The consecution of uncertain knowledge, hypotheses and the design of abstraction

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Abstract: The paper describes the necessity of architectural design in the process of creating abstract geometry as representation of archaeological hypotheses in opposition to pretended reconstructions.

Methodology: How were the objectives reached? Which methods were used?
Knowledge in archaeology, building or art history is generally of largely different certainty including contradictions and multivalencies, which unambiguously excludes true reconstructions in the sense that the reconstruction equals its origin. Instead there is a number of hypotheses that approximate the historic state. The visualisation of hypotheses with a special regard on uncertain knowledge, i.e. respecting and explicitly showing this uncertainty, is a counter position towards pretended reconstructions.

Results: What are the results of the work?
A number of projects e.g. in cooperation with the German Archaeological Institute DAI, the State’s Museums in Berlin SMB (e.g. the first scientific 3D model of Pergamon and the Palatine palace in Rom, both presented in the Pergamon Museum Berlin), the Museum for Islamic Art Berlin (e.g. the Sasanian metropole Ktesiphon), funded by the German Research Foundation DFG and as part of the DFG Excellence Cluster TOPOI (mainly hosted by the universities FU Berlin and HU Berlin) that successfully visually mediated the state of science and its scientific characteristics among the scientists as well as to the public.

Innovations: What is new and significant about your ideas, methods, and results?
The visualisation of hypotheses has a higher scientific impact incorporating uncertain knowledge as inevitable characteristic of science. One way of visually expressing different possible states in one image is the use of abstract geometry. This implies a highly qualified handling of abstract geometry (model making) and imagery (architectural photography) being a creative act of design with effect on the inner-scientific and public perception of the historic topic. So qualified architectural design makes the difference.

Keywords: visualisation, uncertainty, hypothesis, abstract design

Introduction
There is a common understanding of the meaning of \textit{uncertainty, knowledge and hypotheses} whereas \textit{uncertain knowledge} seems to be contradictory at first. Also, the expression \textit{design of abstraction} seems ambiguous since design usually describes the very concrete shaping of forms whereas abstraction is rather a matter of the fine arts. In the following these expressions will be examined in order to create an understanding for the necessity of design in the context of visualizing scientific contents in archaeology, building history and also art history (Fig. 1).
Basics

The expression *uncertain knowledge* underlines the large and productive field between knowledge on one hand and the lack of knowledge on the other hand pointing out the other states of knowledge in between.
Uncertain knowledge takes into account incomplete knowledge, e. g. if some parts of a structure are known while other parts are unknown, but also contradictory knowledge, that is if the stringent deduction of prerequisites allow contradictory yet equivalent conclusions. Incomplete and contradictory knowledge is then summarized as uncertain knowledge. Uncertain knowledge and knowledge at all is not to be discussed in a philosophical way, that is regarding the question if knowledge exists at all. Knowledge in the present context of archaeology and visualisation assumes that within this scientific field of archaeology, building history and architecture certain issues and facts are regarded as certain, as well-known and beyond all question. While the certain and undoubtful scientific knowledge in archaeology is mostly based on findings, that is artefacts in situ, hypotheses on the other hand, with reference to closer respectively further analogies, hypotheses about their function, context and meaning are developed as an attempt to a better and overall understanding of relations, provenance and so forth. But as soon as these analogies are ambiguous or just numerous, there is a number of several, possibly even equivalent hypotheses created in contradiction to each other.

**Visualization versus depiction**

The depiction of certain knowledge is a matter of straight-forward, realistic simulation. But in all other cases, where knowledge is not sufficient for a realistic simulation, usually fictional additions that do not refer at all to scientific knowledge are attached in order to enhance the overall vividness, relating to the cineastic experience and conviction that the depiction of pure phantasy is broadly and easily accepted. Contrarily to the movie industry strategy, the subject of the following is the visualisation of uncertain knowledge. Uncertain knowledge occurs in a wide range and in a large variety and scale. This makes the Visualisation of Uncertainty an infinite challenge and worth a deeper examination (Fig. 2).

Fig. 2 – Sasanide palace of Ktesiphon (Copyright: Lengyel Toulouse, BTU Brandenburg University of Technology)
The attached presented work focuses on architectonic structure. There is a number of aspects that are not represented, such as the use of space. Therefore people, people’s movements, costumes, utilities etc. are not integrated. But the lack of these aspects is an emphasis instead of a lack, this emphasis on the structure enables the visualisation to focus not only on the hypothetic structure itself but also enables the visualisation to open its interpretation towards a general understanding of architectonic space, apart from its historical procedural and habitual meaning, its spirit of the time (Fig. 3).

