Previous works on geometric modeling

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This presentation will **briefly** cover three aspects of presenter's past and current research focusing on the CG 3D data representation. The three geometric models are briefly defined below:

1. Surface cellular structure for natural phenomena simulation

This geometric model describes the generation and rendering of three-dimensional (3D) surface cellular automata (CA). Its main advantage is that it gives direct texturing simulation based on the actual shape of any triangulated input object. Application domains mainly cover automatic texturing of surface natural phenomena, *e.g.* generation of metallic patina (see figure 1), painting peeling, glaze fractures.

2. Cellular networks for computer graphics applications (texture and geometry) and for retina simulations

This model of three-dimensional cellular automata allows simulating different phenomena in the fields of computer graphics and/or image processing. The method allows to produce complex effects such as automatic texturing, surface imperfections, or biological retina multi-layer cellular behaviours –see figure 2. Based on cheap and widespread computing systems, real-time performance can be reached for simulations involving up to a hundred thousand cells.

3. GPU-accelerated computation and visualization of cellular automata

This technique proposes a graphics processor unit (GPU)-accelerated method for real-time computing and rendering cellular automata (CA) applied to three dimensions: 1D, 2D regular, hexagonal, and voxel space grids (see figure 3). This presentation introduces a novel method to encode and transmit any CA key-codes to the graphics card so that:

- Computation and visualization of 3D data and therefore CA information flow can be achieved in real-time;
- Consequently emerging behaviors even for large data sets can easily be identify for deeper formal studies.

Content of the presentation —

- A brief introduction to CA concepts –*optional, depending on time and audience*;
- 3D surface cellular automata and its applications to simulation of natural phenomena;
- Cellular networks and its applications in computer graphics and simulation of retina;
- A brief introduction on GPU programming –*optional, depending on time and audience*;
- 1D, 2D, and 3D CA, model and results;
- VR, CA, and crowd simulation;
- Conclusions, perspectives, and discussion;
- Demos –*optional, mainly depending on time and audience interest*.

Fields of research — Computer science, computer graphics, image processing, information visualization, virtual reality

Keywords — Polygonal surface cellular structure, cellular networks, cellular automata, multi-dimensional and structure grids, voxel space, GPU-accelerated computation (GLSL), digital imaging, real-time computation, emerging behavior, tomography

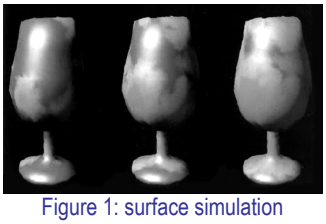

Figure 1: surface simulation

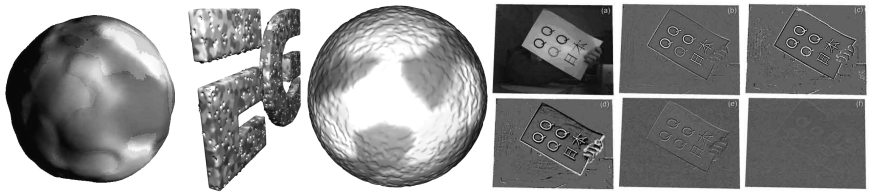

Figure 2: cellular networks applied to computer graphics or image processing algorithms

Figure 3: GPU-accelerated interaction and visualization of 3D cellular structure

Stéphane Gobron's bio — Specialized in software engineering (SE) and computer graphics (CG), he embarked on an international studies plan, starting with a four-year for a US Bachelor of Science degree, then a two-year Masters Degree in France, and finally five years in Japan teaching and studying for a Ph.D. at Iwate University. His research activities have first focused on numerical modeling of environmental phenomena, such as ceramics and glaze fracture propagations, metallic patina and corrosion simulations, three-dimensional material deformations, aging, weathering, hyper-texturing, and virtual surgery. A couple of years ago he has been teaching mainly SE and CG at Henri Poincaré University (Nancy, France) at the undergraduate level. For the last two of years, he was in charge of the CS R&D at the Mediterranean Virtual Reality Centre (Marseille, France), and since September he is working in a private company (Belfort, France) in R&D for embedded video surveillance specialized in a project including virtual mockup and live video. His research interests mainly include real-time simulations, virtual reality, behavior of large set of interactive cells (especially cellular automata and dynamic cellular networks), GPU programming, large matrices real-time computation, human retina simulation.