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---keywords
> qq
> qq
> pp
> tobecontinue
> tobere
---preview
---detailview
---essential
pruf-re-ok- slides-intro
+qq Computational fluid dynamics - Wikipedia
qq what are typicall complicated computing cases? x2
qq whats the diff. bet. FVM and FEM
qq how can we model the fluids?
qq what is lageridian multiplier? how it was used?
qq what is the diff. bet. cfd and sph?
qq explain following: DEM, CFD, SPH, FEM, FVM? FDM
qq if we want to simulate fluid, what kind of method can we use?
qq if we want to siulate sand?
qq what if we want to similate powders?
> sugar or proteins
> bulk materials in storage silos
> granular matter, like sand;
> Blocky or jointed rock masses
> rock masses
qq compare CFD methods: FEM, FVM, and SPH
qq if we want to simulate: gases, wind
pruf-re-ok- slides-1 CG3_01_Physically-Based-Simulation
qq the idea of nondimensionalization?
qq what is the equation of harmonic oscillator? p4
qq solve?
qq rewrite with state vector
qq when using numeric method, there will be err,
> how can we know that?
> how to solve? x2 p5
qq physical quantities and their relationship? -large
qq how derived units can be written?? in terms of base units x7+1 p7
qq What unit has damping constant? p8
qq how units can be used? x2 p8
> derive units of physical constants
qq how can we validate physical formulas??
qq the case of a sphere? p9
qq solid angle def.?
qq the unit of solid angle?? p9
qq extended units and their expression with standard units p11
qq drive nondimensionalization of damped harmonic oscillator p14
> why damping ratio is unit free?
qq a few characteristic unit free parameters, why are they useful?
qq how density is defined? tribble derivative? op18
> convert from and to density and mass?
qq what is Eulerian and Lagragian view of a sys.? p19
---
qq convert from above one to an other? p20
qq how forces can be computed in a field? p21
qq what is gradient? express with standard unit vectors
qq what is Conservative Force def.??
qq what is gradient theorem? proof it! computes the Work done with force.
qq the condition that the force is conservative??
qq how to compute curl? wiki

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qq compute the work done by force f from x_1 to x_2 p22
 qq the equ. of solid angle?? wrt. θ ϕ p23
 qq &h The solid angle corresponding to all directions is 4π
 qq proof that $\Omega_{\text{all}} = 4\pi$ p24
 qq euler Lagrange equation? describing a harmonic oscillator p29
 qq Lagrangian of a whole sys. ? p28
 qq action S of a sys. ? p28 ?? pp
 qq what is the principle of stationary action? used to compute the what? wit
 h variational calculus?
 qq Noether theorem?
 qq what are typical Conserved quantities? p32
 qq diff. integration methods and their properties,
 > stable? preserve energy?...
 > show them shortly, and the pic
 qq quantities that are conserved, due to spatial and temporal symmetries in
 the laws of physics....
 qq flux def.? p34
 qq velocity field def. p34
 qq function for both integral form and differential form.
 qq why no source term in conserved quantities?
 qq what is continuity equation used for? p35
 qq diff. bet. gradient/ divergence/ curl operators??
 qq The formula for the vector product??
 qq formulas op04
 qq product rule??
 qq Derivation of the Explicit Euler Method
 qq Graphical Illustration of the Explicit Euler Method
 qq proof the stability
 qq numerical solution op5
 qq what is derived units, how they look like?
 qq what unit can we use for measuring luminous intensity
 qq what is the unit of xxx constant??
 qq what is Nondimensionalization
 qq Buckingham π theorem??
 qq what is the unit of Solid angle??
 qq why we still write sr unit??
 qq example of damped harmonic oscillator
 qq compare those two views
 qq how can we transfer from field view to particle? and back?
 ---REVIEW---

 qq compare the direction of force and gradient of potential?
 qq how is conservative force defined? op22
 qq def. of Conservative force
 qq the condition of a force that is conservative
 qq express the dir with θ and ϕ
 qq what is Minimization Principle
 qq what is Fermat's Principle
 qq what is 斯涅尔定律 Snell's law?? law of refraction
 qq derive the equ. of refraction
 qq the equ. of scalar Lagrangian?? op28
 qq action S of the system?? op28
 qq the euler langrange equ.?? op29
 qq apply euler langrange equ. to harmonic oscillator!! op29
 qq proof that line is the shortest distance bet. two points !!
 qq how can we apply functional Analysis/ principle of least
 def. action $S \rightarrow$ scalar Lagrangian $L \rightarrow$ Euler Langrange Equation \rightarrow solve

qq what is Noether's theorem
 qq what are typical diff. symmetry and their corresponding
 qq the equ. for numerical integration? x3!! op33
 qq compare them!
 qq what is dS vector here??
 qq what is the continuity equation? def. ?
 qq integral and differential form of Continuity equation! x2
 qq what is the reason of conservation law in phy? in depth
 qq For conserved quantities they do not have a source term??
 qq what is source term?
 qq how can we describe the temporal changes of physical quantities in a phy system? fluid...or other quan, mass....
 qq what is divergence theorem?? the basic of continuity equ.
 qq gradient theorem, proof op22
 qq what is the def. of conservative force??
 pruf-re-ok- slides-8 CG3_08_DGLs(Differentialgleichung)
 qq what is differential equation?
 qq what is the diff. bet. ode and pde??
 qq what is boundary conditions??
 qq implicit representation of an ode of order n?and explicit representation?