The exclusion of the – hypothetic – antic population in particular reveals and emphasizes the eternal spatial qualities of the architectonic structure. Urban space, spatial relations in general, even sculpture and its relation to its surrounding architecture – the fact of the sculpture’s recontextualisation itself (LENGYEL 2014) – may also be interpreted as architecture as such, apt even to be transfered, directly or subtly, onto today’s perception and even contemporary planning processes. As a comparison, medieval cathedrals do have a strong impact, a spatial and strong architectonic impression on their spectators and visitor, independant from their religious attitude (Fig. 4).
So the focus on the architectural structure reveals more potential effects of the architecture than even a realistic simulation of the antic world ever would. Still, the transition from architecture to its structure though is primarily a matter of diminishing – of abstraction (LENGYEL 2011a).

**Abstraction**

Abstraction is the traditional way of choice for visually expressing ideas but also interpretations, i.e. in particular fictional designs or scientific hypotheses. Two aspects of abstraction are important for the following: first, abstraction is often used in different degrees simultaneously, that is, while some parts are defined at a high level, others are left less defined or even undefined (Fig. 5). Second, different intentions lead to similar visual results: In sketchy drawings like Le Corbusier’s Athens perspectives from 1911 certain aspects are emphasized while others are left behind. In this particular example one would possibly interpret the focus of the power of the particular landscape, that is a massive rock that a temple stands upon, lying in a constrastly soft landscape. Certainly the attraction of the drawing originates from the multitude of possibilities of interpretation. Also there is a certain amount of geometric depiction – the landscape roughly resembles the sketch – but apparently sketches like this one do rather depict an idea than a realistic vision.

Architectural design sketches usually use the same compositional techniques to focus on an idea instead of completing a project in detail, like in the design sketches by the architect Alberto Campo Baeza for his project Casa DB that rather give an idea – as of a light structure above a solid block – than an image of a habitable building. Long before defining any architectonic detail a sketch provides a more or less complex architectonic idea. This makes the drawing a projection of the spectator’s personal, individual imagination or even better of the spectator’s desires. Sketchy drawings unleash the spectator’s phantasy. So the depicting sketch rather interprets a given situation, that is it deforms reality through focusing, arranging and sorting, the prospective
sketch instead visualizes a mental image – yet using similar techniques. So even if the intention of these sketches are different, they are presented in a similar visual expression.

Regular drawings, often even constructed with methods of the descriptive geometry, resemble the sketch regarding their respective intention. Early drawings of hypotheses of the appearance of the Pergamon metropolis like the drawings by Richard Bohn from 1896 provide a lot of information but leave many questions unsolved. Due to the geometric origin of constructed drawings, other drawing methods are used for focusing on the idea behind the image. First of all, the perspective choice of the point of view only reveals and occludes partially. Some parts are just not in the field of view, some parts are simply hidden by other parts, the methods of intentionally composing a perspective are numerous (Fig. 6).

Physical modelling works similarly: in particular historic architectural plaster models focus on geometry (EVERS 1995). Materiality but also many other aspects are left apart, in favour of the better understanding of
the architectonic form itself. Just as in drawings, abstract models define structural ideas and leave details
undefined. And just as hypothetic historic visions – like the drawings by Richard Bohn – there are similar
abstract physical models like e. g. Gismondi’s model of Rome.
If abstraction is widely used in the fields of architecture as well as in archaeology and building history, there are
two more aspects to consider: First, just as uncertain knowledge varies in its degree of uncertainty, abstraction
itself is not of constant state and grade. Just as knowledge, abstraction can be slight or severe, explicite or
implicite. It is important though to differentiate that abstraction does not pursue imitation or simulation, but
explanation or – depending on its purpose, and this is what hypothesis are about – argumentation (Fig. 7).

