The Geometric Toolbox project

The typical geometric modeling situation of today is characterized by - and quite frequently plagued by - a number of tools with a high degree of special "stream-lined" performance. This has almost invariably led to "ad hoc" choices and simplifications that have created mathematical inconsistencies and thereby rendered almost all of the tools incompatible with the others -- preventing them to work together in a coherent fashion against the same "all inclusive" universal geometric background.

At CVAP , Ambjörn Naeve and Johan Appelgren have developed a software package called Reflections [1], which is a system for the interactive study of surface shape. This system was used as an experimental platform for the theory developed by Naeve in his dissertation [3]. Reflections is part of a software system called Surface-Geometry, which is a mathematically based, computationally efficient geometric representation scheme for 3D surface [4].

The Surface-Geometry system is itself part of a larger geometric modeling project within CVAP, called Geometric Toolbox, which is aimed at producing an interactive "mathematics-friendly" geometric experimentation environment - a kind of geometric "object library" - consisting of a collection of compatible and reusable geometric structures and algorithmic components. Using this kind of geometric toolbox, different kinds of geometric experiments - of relevance in such fields as e.g. computer graphics, computational geometry and computer vision - can be easily "wired together" and all the relevant parameters can be manipulated in a mathematically controlled and interactively observable way.

The desire to perform such experiments - where one is combining "heavy computing" with "immediate viewing" of the result - is growing rapidly within the community of computational geometry - as the power of such techniques in developing and testing different algorithms is becoming more and more apparent. This is due to a combination of the enormous increase of computational power that has manifested itself in hardware components over the last few years and the advanced graphics workstation capabilities that are on the verge of settling down on everybody’s desktop. It has finally become feasible to simulate a large class of complicated geometrical situations and obtain information online with direct relevance to the understanding of the underlying problem. The possibility to interactively expand ones intuition about a problem - by performing mathematically controlled experiments in this way - is a very powerful technique that is bound to have a profound effect on the entire research methodology of the future.

For a detailed description of the results of the Geometric Toolbox project, the reader is referred to [1], [2], [3] and [4].

References

[1] Appelgren, J., *Reflections - a program for the interactive study of surface shape*, MSc thesis, TRITA-NA-94/08, CVAP, NADA, Nov. 1994

[2] Naeve, A., *Geometric Modeling - a Projective Approach*, CVAP-63, TRITA-NA-P8918, Department of Numerical Analysis and Computing Science, KTH, Stockholm, 1989.
[3] Naeve, A., *Focal Shape Geometry of Surfaces in Euclidean Space*, CVAP-130, TRITA-NA-P9319, Dissertation, Department of Numerical Analysis and Computing Science, KTH, Stockholm, 1993.
[4] Naeve, A., *IT-baserade Matematikverktyg - några tidigare och några pågående KTH-projekt,* CID-49, TRITA-NA-D9907, Department of Numerical Analysis and Computing Science, KTH, Stockholm, 1999.