**INRIA Summer 2010 Internship Proposal**

# Gabor noise and implicit surfaces

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## Description

This internship is situated in the field of *computer graphics*. One of the main research topics in computer graphics is rendering, where a new image is synthesized from a description of a three-dimensional scene, including the geometry and the appearance of the objects. Modeling the geometry of objects can be done using implicit surfaces [BBCW10], and modeling the appearance of objects is often done using *noise* [EMP+02]. The goal of this internship is to explore exciting new possibilities enabled by combining state-of-the-art techniques in implicit surfaces and noise.

Noise is a random and unstructured pattern, the random number generator of computer graphics so to speak. Noise is used for efficiently adding rich visual detail to synthetic images. This is illustrated in Fig. 1. *Gabor noise* [LLDD09] is a state-of-the-art procedural noise function based on sparse convolution and the Gabor kernel. Gabor noise offers a unique combination of properties not found in other noise functions: accurate spectral control with intuitive parameters for easy texture design, setup-free surface noise without surface parametrization for easy application on surfaces, and analytical anisotropic filtering for high-quality rendering.

Implicit surfaces [BBCW10] are surfaces defined as contours or iso-surfaces of a scalar 3D field function. This is illustrated in Fig. 2. Implicit surfaces are popular in both computer animation, because of their ability to animate topological changes (for example, for modeling liquids or melting objects), and in modeling, because they enable a constructive approach to assemble object components.

Figure 1: Modeling the appearance of objects with noise. (Left) A noise pattern is designed by a user. (Middle) A leather texture is obtained by combining the noise pattern with a color map. (Right) The leather texture is mapped onto a dynamically changing implicit surface. (Figure from [LLDD09].)

Figure 2: Modeling the geometry of objects with implicit surfaces. These models were generated interactively using a new approach to implicit blending. (Figure from [BBCW10].)

However, texturing implicit surfaces using traditional texturing techniques is challenging, mainly because computing a texture parametrization of a surface that changes shape and topology at interactive rates is difficult. Gabor noise does not require a texture parametrization. This opens up exciting new possibilities, such as preserving the aspect of the texture while animating the surface, or blending the texture when blending the geometry. In this internship, the successful candidate will explore these new possibilities.

## Practical

**Lab** REVES / INRIA Sophia-Antipolis (`http://www-sop.inria.fr/reves/`)

**Duration** three months (May 1st 2010 - July 31th 2010)

**Supervisors**

- Ares Lagae (Postdoctoral Fellow of the Research Foundation — Flanders (FWO), Katholieke Universiteit Leuven and INRIA Sophia-Antipolis, http://www.cs.kuleuven.be/~ares/, ares.lagae@cs.kuleuven.be)
- Marie-Paule Cani (Group Leader, EVASION / INRIA Rhône-Alpes, http://www-evasion.imag.fr/~Marie-Paule.Cani/, Marie-Paule.Cani@inrialpes.fr)
- George Drettakis (Group Leader, REVES / INRIA Sophia-Antipolis, http://www-sop.inria.fr/members/George.Drettakis/, George.Drettakis@sophia.inria.fr)

**Prerequisites** computer graphics (optional), computer science (C/C++), mathematics (Fourier analysis)

## References


[BBCW10] Adrien Bernhardt, Loïc Barthe, Marie-Paule Cani, and Brian Wyvill. Implicit blending revisited. *Computer Graphics Forum (Proceedings of EUROGRAPHICS 2010)*, 2010. To appear.

[EMP+02] David S. Ebert, F. Kenton Musgrave, Darwyn Peachey, Ken Perlin, and Steven Worley. *Texturing and Modeling: A Procedural Approach*. Morgan Kaufmann Publishers, Inc., 3rd edition, 2002. http://www.cs.umbc.edu/~ebert/book/book.html.

[LLDD09] Ares Lagae, Sylvain Lefebvre, George Drettakis, and Philip Dutré. Procedural noise using sparse Gabor convolution. *ACM Transactions on Graphics*, 28(3):54:1–54:10, 2009. http://www.cs.kuleuven.be/~graphics/publications/LLDD09PNSGC/.