GPU Accelerated Visualizations in Education

Aaron Montag
Technical University of Munich, Germany
montag@ma.tum.de

Jürgen Richter-Gebert
Technical University of Munich, Germany
richter@ma.tum.de

Abstract

We present an approach to integrate graphical shaders into dynamic geometry software in order to enhance mathematics education. We have developed the plugin CindyGL for CindyJS, which translates the Cinderella inherent high-level programming language CindyScript into shader code. Shader code is then automatically used to accelerate content on the GPU via WebGL.

With this tool, we provide a natural workflow to generate GPU-accelerated applets. In contrast to conventional shader programming techniques, the programmer seamlessly integrates the shader program into a scripting language. This integration makes CindyGL readily usable for both instructors and students without preceding experience in shader programming and thereby leverages the first steps in shader programming.

Furthermore, a wide range of interactive, GPU-accelerated teaching material can be generated by CindyGL. It can be examined on most modern portable devices since CindyGL uses commonly available WebGL. In the session we are going to show some CindyGL-supported teaching material for upper secondary school and university that demands GPU-acceleration:

- Real-time interference of waves.
- Instant phase portraits of complex functions.
- Visualizations of the convergence discs of Taylor series.
- Rendering implicitly defined functions in three dimensions.
- Interactive visualizations of three-dimensional concepts such as the stereographic projection.
- Mathematical processing of live footage.