![Fig. 7 – Cologne Cathedral predecessor 6th–7th century (Copyright: Lengyel Toulouse Architects Berlin)](image)

That is, abstract representations are capable to mediate hypotheses as well as knowledge, and this among
scientists as well as towards the public (MAISCHBERGER 2012, MÄRTIN 2012). But their capability does not
guarantee a successful mediation, since as far as abstract representations express certain ideas of various
complexity, their reception depends – on the sender’s and the receiver’s side – on a general prerequisite, that
is coding and decoding – and in the attitude and the will to use the coding and decoding capabilities. But this is
not a visual phenomenon, but a general communication difficulty, independant from the medium: visual
explanations behave – regarding their acceptance – just the same way as verbal explanations (Fig. 8).
Design

The commitment to stay as close to the scientific hypothesis as possible while at the same time to provide an attractive and immersive vision leads to a pretended dilemma – pretended, because this dilemma only seems to be a dilemma in the first view.

Instead, abstraction and attraction do harmonize, they may even complement each other, if – and this is the focus of the Visualisation of Uncertainty – if the designing of abstraction is performed on a high level of design, architecture and, last but not least, photography. These professions certainly depend on competences in technology and partly informatics, but the technological dependency is limited. The fundamental competences for designing abstraction lie in those professions that are used and trained in dealing with abstraction: Some fine art’s abstract sculptures reveal and explain the characteristics – possibly the quality – of nature through their artificial appearance, their sculptural interpretation of pure geometry.

Abstract architectonic design consequently focuses on the balance of body and space, that is spatial relationships contrasting discrete objects’ qualities.

Abstract architecture goes further and does not only provide a bold and clear spatial experience, but focuses on spatial experience itself, leaving any practical considerations aside.

This makes abstract architecture and abstract architectural design seem suitable for the purpose of the Visualisation of Uncertainty. Still the obvious and visually dominant stylistic point of view has to be examined.

This is to be done by differentiating design style from design quality. Design is not a question of taste. Taste is indeed a question of individual preferences, but design quality is a question of discipline, in the meaning of comprehensive, understandable and maybe even replicable work that follows and maximizes principles, that elaborates ideas to their extent, independant from the taste – from the design style. This differentiation allows to judge design quality across the stylistic field and so far to compare design works independant from their stylistic direction.
In recent history of architecture there is a number of design styles, even directions that clearly and expressively contradict each other (e.g. in comparison: O. M. Ungers Haus ohne Eigenschaften, James Stirling Staatsgalerie Stuttgart, Zaha Hadid Feuerwehrhaus Vitra AG, Frank O. Gehry Guggenheim Museum Bilbao). Still, their flag ships are identifiable, in some way depending on their date of creation, but further on and most apparently because of their design quality, their long term influence (LEPIK 2006). 
The main quality that concerns all of these examples is their consequent pursue of purity in their particular, individual formal approach – in other words their formal consistence or coherence. 
This lead to the assumption, that if one of the existing design styles is more capable of fulfilling the perceptual needs of visualizing uncertainty in knowledge just because of its large openness towards an individudal interpretation, there are only personal preferences in style that might interfere. But if questions of taste are identified – and in a way unmasked – as such and therefore voluntarily neglectable, the advantages can be used to achieve a high level of matching between the needs of visualisation and its formal appearance.
To accomplish this, the Visualisation of Uncertainty continues the works of abstract architecture and architectural design and the tradition of architectural – in early design phases abstract – model work and defines a range of methods for designing abstraction. Other than built architecture, the Visualisation of Uncertainty concerns two subsequent and reciprocal transformatory processes from the original hypothesis to the mediating visualisation, that it the shape itself – the virtual model – as well as its representation, that is its projection or even further – taking the abstract shapes for serious, as if it were built architecture again – its virtual photography.
Both aspects are described in detail as references to traditional architectural modeling respectively traditional architectural photography (Fig. 9).
Visualisation of Uncertainty

As a result, the projects that have been visualised according to the methods of the Visualisation of Uncertainty have been visualised in a way that they do not pretend to show any sort of reconstruction – not even visual nor virtual – but on the contrary explicitly visualize hypotheses, that is, in a way, supposed design ideas (Fig. 10).

