# GPU-accelerated computation and visualization of multidimensional Cellular Automata

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

- computation and visualization of CA information flow can be achieved in real-time;
- consequently emerging behaviors even for large data sets can easily be identified for deeper formal studies.

As symmetrical CA rules can be useful in several fields of study, we also detail extended encoding techniques to automatically derive their codes for the second and third dimensions.

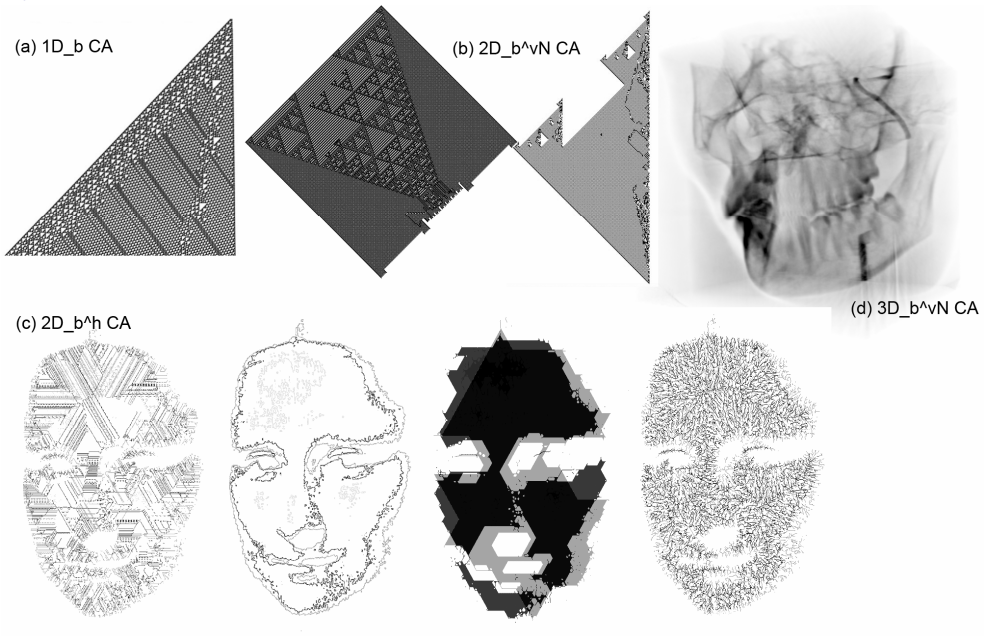


Figure 1: samples of multi-dim CA, (a) 1D, (b) and (c) 2D, (d) 3D approaches

## Content of the presentation

- brief summary of CA concepts –optional, depending on the audience;
- brief summary of C++ / GLSL double programs communication –optional, depending on the audience;
- 1D CA, model and results;
- 2D CA, van Neumann and hexagonal neighborhoods, models and results;
- 2D Symmetrical rules and demo of the interface which processes these models and visualizes the results;
- voxel space CA, 3D symmetrical rules, models and results;
- conclusions, perspectives, and discussion.

**Keywords –** Cellular automata (CA), computer science (CS), computer graphics (CG), 1D, 2D grid, hexagonal grid, voxel Space, graphics processor unit (GPU)-accelerated algorithm, linking C++ & GLSL, digital imaging, real-time computation, emerging behavior, information visualization

**Bio –** Specialized in SE and CG, Stéphane Gobron embarked on an international studies plan, starting with a four-year US B.Sc. degree, then a two-year Master's Degree in France, and finally five years in Japan teaching and studying for a Ph.D. at Iwate University and a post-doc. His early research interests 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. Until a couple of years ago he has been teaching mainly SE and CG at Henri Poincaré University in France. He is now in charge of the CS R&D at the Mediterranean Virtual Reality Centre where his research interests mainly include virtual reality, cellular automata, dynamic cellular networks, GPU programming, large matrices real-time computation, human retina simulation.