

Volumetric and Multidimensional Modeling Using HyperFun

Alexander Pasko*, Valery Adzhiev+, Vladimir Savchenko*

*Hosei University, Tokyo, Japan

+ Moscow Engineering Physics Institute, Russia

Abstract

This invited talk describes basics and current developments of an approach to modeling volumetric and multidimensional objects using HyperFun language and associated software [1]. HyperFun is a modeling language designed to be a high-level tool suitable for specifying functionally based (F-rep) models [2]. While being minimalist, it supports all main notions of F-rep. HyperFun is also intended to serve as a lightweight exchange protocol to support platform independence and Internet-based collaborative modeling.

Software tools for HyperFun are being developed in an open source project manner by the team of collaborators from several countries. Application software deals with HyperFun models through the language interpreter or using the compiler to C/C++/Java and a set of utilities of the HyperFun API. The project description and current application tools (HyperFun polygonizer and plug-in to POV-Ray) are available at the devoted Web site

<http://www.hyperfun.org>.

A volume can be thought as a subset of 3D space with additional scalar value given in each its point. Scalar values can be given in the nodes of a regular space grid (voxel data) or by a continuous function of three variables. In this sense volumetric models are included in the F-rep concept. However, there are advantages in a hybrid volume modeling system based on both F-rep and voxel data. We describe the hybrid system architecture and give details of its implementation [3]. We describe the tools under development: volume sculpting with 4D spline volumes [4], interactive modeling using convolution surfaces [5], and real-time volumetric fly-through [3].

F-rep naturally allows for multidimensional modeling using functions of several variables. Practical multidimensional modeling is supported by HyperFun. Approaches and tools for interpretation of multidimensional models in terms of multimedia and animation are described [6].

Main current application areas of the presented approach include education (geometry, computer graphics, programming languages), animation and multimedia, and computer art [7]. We are also planning to develop an advanced computer-aided design system based on several geometric representations including F-rep and voxels.

Keywords: *shape modeling, volume modeling, multidimensional modeling, F-rep, implicit surface, voxel, animation, multimedia.*

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About the authors

Alexander Pasko is an associate professor of Hosei University, Tokyo, Japan E-mail: pasko@k.hosei.ac.jp

Valery Adzhiev is an associate professor of Moscow Engineering Physics Institute, Russia E-mail: valchess@hotmail.com

Vladimir Savchenko is a professor of Hosei University, Tokyo, Japan E-mail: vsavchen@k.hosei.ac.jp