 qq what is Order reduction?
 qq what is phase space, the case in physical system of 2nd order?
 qq 自治 (驻定) 的系统?
 qq the case of Harmonic Oscillator, phase space?? what is that equ.??
 qq what is the time evolution func. of Harmonic Oscillator?? p6
 qq what is autonomous DE?? how can it be used? why we need to know this?
 qq what is Picard-Lindelöf theorem
 qq does Picard-Lindelöf theorem always true?
 qq 初值问题边值问题与柯西问题
 qq describe the initial val. problem! of odes
 qq what is Lipschitz condition? **
 qq re- what is Lipschitz-condition, bi-Lipschitz-condition??
 qq explain: * Every function that has bounded first derivatives is Lipschitz continuous
 qq can we solve sys. with collisions with closed form?? n why?? op08
 qq how can we achieve Analytic Solutions of odes??
 qq how can we solve initial value problem numerically?? p10
 qq re- how conditions like initial value be used??
 qq formulate a numerical solution form of a DE
 qq why not a typical integration? how can we solve it? op10
 qq use explicit euler to solve this??
 qq what is the bkg image p13? what field?
 qq error with respect to what?
 qq expression of the accu. error?? op15
 qq what is the appro. order of explicit euler method??? error estimation? op15
 5
 qq but the accumulated error grows with $O(h)$? not h^2 ??
 qq what is the approximation order of a method whose has error pt. h^2 ??
 qq what is the approximation order of explicit Euler?
 qq what Numeric Integration methods do you know? x5
 qq how does Verlet Method get a higher order?
 qq estimate velocity from Numeric Integration, which difference scheme?
 qq whats the approxi. order of Verlet method??
 qq the fomr. of verlet method, limitations of it?
 qq the formula/ proof of 4 methods -large
 qq formula of diff. interpolation schemes x3 which one has better approxi. order??
 qq does Euler-Cromer Methode have approx. order ?

qq why is Euler-Cromer Methode more stable than others of the same order?
 qq what is the App. ord. of Runge-Kutta Methods??
 qq the idea of RK? why have higher order?
 qq explain A-stable op21
 qq what test case does A-stable use?
 qq what means of a DE is stiff??
 qq does implicit Euler Method is A-stable?
 qq proof that! op22 large
 qq f ! explicit and implicit case! for Midpoint methods
 qq implicit midpoint is also symplectic??
 qq what feature does symplectic mean?
 qq let step be a kth app.ord. method. how can we adapt stepwidth? op26
 qq how can we estimate step error??
 qq why use damped harmonic oscillator as a demo?
 qq does most efficient scheme depends on application?
 pruf-re-ok- slides-4 CG3_04_Sampling-Techniques
 ---REVIEW---

 qq how does nrook sampling work? p3
 qq how one can gen. random shuffled vector? p3
 qq what means caustic ?
 qq how to gen. uniformly distributed random points with shuffle in c++ p4
 qq what means sampling in regular grids ? p5
 ---r1
 qq which Sampling Techniques do you know?
 qq what means sth. follow a specific random variable distribution, draw to i
 llu.
 the <algorithm> header
 qq with which func. can we gen. random var.?? op03
 qq bring a vector into random order?
 std::random_shuffle() from the <algorithm> header
 qq how can we use std::mt19937 to gen. uniform distributed 2d samples??
 > it is only a generator, must act as a parameter
 qq what is sample clustering?
 qq what is the problem of such a graph?(above)
 qq what is a good sampling ??
 qq what is Poisson disk sampling, idea?
 qq compare Stratified grid sampling and N-rooks sampling
 qq how can we sample according to a distribution: function_f/ integrate(f)?
 qq what's the problem with Rejection Sampling?
 qq how Rejection Sampling can be used explain the pic! op06
 qq how can we Sampling any Shape? in a simple manner?
 qq how can we sample uniformly inside a given shape?
 qq the idea and the goal of Transformation Sampling??
 qq what is marginalization?
 qq what is cumulative density function CDF
 qq derive the equ. used in tranformation sampling, the key condition connect
 ing both?
 qq how can we understand transformation?? g(ita)
 qq compute an example as found in picnotes
 qq we know how to gen. uniform distributed val.
 > in a [0,1] interval, but how can we transform it to arbitry interval??
 qq can we change the interval with transformation sampling? y
 qq which relations do we have in 2d?
 qq the results! op11 down side
 qq and folow arbitry distribution at the same time??
 qq why do we compute conditional probability pdfs and cdfs??

