

Toward the Conceptions of Visualization Language and Visualization Metaphor

Vladimir L. Averbukh

Inst. Math. Mech. & Urals State University
GSP 384, Inst. Math. Mech. 16. S. Kovalevskoi.
Ekaterinburg. Russia. 620219
averbukh@oso.imm.intec.ru

In this article the conceptions of Visualization Language and Visualization Metaphor are suggested. The structure of a metaphor and the some conception linked with visualization languages are considered. The approaches to evaluating of visualization systems based on adequacy in visualization are suggested.

Keywords visualization language, visualization metaphor, adequacy in visualizations

1 Introduction

It should be note that in spite of differences both in their purpose and methods of realization in each visualization system it is possible to point out their unity in mapping of a computer model into graphical representation based on the visual model of the phenomenon in question.

We suggest an approach that will make it possible to unite in the common frameworks the researches of different visualization systems and also to provide the base for formalized techniques of visualization system evaluation. This approach is based on extraction and analysis of visualization languages. Each visualization system contains as its core the language considering as an unity of the vocabulary, syntax, semantics, and (the last but not the least) pragmatics that is the user interpretations of language sentences. Visualization languages are constructed on some basic idea of similarities between application domain entities and visual objects that is visualization languages are based on the visualization metaphor. In our opinion it is necessary to consider, first, computer model of an interesting entity and, secondly, mental model of this entity being in the minds of the visualization system users and/or its designers. Defining the conception of visualization it is important to consider the stage of mapping of the given computer model into the visual

model based on given mental model.

2 Visualization Metaphor

We consider a metaphor as *the main idea that determines the mapping from application domain to the visual world*. Our approach to understand a metaphor is extended in comparison with traditional one and in the significant measure is based on semiotics. This approach has to formalize the search, design, and generation of visualization *views*. In our opinion there are no "metaphorless" visualizations of computer models and program entities (in spite point of view declared for example in [2]). In the literature it has long been observed that any metaphor is a picture and accordingly that all graphical images of visualization are based on metaphors and so are of metaphorical nature. All cases of visualization are properly metaphors since it represents one things (model objects) as something else (visual objects) in order to interpret the results of computing. In this connection it is necessary to consider the term of *visualization metaphor* as a mapping that provides correspondence between notions and objects of modeled application domain and a system of similarities and analogies. This system of similarities and analogies generates a representational set (a set of *views*) and techniques of interaction with visual objects.

The analysis of visualization systems shows the presence of metaphor "focus". Focus has to supply the main influence of the perception of the language building on the visualization metaphor. Sometimes the metaphor focus is based on any differences of application and metaphor entities. It is significant that metaphor focus is the subjective conception and that there are examples of visualization metaphor without any foci.

Thus the visualization metaphor may be described as set consisting of:

- metaphor imagery;
- operations directed by metaphor both animation operations and user's manipulations (in degenerated case the observation may be considered as these operations);
- the set of similarities between model and metaphoric entities and/or elements of semantic nonconcurrency;
- metaphor focus.

A quality evaluation of visualization and visualization metaphors have no to be based only on the simple tests and experimental situations (as for example in [2]). Only a long-term commercial or educational usage of a visualization system is a reliable indicator of its quality.

In our opinion the key feature of visualization systems is adequacy in visualizations. Practically, exactly adequacy in visualizations instead visual expressiveness or other quality features of visualization metaphors (as we considered earlier) we had tried to estimate by indirect techniques studying model tasks (described in [1]) user's perception speed, perception uniqueness, fatigue level, availability (or lack) of an aesthetic and emotional satisfaction and one or another user's preference. We try to prove it experimentally and also to find and to research experimental techniques of evaluation of adequacy in visualization.

3 Discussion and Conclusion

The approaches to a definition of a metaphor conception offered in this article allow to generate new fruitful ideas for visualization and CHI without literal following to (often casual, for example [2]) similarities of entities that occurs with traditional understanding of metaphors. Yet our approach providing a choice of adequate in visualization metaphors and languages unites as traditional understanding as other cases of using of analogies and similarities between entities during the process of visualization.

Our methods also may use in the cases of scientific and information visualization. Thus, this approach was realized in the set of specialized visualization systems using for differential games applications and medicine visual information system. New views and techniques of user's manipulation with images for supporting effective interpretations of modeling results

were developed basing on analysis of characteristics of adequacy in visualization. Note that specialized visualization systems supporting new views and interaction techniques are absolutely necessary on stages of a new computer model development because studying of model objects requires new techniques of visual representations. These problems are traced also in the design of visualization and modeling environments for biomedical researches.

It is possible to consider *generalized views* included as a set of animated images as potential user manipulations with visual objects. Naturally that in a degenerate case the view may consist of static images. Also it is possible to display images without any interactive actions.

Designers of specialized visualization systems have to develop the techniques of constructing such views which answer to concrete user's notions about nature of application domain entities, to user's goals, and to his/her methods of problem solving. Analysis of user's preferences in his/her choice of visualization language facilities during problem solving is the base for evaluations of adequacy in visualizations. In this connection full-blooded techniques of evaluations of visualization system quality based on results of psychological researches are necessary. New approaches to the study of adequacy in visualizations may help to solve an important problem – a problem of generating the visualization metaphors and corresponding visualization languages which have to provide the decisions of problems in the given application domain. The other important problem is the search of mathematical foundation for adequately describing of visualization metaphors formalisms.

References

- [1] Averbukh V.L., Konovalov A.V., Tarskikh I.V., Vorzopov V.V. Analyses of Visual Metaphors and Languages. Toward Prototyping of Software Visualizing Systems // "East-West". International Conference on Human-Computer Interaction EWHCI'94. St.-Petersburg, Russia, 2-6 August, 1994". Proceedings. ICSTI. Moscow. 1994. V.I, pp. 244-254.
- [2] Blackwell A. Green T.R.G. Does Metaphor Increase Visual Language Usability? // 1999 IEEE Symposium on Visual Languages VL'99, Tokyo, Japan, September 1999/ <http://www.cl.cam.ac.uk/afb21/publications/VL99.pdf>