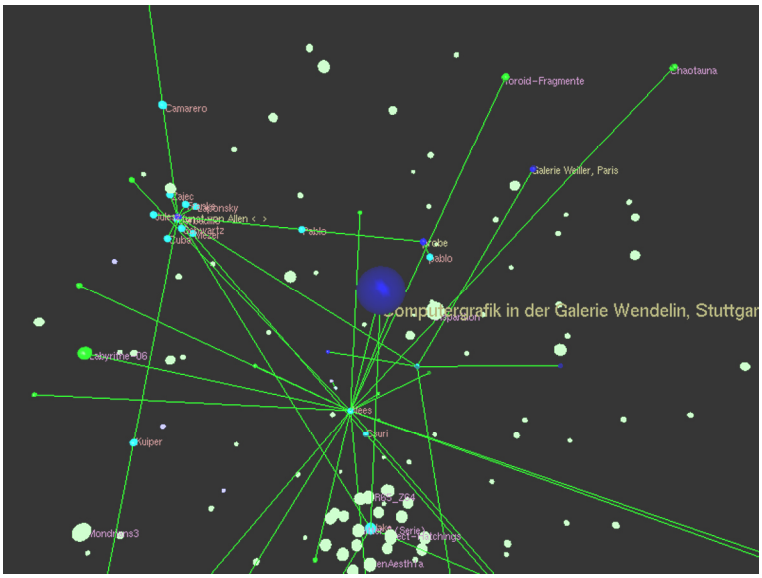

Fig. 3. Space of art: view of entities and relations in fantastic field of forces (from Sven Goeckel's thesis)

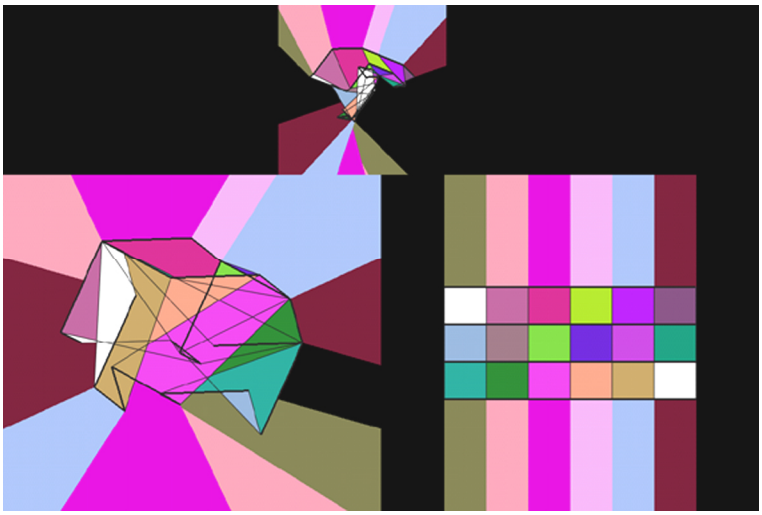

Fig. 4. Space of study: interface to deviceX; geometry lower left; topology lower right; slider, top, on its way (courtesy of Matthias Krauß)

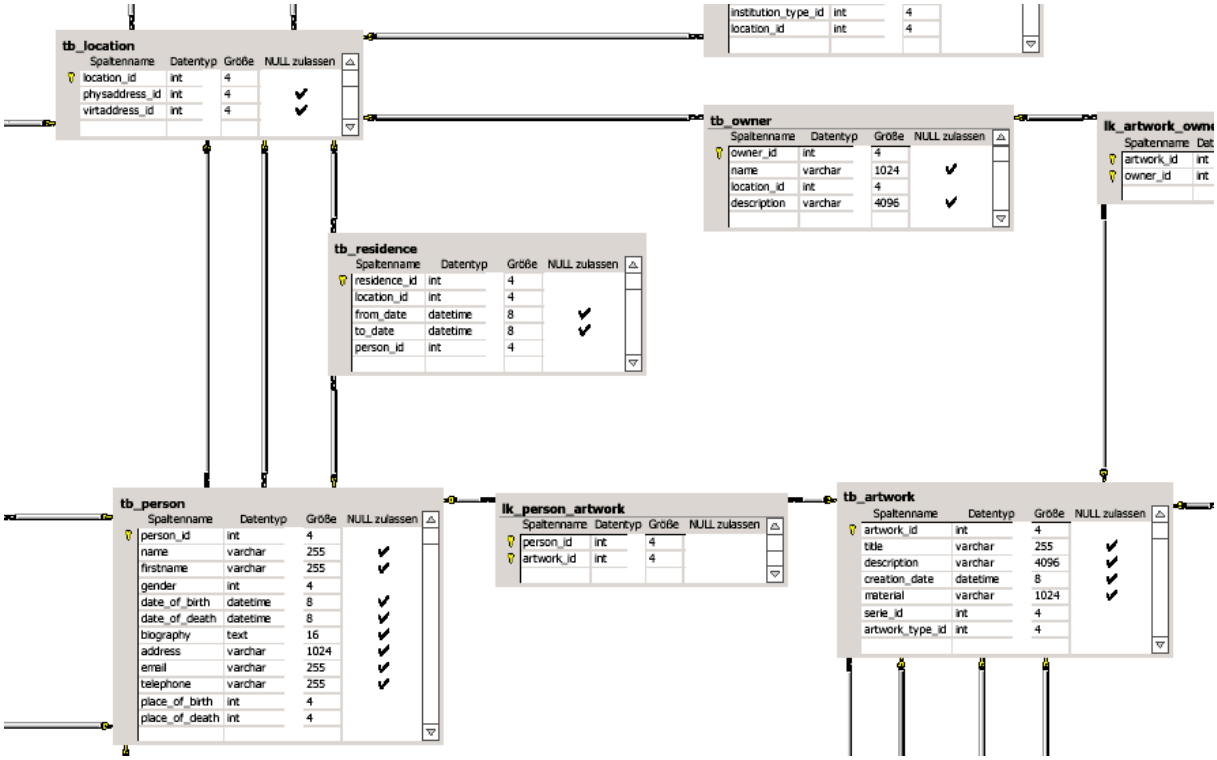

Fig. 5. Space of facts: detail of relational data schema (from Pablo García González' thesis in Lars Fehr's adoption)