qq how can we solve this in 2d??
 qq the sampling procedure in 2d, example op13!!
 qq what is equating cumulative distributions, inverse function??
 qq how can we get uniform distribution over disk??
 > from a square(in uniform distrib.) x2 techniques
 qq the idea of transformation sampling? can we do this?
 > sampling of unit triangle and then transformed to arbitrary triangle
 qq what we have to calculate for a transformation sampling??
 qq how can we sample manifolds?
 qq what is manifold and its embedding space?? draw to illustrate!
 qq how can we get uniform circle sampling?? op15
 qq compare rejection and transformation sampling
 qq how can we uniformly sample the sphere surface??
 **qq why Double Coverage is a kind of transformation sampling technique?
 qq what is Double Coverage?
 **qq how can we sample a triangle uniformly??
 **qq how can we sample normals on a hemisphere??
 > example hemisphere for given normal ?
 qq how can we let probability density $p(x, x)$ be proportional to a constant b
 rdf?
 ---to be continued
 qq what is marginalization approach?
 qq what is the probability density for a hemisphere??
 qq what is Transformation Sampling a Diffuse
 > BRDF in angle parameterization??
 qq what is a Phong model?
 qq how can we make the phong model more physical plausible?
 qq how can we sample a Phong Lobe?
 qq what is the probability density of the Phong Lobe?
 qq how can we sample discrete distribution?? op21
 qq what discrete sampling techniques do you know as example?
 ---Multiple importance sampling (MIS)
 qq MIS-estimator? expression?
 qq why the integrand is often a product of several functions??
 qq why MIS minimize variance?
 qq the idea of MIS multiple importance sampling
 qq give an equation to show what unbiased mean!!!op26
 > the MIS estimator is unbiased??
 qq how can we choose the weight so that MIS estimator is unbiased??
 qq how can we compute average density?? op27
 qq what is Balance Heuristic? formula op28
 qq what is power heuristic?
 qq what is the relationship between them?
 qq two conditions the MIS estimator??
 qq how can we compute optimal MIS weighting?? which heuristic
 qq how can we combine direct light sampling and brdf sampling techniques
 > to reduce variance?
 qq what is a good choice for the exponent ??
 qq distinguish brdf sampling and direct light sampling
 qq compare rejection sampling with transformational sampling
 qq what are low-variance estimators??
 pruf-re-ok- slides-6 CG3_06_Advanced_Materials
 qq what is Physically Plausible
 qq which Empirical Shading Models do you know?? x3
 qq compare diffuse, glossy and mirror reflection with a graph
 qq what is the difference between glossy and specular reflection?
 qq computing reflected radiance from incoming radiance
 > for the following model: Lambertian, phong model, blinn-phong model
 > op07 large

qq what is v here?
 qq how can we compute ω_{half} ?
 qq when is Phong model is unrealistically? why pp
 qq compare white-sky albedo and black-sky albedo, large
 qq what is blue-sky albedo?
 qq 2 properties that Any physical plausible BRDF-model must fulfill?? x2 op
 10
 qq compute the normalization constants!! op11
 qq how can we make Phong model more realistic?
 qq what is normal distribution function (NDF)
 qq cook torrance brdf equ.? write down!
 qq the physical meaning of each term!
 qq how can we simulate/approximate materials with multiple layers
 qq what can be included in the geometry term? x2
 in the cook-Torrance microfacet model
 qq what is self shadowing and self occlusion ??
 qq how can we compute geometry term G ?
 qq describe the filter approach in more detail
 qq compare cook-torrance and oren nayer?
 qq compare cook-torrance and oren nayer?
 qq how can we compute the Fresnel term more effeciently?? why we have to app
 roximate it?
 qq <https://blog.selfshadow.com/publications/s2013-shading-course/>
 qq what is a spectral quantity?
 qq what are isotropic BRDFs?
 qq how can we set the light contributions from any back-facing direction to
 zero?
 qq why we use component-wise vector multiplication here? in computing reflec
 tion?
 qq explain the terms in cook Torrance bsdf! op19
 qq what is the relationship bet. cook Torrance bsdf and Fresnel equation?
 qq how can we compute the Geometry Term? which three cases are there? draw t
 o illustrate!
 qq standerd solutions in applications?
 qq how can we do Improtance sampling in cook torrance model?
 qq Derivation of Frensel Equations
 qq Fresnel Equations for Metals equ?
 qq which fresnel term approximations exists for metals??
 qq Oren-Nayar is a brdf model for diffuse approximation??
 qq 迪士尼原则--brdf的深入研究 <https://zhuanlan.zhihu.com/p/60977923>
 qq 提出了三个方面的工具与资源
 qq 各个模型的年代? 具体的时间要记住!
 qq 什么是艺术导向 (Art Directable)
 Disney采用了通用的 microfacet Cook-Torrance BRDF 着色模型
 qq Overview over BRDF models
 qq why Lambertian model inadequate ?
 qq who introduced microfacet model first to computer graphics?
 qq what is the relationship bet. Oren-Nayar model and Lambertian model?
 qq the idea of oren nayer model?
 qq explain how to use the frensel equ.
 qq what is a Anisotropic material?
 qq what is APS brdf?
 qq how to To support anisotropy??
 qq how can we handle that the energy preservation will not hold?
 qq what materials are typically Anisotropic??
 qq what is Torrance-Sparrow model?
 也被称为 Cook-Torrance 模型
 qq what does color mean when vis. brdf as Lobe?
 qq what means a brdf is phy plausible? x2 +

