*Master Research Internship Project.*
*Inria, Grenoble.*

# Deforming 3D virtual characters with details.

**General Goal.**
The goal of this research project is to develop a new method to interactively deform a 3D surface with structured details.

*Figure 1. Examples of static surfaces exhibiting structured details. Deforming such surfaces should ideally preserve the original structure of the details.*

**Context and previous works.**

3D modeling tools are nowadays able to produce extremely detailed characters (see Figure 1). Still modeling such detailed shapes is a teadious and time consuming process. Moreover, once a given model is created, digital artists may want to adapt them to express specific appearance for a given virtual scene. For instance, the user may want to shorten the legs of the dragon, or extend its neck without having to re-create from scratch a new 3D model for every changes. However, deforming interactively a detailed model in such a way is a complex task. Indeed, applying a local scaling to shorten or extending some part of the shape would result in squeezing or streching the local details on the surface, thus loosing the initial appearance of the character. At the opposite, we would rather expect to see the details continuously adapting to the deformation of the shape such that new details would appear in the stretched parts, and conversely, merge in the compressed parts.

Previous methods have tried to focuss on the problem of deforming surfaces with details [1-3,] but they are limited in the applicable type of deformations, or by too large computational time. Our group recently developed the first approach for interactive continuous generic 3D deformations of detailed surfaces [4] as seen in Figure 2., but it can only handle particule-based details with limited structure.

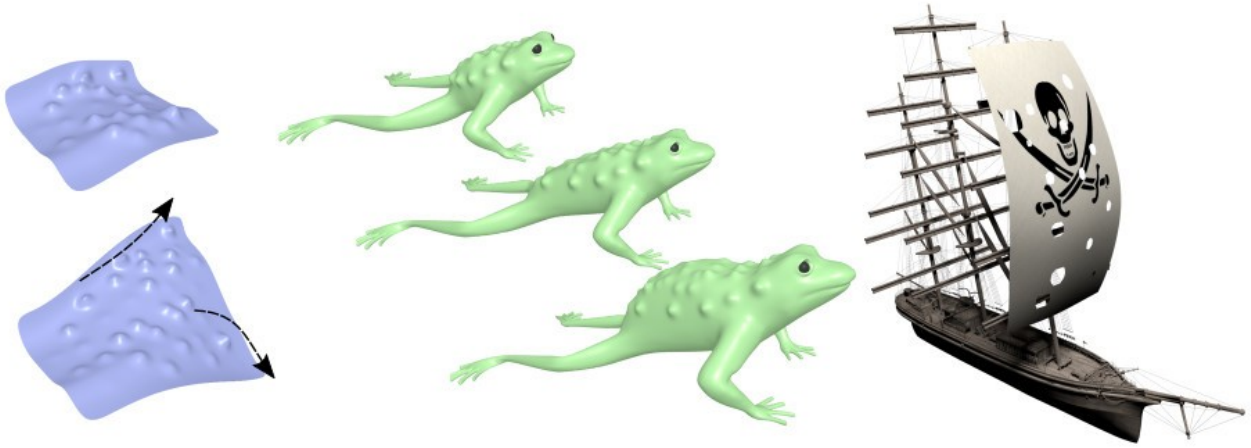

*Figure 2. Deformed surfaces with details obtained in Rohmer et al. [4].Note the creation of new details when the surface is streched.*

**Organization.**

The goal of this research project is to extend this methodology to be able to **deform a surface with a larger variety of details pattern such as oriented patterns, or with specific spatial organisation**.
The project may be conducted in two parts.
- First, an **analysis part** to extract the main characteristics of the distribution of details over a surface. In this context, existing works on pattern analysis may be considered but will be extended to work on curved surfaces embeeded in 3D.
- Secondly, a **synthesis part** enabling to compute efficiently the contious deformation of geometry in merging or creating details.

**Requirements**:

Intern candidates are expected to be able to efficiently develop and experiment computer graphics algorithm in a research context and should have a good background in the following fields
- Computer Graphics: 3D geometry.
- Applied Mathematics: Pattern analysis, statistics.
- Computer Science: C++ development, (OpenGL).
Candidate are expected to be enthousiastic for research and willing to pursue in a PhD.

**Internship information.**

The internship will take place at Grenoble in the research center **Inria**, in the **Imagine** research team.
Intern salary is about 520 euros per month.
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## Bibliography.

**[1]** E. Dekkers, L. Kobbelt, Geometry seam carving. Computer Aided Design (CAD), 46, p. 120-128, 2014.
**[2]** V. Kraevoy, A. Sheffer, A. Shamir, D. Cohen-Or, Non-homogeneous resizing of complex models. ACM SIGGRAPH Asia, Transaction on Graphics (TOG), 2008.
**[3]** A. Milliez, M. Wand, M.-P. Cani, H.-P. Seidel, Mutable elastic models for sculpting structured shapes. Eurographics, Computer Graphics Forum (CGF), 32, p. 21-30, 2013.
**[4]** I. Alhashim, H. Zhang, L. Liu, Detail-replicating shape stretching, The Vis. Comp. 28 (12) (2012) 1153–1166.
[5] D. Rohmer, S. Hahmann, M.-P. Cani, Real-Time Continuous Self Replicating Details for Shape Deformation. Shape Modeling International (SMI), Computer & Graphics, 51, p. 67-73, 2015.