Prefix and Course Number

EE P 525

Course Title (120 character maximum)

GPU-Accelerated Interactive Scientific Visualization Techniques (SciVis)

Abbreviated Title; Must be ALL CAPS (Max 20 characters)

GPU SCIVIS

Catalog course description (450 character maximum)

Fundamentals of interactive 3D visualization on GPU for applications which generate massive-scale datasets. GPU-optimized domain-modeling and visualization techniques for scalar and vector datasets, including volumetric and point-cloud datasets: grid construction, basis functions, triangulation and surface reconstruction methods. Study key SciVis volumetric algorithms such as marching cubes, ray casting, splatting, and direct volume rendering.

Justification for adding course

The ECE Professional Masters Program (PMP) proposes the creation of a new permanent course, EE P 525: GPU-Accelerated Interactive Scientific Visualization Techniques (SciVis). This course has been successfully offered under the special topics course (EE P 590) for 4 credits, meeting for 4 hours per week.

EE P 525 will be offered as part of PMP's standard MSEE degree program and part of the GPU Computing affiliated certificate.

Evaluation details

- 5 Homeworks: 60%
- Final Project: 40%

Learning Objectives

By the end of this course, students will demonstrate the ability to:

- Understand fundamentals of scientific visualization: scalar, vector, and volumetric field visualization methods, data representations, mesh and grid generation, sampling and interpolation, iso- surfaces, and basic color theory concepts.

- Design and implement fundamental SciVis volumetric algorithms such as marching cubes, ray casting, and direct volume rendering (DVR).
- Program optimized SciVis algorithms using the parallelized GPU graphics pipeline (OpenGL) and compute kernel shaders.
- Design programs to take advantage of the host-device, data interface, GPU cache and memory architecture, 2D/3D texture units, and the SPMD execution model.
- Utilize domain-modeling and visualization techniques for point-cloud scattered datasets: radial basis functions, grid construction, triangulation, surface reconstruction methods.