

Raytraced diffusion curves

Problem description: Diffusion curves is a very popular primitive for generating vector graphics imagery [1]. This primitive, based on Laplacian diffusion of colour, was later extended via bi-Laplacian diffusion to also support the specification of (colour) gradients across the defining (diffusion) curves [2].

A nice video is available here: <https://www.youtube.com/watch?v=VE1wEwiwmSM>.

On the negative side, images created via (second-order) diffusion curves are expensive to render as there is no available closed-form solution to the diffusion process in general. To avoid the need for numerical discretisations of the diffusion formulation, an alternative based on raytracing was proposed [3, 4].

Building on the raytracing ideas, the research question of this project is to see if the raytracing approach can also be used to take into account (colour) gradients. More details will be explained in a meeting with J. Kosinka.

Expected outcomes: An algorithm and a proof-of-concept tool with a user interface should be researched and implemented. The student will be provided with a framework (OpenGL, Qt, C++) with some in-built capabilities (again, to be specified in detail in a meeting).

Prerequisites: The tool is expected to be implemented in C++ using OpenGL and Qt. The interested student should be familiar with basic graphics algorithms (at the level of the Bachelor Computer Graphics course), have some experience with OpenGL and C++, and ideally be familiar with B-splines and vector graphics primitives.



Figure 1: Vector images created using diffusion curves and points. Reproduced with permission from <http://edu.hioa.no/hlieng/data/SIG16.pdf>.

References

- [1] Alexandrina Orzan, Adrien Bousseau, Holger Winnemöller, Pascal Barla, Joëlle Thollot, and David Salesin. 2008. Diffusion curves: a vector representation for smooth-shaded images. In ACM SIGGRAPH 2008 papers (SIGGRAPH '08). ACM, New York, NY, USA, Article 92.
DOI: <https://doi.org/10.1145/1399504.1360691>
- [2] Mark Finch, John Snyder, and Hugues Hoppe. 2011. Freeform vector graphics with controlled thin-plate splines. In Proceedings of the 2011 SIGGRAPH Asia Conference (SA '11). ACM, New York, NY, USA, Article 166.
DOI: <http://dx.doi.org/10.1145/2024156.2024200>
- [3] Prévost, R., Jarosz, W. and Sorkine-Hornung, O. (2015), A Vectorial Framework for Ray Traced Diffusion Curves. Computer Graphics Forum, 34: 253–264.
DOI: <http://dx.doi.org/10.1111/cgf.12510>
- [4] Henrik Lieng. 2016. Ray-traced diffusion points. In ACM SIGGRAPH 2016 Posters (SIGGRAPH '16). ACM, New York, NY, USA, Article 7.
DOI: <https://doi.org/10.1145/2945078.2945085>