![Cologne Cathedral 1320](Image)

Fig. 10 – Cologne Cathedral 1320 (Copyright: Lengyel Toulouse Architects Berlin)

The use of colour for example is restricted to projects that provide a high level of certainty about their original polychromy. The main task in mediating hypotheses is in any case to maintain the highest correspondance possible between the verbal form of the hypothesis and its visual counterpart. So in order to maintain a high level of certainty that in most cases of antic architecture concerns its geometry, the correspondant visual representation – the hypothesis’ visualisation – excludes polychromy. Antic architecture’s polychromy would implement a large, nearly infinite amount of uncertainty, not only regarding the hues and tones of the surfaces but because polychromy in internal spaces means figurative painting of highest individuality that importantly overlays space and geometry. In the visualisations of geometry focused hypotheses, this demand is accomplished by black and white photography (Fig. 11).
The reference to black and white photography underlines the importance of the unity of the visual impression of a visualisation. If undoubtedly coloured objects or picture elements like the sky were shown in their possible natural colour – that might be blue in case of the sky – the general image would gain a new dimension, the dimension of colour. And immediately every gray surface would also gain this new dimension of colour information, that is, gray image areas would stand for white architectural surfaces: a blue sky would literally paint the buildings white (Fig. 12).
Only a black and white photography leaves the buildings’ colours completely unclear, uncertain and literally neglected, even unmentioned (Fig. 13). Monochromatic hueing like an overall ochre tone (Fig. 6) to adapt the genius loci is not concerned (LENGYEL 2011c).

In cases where the degree of certainty – e. g. provided by the appropriate findings or remains – is high enough not to overwhelm the geometry’s certainty, a visualisation may turn out to be very close to the hypothesis but still – and then completely polychromatic. Different resources lead to different visual results while following the same principles, the methods of Visualisation of Uncertainty. And still there is a lot of abstraction in these visualisations, but less obvious since polychromy unintentionally encourages the acceptance of an image, or in other words, lowers the criticism against a visualisation, as is commonly the case in self-appointed, so-called reconstructions (Fig. 14). The discussion of reconstructions in historic preservation concerns authenticity which is a widely different approach compared to the visualisation of hypotheses (NERDINGER 2010).
Designing abstraction is – just as design in any field mentioned before – explicitly not a pure application of rules. At least not only, since designing always implies a special, personal and in the best case, innovative view on the topic, a profound knowledge of visual perception, an important amount of practice and experience.
in art, architecture and design, an aesthetic understanding. Design can not rely on spontaneous inspiration only but on a large amount of disciplined work.

The design of abstraction, to some extent described in the method of the *Visualisation of Uncertainty* (LAUFER 2011, LENGYEL 2011b, LENGYEL 2011d, LENGYEL 2015), considers itself as an alternative to the common agreement in heading for the most realistic vision suitable for the movie industry, the so called *Hollywood realism*, that makes its audience believe in what it sees, partly or even fully ignorant against any scientific concerns.

With an appropriate technological effort, realistic virtual worlds – and in so far also pretended reality – can more or less easily be achieved. From the point of view of design, the artistic needs are completely different from the design of abstraction since the obvious reference for realistic visualisations is reality, for both, creator and spectator. Creators of realistic visualisation would ideally combine – the maybe even passive adoption of – realistic design examples in architecture, object design, art etc. with – technologically sophisticated – simulation techniques.

Contrarily, the creation of abstract visualisations demands artistic professionals in abstraction. During the process of designing abstraction, reality only remains a metaphor that needs to be more or less subtly substituted. This difference induces not only a completely contradictory approach but equally specialized knowledge and competence in creativity. The competence of combining mental images, theoretical projections, technological needs and subtle suggestive means is the core of architectural design capability (Fig. 15).

![Cologne Cathedral predecessor 1025 „Alter Dom”](image)

**Fig. 15 –** Cologne Cathedral predecessor 1025 „Alter Dom” (Copyright: Lengyel Toulouse Architects Berlin)

**Conclusion**

The differentiation between simulations and visualised hypotheses make uncertain visualisations an issue of mind, of imagination and creativity. The design of abstraction makes clear that the idea, the image of architecture in the end is created in the spectator’s own mind.
That is, just as the design process requires creativity, visualisations of uncertainty with their inherent abstraction also induce individual creativity in their recipients.

But only as long as – and this is an important point to consider, since the design of abstraction is a substantive profession – the creational process of virtual modeling and virtual photography is performed seriously and professionally: as qualified – architectural – design.

References


MAISCHBERGER ET AL. ED. (2012) Martin / Scholl, Andreas / Schwarzmaier, Agnes (Ed.) Staetliche Museen zu Berlin – Die Antikensammlung, Verlag Philipp von Zabern, Darmstadt, 2012, p. 319, Fig. 20