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---Messung von BRDFs tobecontinue
qq measures reflectance for combinations of?? what are inputs of the measuring process?
qq how can we reduce number of necessary measurements? x2
qq how can a single BRDF sample can be illustrated?
qq For isotropic BRDFs all measurements with the dots rotated around the normal
qq how can we get the brdf result? completely measure a BRDF
qq how can we measure a brdf with minimal effort ?
> sensor locations can be restricted to?
qq which devices can be used to measure brdf?
qq Three elemental components that can be used to model a variety of light-surface interactions??
> draw a graph to show the results
qq what pre requirements are needed?? op48
qq describe the image-based BRDF measurement system??
> what is the idea behind? x2
qq idea of Lafortune model? the formula?
qq three types of brdf? compare them!
qq the idea of Lafortune Model
qq how many parameters should be computed for a one-Lobe model? two-Lobe model?
---Bidirectional texture function (BTF)
qq what is BTF
qq idea of spatial BRDF?? sBRDF
qq the form of a btf database?
qq two representation of BTF? draw a graph to illustrate!
qq applications of BTF? x2 typical applications! best suitable applications!

qq what is BSSRDF
qq the idea of BSSRDF
qq unit of a bssrdf? and its dimension?
qq how bssrdf is used?
pruf-re-ok- slides-3 CG3_03_Monte-Carlo-Techniques
qq the operator form of the rendering equation? op4, i wrote
qq what is the meaning of each component? s3op6, i wrote
qq trace-reflection operator? s2p18
qq splitting of the BRDF s2p18
qq what is measurement operator? p4
qq explain the dimensional explosion p6
qq how can we solve an integral numerically? p6 x4 methods... roughly
qq what is a quadrature rule
qq why single sample estimator functions? p9
qq what is importance sampling? p9
qq how does Monte Carlo Techniques solve the problem of the curse of dimensionality? p11
qq why we use importance sampling?
qq what is the MC technique applying to reflection integral? p17
qq how can one compute  $L_{in}$  recursively in p17? code online
qq why not use fixed termination depth? p18
qq proof that the expected value will stay the same! p18
qq how to implement russian roulette? p21 returns the estimate?
qq explain the given code p19-21
qq why sampling? p27
qq explain code p29
qq how to sample when there are a lot of light sources? p30
qq what is path tracing p31
qq the monte carlo case of path tracing p32 formula
---r1

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qq measurement equ in operator form and rendering equ. op4
 qq why nested integrals?? op5 formulation
 qq how can we compute spectral power with help of nested integral?? op5
 qq what is the dimension of the nested integral??
 qq quadrature rule
 qq error estimation in brick-rule?? 1d,2d,d dimension!
 qq why exponential to d?
 qq explain dimensional explosion or the curse of dimensionality
 qq error estimation for d dimension??
 qq what is the idea of Monte-Carlo Quadrature
 qq the expected val of func. f in uniform distribution case ?? op07
 qq the error analysis of Monte-Carlo estimator,
 > how it decreases with increasing number of samples
 qq the most imp. part of MC estimator is that Independent of the dimension
 qq variance of the expected val??
 qq the expression of the estimator?? op7
 qq how fast error changes with the number of samples?? compute?
 qq a modified estimator? why we do the modification??
 qq what is the new expected value of estimator and variation?? op09
 qq what simplification will be done for nested integrals
 > along light transport paths
 qq what is Importance sampling, why good for estimating ??
 qq why can we reduce variance in this way??
 qq what can we do to reduce variance with MC estimator??
 qq ofcourse we can do every thing with uniform distribution
 > instead of Importance Sampling? but with a high variance!
 qq the idea of MC integration?
 ---MONTE CARLO GLOBAL ILLUMINATION
 qq why can we sample independently?
 qq how can we sum over all contributions of rays ??
 > single path Monte Carlo estimator looks like?
 > from all diff. paths
 qq how can we Sampling the spectrum??
 ---lense equation
 qq what is focal points? not always pass through a focal point!
 qq give the names in blank places!
 qq lens equ.! large
 qq how can we simulate depth of field (DoF) in GI??
 qq Three main factors that will affect your control of the Dof???
 qq How does aperture control depth of field? addi
 qq how can we simulate Dof in rendering ??
 qq the longer you set your focal length the shallower the depth of field?
 ---Spatial and Temporal Filtering
 qq what is box filter when doing spacial filtering??
 qq what is optimal sinc-filter ?
 qq what is box filter
 qq what is tensor product
 qq how can we do Spatial filtering ??
 > temporal filtering for a blur effect?
 qq how can we achieve motion blur?
 qq how can we extend 1d filtering to 2d? when applying spatial and time spac
 e filtering?
 qq why uniform sampling of the pixel area corresponds to a box filter??
 qq what is the filter kernel looks like for box filter?
 > and its relationship with gaussian filter?
 qq what is theoretically optimal sinc-filter??
 > Skalierung von Rastergrafiken verwendet werden k黵zen
 qq how can we extend 1d filter to 2d?? op17
 qq how can we approximate the reflect term of RE?? approximate the direction

al form?? op18

> using MC integration, the equ! fully understanding!

