

CG3 WS23/24

Several print outs have been prepared for the oral exam that contain all versions of the rendering equation and examples of rendering results from different algorithms. It is therefore necessary to be able to explain a given rendering equation. You do not have to learn the rendering equation by heart. The same holds for formulas of rigid body time evolution and collision handling.

Sample Questions, Techniques and Concepts that can be asked for in oral exam

Explain algorithmic techniques

- path, light and bidirectional path tracing
- idea of multiple importance sampling according to brdf and incoming light
- idea of multiple importance sampling in BPT
- direct and indirect light sampling
- final gathering
- photon mapping
- reverse photon mapping
- progressive photon mapping
- vertex merging
- given slide 50 of "Cache Based GI" on the runtime split of image space photon mapping (ISPM) explain why ISPM is so much faster
- explain the different textures used in image based lighting and give an overview of how they are used to support environmental lighting for an arbitrary environment map!
- general idea of gammaton tracing
- idea behind boids
- how to simulate a piece of cloth with a particle system?
- Why do stiff springs cause problems?
- How to model hysteresis in cloth simulation?
- How can one avoid collisions in a rigid body simulator?
- What is a contact point and what kind of non-degenerate contacts exist for polygonal meshes?

Explain math

- integration over solid angle
- Monte Carlo (MC) estimation of integral
- variance, bias
- when is MC better than Riemann Integration?
- MC estimation of reflection integral
- idea of importance sampling
- Russian Roulette

- Nusselt's analogon
- uniform, rejection, N-rooks, transformation sampling
- What parts of the reflection integral in directional form can be importance sampled?
- ordinary and partial differential equations
- reduction to system of order 1 ODEs
- explicit, implicit, symplectic Euler
- A-stabel
- general idea behind step width adaptation
- how to find the best integrator for a given problem?

Explain physics

- unit, idea of non-dimensionalization
- Noether theorem
- radiometry: energy, power, radiosity and irradiance, radiance (incoming vs outgoing), brdf, albedo, potential, spectral quantities
- rendering equation in directional, area formulation and operator form, regular expression notation for light paths
- geometry factor and visibility
- emitted radiance of light source, sensor efficiency and measurement equation
- brdf properties: Helmholtz reciprocity, energy conservation
- how to make Phong and Blinn-Phong brdfs physically plausible?
- explain microfacet models on a coarse level, what are the individual parts?
- what do the Fresnel coefficients describe?
- what is an anisotropic brdf, what an isotropic?
- how to measure a brdf?
- how to represent a measured brdf efficiently?
- What is a bssrdf?
- quantities: mass, acceleration, momentum, (conservative) force. energy (kinetic, potential)
- what different forces do you know?
- inertia moment, inertia tensor, vector representation of angular velocity, angular acceleration, torque, rotational kinetic energy
- how can pose of rigid body be described
- how does pose evolve over time without friction?
- how does orientation change in dependence of angular velocity?
- how do forces applied to a point on a rigid body act on its linear and angular velocities?
- what is an impulse and how does it help to compute the change in linear and angular momenta in a rigid body collision?