

Advanced Graphics

Photorealistic Image Synthesis

Syllabus

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This course calls upon techniques from four fields of study: Physiology, Physics, Applied Mathematics and Computer Science. No specific prerequisites for this course is required, but the student should feel comfortable with the multi-discipline approach of this course.

1. Physiological structure of the human eye
 - (a) Photo-receptors rods and cones
 - (b) Trichromatic theory of color Vision
 - (c) Color opponency theory
 - (d) Color models (RGB, CIE, YUV, CMY)
 - (e) Limitations of visual perception
2. 3D Geometry in Computer Graphics
 - (a) Vectors in computer graphics
 - (b) 3D representations
 - (c) Affine transformations
 - (d) Structure deforming transformations
3. Representation of Objects
 - (a) Modelling of geometric objects
 - (b) Polygon representation
 - (c) Bicubic parametric patches
 - (d) Constructive solid geometry
 - (e) Space subdivision techniques
4. Viewing in 3D
 - (a) Projections
 - (b) Specifying an arbitrary 3d view
 - (c) The mathematics of planar geometric projections
 - (d) Frequency space representation
 - (e) The sampling theorem - Aliasing
5. Reflection and Illumination Models
 - (a) Theoretical considerations of light reflection and illumination
 - (b) Physically based illumination models
 - (c) Color
 - (d) Transparency
6. Rendering Algorithms
 - (a) Culling and clipping
 - (b) Incremental shading techniques
 - (c) Rasterization
 - (d) Hidden surface removal
7. Shadow and Textures
 - (a) Simple shadows on a ground plane
 - (b) Shadow algorithms
 - (c) Textures
 - (d) 2D texture mapping
 - (e) Bump mapping
 - (f) Anti-aliasing techniques for texture mapping
8. Ray Tracing
 - (a) Basic algorithm
 - (b) Recursive implementation of ray tracing
 - (c) Reflection-illumination model
 - (d) Shadows
 - (e) Distributed ray tracing