qq when to terminate?

qq the diea of Russian Roulette?

qq the form of expectation in RR?? and why it looks like this? op19

qq why rr need a binary random variable b

qq why the expectation remains the same

qq why we have to make sure that the expectation remains the same??

qq why not terminate in a fixed way?? op19

qq will the success probability decrease?? pp

qq how can we do sample_hemisphere()? what should be feed in, what do we get from that?

qq what is Nusselt's Analogon?? how can be used to improtance sampling?? op25

qq how can we do this? projection back? the formula?

qq we sampled according to what?? op25

qq draw a graph to illus.

qq what is Direct Light Sampling??

qq the expression of L_{direct} and $L_{indirect}$?? op26

qq which light sources are there? x3

qq how can we sample light source in this picture?? op28 draw!

qq explain the code

qq how to Dealing with Large Number of Lights with help of the idea of RR??

qq how can we define the probability for each light source,

> when we have multiple sources ?? op31

qq how can we reduce variance in Path Tracing?

qq Importance sampling is introduced to?

qq explain the process of path tracing (later)

---particle/smoke sim

pruf-re-ok- slides-9 CG3_09_Particles

qq what properties does a Particle have? x4+

qq how can we gen. particles, randomly? which sampling?

qq what is boids, how diff. from particles ??

qq what should we cosider when imp. such a sys.?? x4 what cases should be av

oid?

qq how can we do Visual Simulation of Weathering?

qq the idea of gamma-ton Tracing

qq Movement Probabilities for Each particle? possible movement??

qq when does the movement probabilities change?

qq where does γ -ton reflectance stores initially??

qq Patina case? how can we achieve this??

qq what does a particle carry in this case?? op15

qq Woven fabrics typically has which two distinguished directions?

qq how can we model this?

qq how can we simulate internal forces? x3

qq what If spring constant is chosen too small for easier integration

qq solution to this problem? x2 how can we simulate clothes more stable and stiff? x2

qq what is Kawabata-Measurements? x3 test in three cases!

qq which three forces are used?

qq what is Hysteresis effect? how can we simulate?

qq what possible additional connections are there?

---rbody sim

pruf-re-ok- slides-10 CG3_10_RigidBody

qq what are Dynamics and Kinematics

qq short notation that projections from one onto the other vector op3

qq what is Euclidean transformation

qq how can we define natural origin and rotation of a rigid body? in 2d and

3d

qq what is the natural origin of an object?

qq how can we compute center of gravity in discrete case and continuous case??

qq what is affine combination

qq draw the base vectors on a given graph!

qq transform from object coordi. to world coordi. *** and back. formula!!x2

qq derive velocity equ.!! both angular and linear velocity!

qq what is the diff. bet. kinematics and dynamics??

qq what is the dir. of Torque?? to be

qq how to understand this? :force acts twice once for linear and once the angular dynamics

qq expression of the torque? in 3d case. vec3 calcu. op10

qq the dimension of a torque in 3d case?

qq what is moment of inertia

qq continuous case, the inertia tensor results from? the formula in continuous case?

qq calcu. of Inertia in both continuous or discrete case *

qq derive the formula of Inertia tensor

qq why use $a \cdot a^T$? matrix form??

qq inertia tensor formula op11 both discrete case and continuous case! In 2d and 3d! x4

qq * give the formula in 3d case! op12 calcu. Inertia in Example of circular disk

qq how can we express inertia tensor in program?

qq what is the dimension of inertia tensor??

> and inv_mass? and angular velocities? position? orientation?

qq give the calculation formula of computing the I of Cuboid! op13

> and the result that we can directly use later!

qq how can we compute inertia tensor in world coordinate system?

> transform from local coordi to global coordi. op14

&p ok-op14 why this? have we imp. this before?? yes

qq how can we change bases from one to another?.... matrix calcu. later!!!
tt

qq what is the relation between force and linear momentum? to be

> Torque and angular momentum??

qq Inertia Tensor are changing during simulation?

qq what kind of spinning tops are there?? !

qq will angular momentum and angular velocity

> pointing at the same direction?

qq say, what's the dir of angular velocity and the one of torque!?

qq when will they pointing to the same dir?

qq where are spinning tops??

qq what kind of spinning tops are there?? x2

qq how a state of a rbody is defined?? x4 by four components?? position, ori . and?

qq why only reciprocal values are needed?

qq rotation must be orthogonalized after each integration step? we did not do that ?

qq what is the The time evolution function as motion equ.?? op17 *** research

qq what does it mean if a 0 is stored in reciprocal mass or tensor of inertia???

qq Normal component of mass matrix compute!! task5!! description..

pruf-re-ok- slides-11 CG3_11_Collision

qq what is coll. handling??

qq what is free motions

qq what is penetration depth??

qq the sub tasks of a rbody simulator?? which components are there? op07 lar
ge
> explain their functionalities!
qq Filtering of contact points, what kind of contact pairs can be ignored??

