Master Thesis 2010

Design of Flows on Smooth Surfaces

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Motivation :

Vector fields tangent to a 2D manifold surface have many applications in Computer Graphics, Scientific Visualization and Geometric Design. These Tangent Vector Fields (TVF) may be used for generating textures on a surface, computing expressive renderings of a surface, modeling and visualizing a shear stress, simulating the flow of fluids or fire on a surface. These methods usually require the design of the TVF over the surface. In the past years there has been several papers on the design of TVF on a given 2D manifold either defined as a triangulation ([1], [2], [3]) or as a subdivision surface ([4]). At the kernel of each of these methods is a function that interpolates continuously discrete values of a tangent vector field over a surface.

Objectives:
We have two objectives. First we would like to establish a proper comparison between the previously proposed interpolation methods. Second we want to establish a new TVF design method targeted to smooth piecewise polynomial surfaces. Such surfaces are the standard model for manufactured objects, and can also be used to model arbitrary topology surfaces ([5]). We expect that a dedicated method for smooth polynomial surfaces will speed up in an order of magnitude the design of TVF on such surfaces, thereby allowing real-time design of TVF.

Pre-requisites:
Required skills include computer graphics techniques, linear algebra and numerical analysis. Technical skills include C++ and OpenGL programming.

Bibliography:

[1] M. Fisher, P. Schröder, M. Desbrun, H. Hoppe, Design of Tangent Vector Fields. Proceedings of Siggraph'2007
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[5] G.-P. Bonneau, S. Hahmann: Polynomial Surfaces Interpolating Arbitrary Triangulations, IEEE TVCG, Vol 9 (1), pp. 99-109, 2003