qq why we filtering
qq main idea/ gen. idea/ which phy. laws are used in computing collisions?
qq when and how we have to do an integration step?
qq what impact types are there?? x3
qq what is Hertz's force law?
qq which two phases are there?
qq what is local influence area
qq the Hertz's constant can be calculated with a formula, for spec. shape?
qq compare Rigid Body Impact and inelastic impact
qq deformation work and velocity after collesion? -noneed
> for both cases: elastic and inelastic cases
qq the velocities and work can be computed? op13
qq nearly all materials are partially elastic?
qq how can we quantify the elastic property if a material? formula? tobere
qq what is COR? coeffi. of restitution??
qq what is the direction of relative velocity before and after collision?
qq the velocities can be computed with epsilon! op14
qq is the rel. velocity reversed after collision??
qq If both masses are the same, we have a trivial solution?
qq which non conservative forces do you know?? p15
qq how is the relationship bet. Stokes' friction and Air friction and veloci
ty? how to determin the coef.?
qq is COR and coeffi. of friction properties of an object or material??
qq Typically used values can be found online? which key word?
qq which contact types are there for polyhedral?
> 2 non-degenerated contact types?
> degenerated cases
qq hwo can we calcu. contact normal in edge-edge case?? op18
qq what is a trival solution?
qq what is a degenerate case?
qq how can we handle multiple contact normal directions?? avoid NP hardness

qq what is indeterminate contact?
qq what are degenerate types typically? x5
qq how can we handle face overleap?
qq how can Rectangle intersection problem be solved? algo! the complexity? o
p21
qq the idea of BVH collision test
qq what do we need to test collections in near phase?
qq tt how can we do xxx intersection tests?
qq Contact Extraction algo? large x3+ tobere
qq Near Phase with SAT for OOB, how many axis to be tested??
qq the idea of SAT theorem??
qq we have to express conservation law in normal direction! ??!
qq how can we simulate joints? ensure the joint constraint?
qq what is cross product matrix?
qq explain the idea of inverse mass matrix! K-matrix!
qq tt Derivation of K-Matrix!
qq tt compute the Change in Total Energy, derivation and the result?
qq how can we compute impulse? how can we update velocities of the two? pp w
ith code??
> how can we compute impulse in: inelastic/ elastic/ partial elastic case?
> (based on ennergy conservation)
qq how can friction force be visualized?

qq what does it indicates if a spin of the rigid body is observed?
 qq what is normal_mass and tangent_mass? what are their difference?
 > and how are they used??
 qq how can we compute/ include friction forces?
 qq * how can we decide whether to apply static or sliding friction??
 qq draw to illu. parallel and orthogonal force impact! op36
 qq how can we compute tangential part of K matrix??
 qq impulse transfer?
 qq how can we handle Multiple Contacts? op39
 qq * for the Newton's Cradle, our current knowledge is not sufficient! why?

 qq how to handle this case? we may can not simulate Cradle
 qq describe the Sequential Impulses Algorithm(loop) detail op46
 qq how can we avoid penetration between diff. bodies?
 qq what is the pre-condition of impulses computation?
 qq impulses computation: op47
 qq how can we improve the stability of the Sequential impulse loop? ** x2
 qq examples of Contact Constraints (for contact forces)
 qq what is contact forces vector? can we apply constrains on it?
 qq how can we solve LCP problem arises in computational mechanics?
 qq how can we deal with Interpenetration from discrete time stepping ?
 qq how can we handle in games? e.g. chains of bodies?
 ---fluid sim
 pruf-re-ok- slides-12 CG3_12_Fluid
 qq Incompressible Navier-Stoke's op7 equ.
 qq "Incompressibility condition"?
 qq what is divergence of a vector field u ? op08 the pic!
 qq does div depends on time??
 qq what is Reynolds Number
 qq what is $Re < 1$, $Re > 40$, $Re > 2000$??
 qq what are particularly hard to simulate?
 qq what is Existence- and Uniqueness of „physically plausible “ (energy-rest
 ricted)
 > solution of Navier-Stoke's-Equations in 3 dimensions? tt
 qq what are our goals in cg?
 qq what happens to Reynold when simulating gases??
 qq explain the behavior of Re number
 qq how Re affects turbulent fluids??
 qq what is material derivative??
 qq What forces act on the blob? x4
 qq the momentum equation?? Navier-Stokes momentum equation!
 > explain it! derive! op19
 qq we define a quantity in Eulerian view, how can we compute the derivative

 > in Lagrangian view?
 > derive the material derivative!`
 qq what is advection?
 qq the expression of heat equ. op22
 qq compare those two viewpoitns
 qq what is Material Derivative? can we tell how
 > fast this quantity changes?? op26
 qq why equals to zero?? in "advection" equ??!!
 qq what is the phy. meaning of xxx op27, how can we compute the changing in
 > a fixed point?
 qq what do we know if the fluid is advection fluid? op27 !
 qq what if our fluid is color ... even if the vector field is velocity itself
 > how can we handle this situation?
 qq Advection Equation

qq Real fluids are compressible why we assume liquids are incompressible
 > in fluid simulation?
 qq derive the incompressible condition op31
 qq why irrelevant for animation?? op30
 qq the reason that $\text{div of } \mathbf{u}$ is zero everywhere?? for incompressible fluids.

qq why velocity field is divergence free for incompressible fluids?
 qq how can we simulate this div free system? x2
 qq besides grid based methods, what other methods do you know?? web
 qq what is numerical dissipation??
 qq what is numerical dissipation? how can be solved ??
 qq what is kinematic viscosity
 qq is air more viscous than water?
 qq incompressible Euler equations? and explain!
 qq which Three types of surface can be found with fluid??
 qq how can we model solid wall? No fluid can enter or come out of!
 qq mathematical expression of this? op38
 qq what is "no-stick" condition
 qq what is "no-slip" condition?
 qq how can we model Free Surface?
 qq what if surface tension is impro. ??If surface tension is important
 qq how about the pressure in this case??
 qq how can we model surface tension in Free Surface?? op39
 qq when simulating two fluids interacting with each other,
 > do we know Density jump?
 > what about the Normal velocity jump??
 > what about pressure jump?
 > (take the previous video as example!)
 qq how can we split a differential equation?? op43 pic given
 qq can we split any equ. by solving them separately? how? op43
 > F and G function
 > and in First order accurate in time!
 qq which component can we Split Momentum equ? x4
 qq How can we make the fluid incompressible?
 qq compare simulation strategies: Eulerian grid and SPH based in nutshell
 qq op45 x3x1
 qq what is A Simple Grid Disaster??
 qq how can we solve such Simple Grid Disaster?
 qq what is The MAC Grid? pros and cons for it?
 qq compute pressure gradient at velocity sampling point?
 qq where are the velocity sampling points? and pressure sampling points?
 qq where is the velocity??
 qq how can we compute velocity and pressure gradient in this pic.?? op48
 qq where are we going to compute pressure gradient??
 qq what are downside of MAC grid? And array storage??
 qq Downside of this MC grid based strategy, possible solution??
 qq what is Semi-Lagrangian Advection??
 qq the idea of Semi-Lagrangian Advection??
 qq why Chief interesting aspect of fluid motion is vortices??
 qq compute the \mathbf{x}_{old} with help of \mathbf{x}_{new} ? in explicit euler?
 qq compute \mathbf{u} at staggered location?
 qq what is the particular requirements of a stable ODE integrator?
 qq does Forward Euler handle vortices well? why?
 qq can Forward Euler handle vortices correctly?? op53
 qq which ODE integrator can be used here with a better result?
 qq how can we get the velocity and compute $\mathbf{u}(\mathbf{x}, \mathbf{y}, \mathbf{z})$ vector?? based on MAC grid
 ?
 qq op54
 qq why advection step should be the first in the split integration?? op55

qq how can we get $q(x_{old})$ when the x_{old} position is not on grid?
 qq What if x_{old} isn't in the fluid? what should we do in this case?
 qq what happens when we are beyond the original observation range
 qq what is the diff. bet. interpolation and extrapolation??
 qq region of interest (ROI)
 qq only constraint the normal components of u when facing solids?
 qq why cannot can't use the solid's own
 qq what is volumetric animator forces?
 qq how can we add such a force?
 qq we have to solve pressure before advection?
 qq "Poisson equation" for pressure?? op62
 qq what is the incompressibility condition on the new velocity on grid ijk ??

 qq what are possible grid point types?? x_3
 qq explain this pic
 qq why we update pressure first?
 qq compute the ghost pressure for the simplest case!
 qq linear equations for pressure due to div free?
 qq do we have apply iterative computing process here? why?
 qq *why Voxelization is Suboptimal?? drawbacks of grid based solution? x_2
 qq how can we compute the "ghost" solid pressure in this case?? op66
 qq re- when solving pressure, how can we handle Boundary conditions?? op65 x_2
 qq how can we compute pressure for solid cells??
 qq how to update pressure and velocity?? op68
 qq what about the pressure matrix?
 qq the linear equ. of pressure can be solved effeciently?
 qq why we iterate?
 qq how can we simulate smoke? phy model?
 qq equ. for soot concentration on grid
 qq why and how can we track temprature?? the Evolution equation!
 qq what is conduction??
 qq how can we handle Boundary conditions??
 qq what is Boussinesq approximation, what may be its advantage?
 qq how can we add external buoyancy force in momentum equation??
 qq which dir has buoyancy force? what are α and β in such equ.?
 qq what If no soot and no temperature difference??
 qq bouy. force is a vector force?
 qq what boundary condition we have to apply when facing open boundaries?
 qq why vortices dissolves too fast?
 qq how can we overcome it?/ how can we preserve the vortices?? x_2
 qq what is vorticity?
 qq what is gradient vorticity?? which direction?
 qq how can we determine vortex strength and axis of rotation?? op77
 qq what is the equ. of vorticity confinement force?? op77
 qq what is the direction of vorticity confinement force??
 qq why we need Δx here?
 qq mark ω , \hat{u} and force dir in this pic.!op77
 qq what is monotonic Hermite Interpolation, how it benefits? solves overshooting??
 qq how can we do vorticity confinement ??
 qq why we would apply monotonic Hermite Interpolation instead of
 > other higher order functions?
 qq draw example curve for Hermite interpolation and the monotonic one!
 qq how can we deal with numerical dissipation?
 qq but can not use higher order interpolation!
 qq why we typically use SPH approach for water simulation?
 qq how can we sampling the water-air surface correctly?
 > two better ways than grid based ones

qq compare voxelization approach and Marker particles
 qq the idea of Marker particles!
 qq idea of Level Sets method
 &pp err? op81 ! $x - x' \Rightarrow (x,y) - (x',y) ^ 2 ??$
 qq what is Fast Distance Function,
 > how can it be used to levelset methods?? op81
 qq the computing example of Fast Distance Function on op82
 qq 3 ways to define a surface when simulating
 qq how lower envelop looks like??
 qq how can we compute the intersection of two evolops?
 qq how Evelop can be built, description? and the code?
 qq the Extrapolation process??
 qq Extrapolation initialization?
 qq Extrapolation methods for surface computation?? x2
 qq the algo. to compute Fast Distance Function??! op84
 qq what means Adaptive Discretization?
 qq what is SPH, and why we use it instead of grid based methods?
 qq what is the sph formulation of the momentum equ.?
 qq how can quantities be interpolated in sph method? op91
 qq which interpolation are we going to use in practice?
 qq which 2 methods to interpolate exists?
 qq which mehtod is the best one theoretically?? why it is probabilistic in p
 ractice?
 qq what is the prob. with gaussian kernel? why we do not use it?? op91
 qq how can we compute partial derivatives of the desired quantity?? Ai,
 > in a simple way? what may be the prob. of that?
 qq how can we compute a robust approx. for gradient and lap. of Ai??
 qq how can we compute pressure?
 qq how can we update pressure and viscosity? what is the updating equation?
 > Basic Algorithm op93
 qq how can we compute, estimate time step width Δ ? smaller than a threshold
 ?
 > with safty term
 qq SPH - Basic Algorithm op93, detail see paper!
 qq how time step width t ? is computed is defined?? computed??
 qq when interpolating, how can we do Neighbor Search effeciently??
 > what may be the benefits?
 qq compare Z-Index Sort and KNN algo.?
 qq why Z-order_curve can provide more locality?
 qq why it has a z shape?
 qq incompressible condition for sph approach?
 qq what search strategies can be used for Neighbor Search?? op94
 qq what sph Algorithm Variants do you know?
 qq how can we make Incompressibility Update in sph simulation ? divergence f
 ree?
 qq how can we do Pressure Projection in sph?
 qq what is Multi-Phase Fluids?
 qq artefacts at the fluidfluid interface? what can be the reason? how can we
 solve it? x2
 qq what is Solid Body Coupling op99 how can we archieve this?
 qq how can we render in sph simulation?? given a set of particles op100
 > how to understand this??
 qq why not use regular grids? when will cause prob.? in which cases?? op46
 ---ray sim
 pruf-re-ok- slides-2 CG3_02_Rendering-Equation
 qq 一个波长为 λ 的光子所携带的能量?
 qq 渲染的稳态假设?
 qq flux?
 qq what is irradiance and radiant exitance?? their unit?

qq what is Lambert's law?
 qq 平面角? projection? unit of plane angle?
 qq intensity vs irradiance?? pp
 qq 辐射率 (Radiance) ? 用的最多! $L(p, w)$
 qq 这里 dA 是和谁垂直?
 qq what is the parameter of the radiance function? L ? $L(p, w)$
 qq radiance depends on position and solid angle, irradiance depends only on position!
 qq compute energy from L , radiance! by integrating multiple times!
 qq what is theta?
 qq parametric representation of flux, with radiance known!
 qq brdf defined? parameter of brdf?
 qq formulation to show that brdf has: 互易性 (reciprocity) and 能量守恒 (energy conservation)
 qq what is bsdf?
 qq should we always compute absolute value for cos term?
 qq what is the diff. bet. scattering equation and reflection equation?
 qq derive the refraction/transmission equation with brdf and bssrdf??
 qq why we need Ambient Occlusion?
 qq basic rendering equation p10(transport equation, directional form)
 > explain the meaning of them p12
 qq rendering equation II, area formulation. with visibility check p16
 qq operator form p17
 > what means double refraction of emitted light? in equation. p17
 qq refined with $D, S, M...$ p18
 qq mark them p19
 qq measurement equation calculating brightness of a pixel? p20
 > what is spectral efficiency?
 > spatial power?
 qq spectral importance function? p21
 qq speed and energy of a tiny photon
 qq calcu. of photon energy p25
 qq Spectral Energy Density of diff. light source judge. p26
 qq def. of radiance and irradiance p27 p28
 qq how comes the integration part in rendering equation? p29
 qq def. of BRDF p29
 qq diffuse brdf? p30
 qq Without volumetric scattering, the radiance is constant along rays?
 qq brdf relates incoming irradiance with outgoing radiance?
 qq BRDFs can be analyzed by integrating over one directional argument. Integration over outgoing directions yields directional hemispherical reflections that must be ≤ 1 .
 > why? p32
 qq how can we Solve the Rendering Equation? x2 p34
 ---REVIEW---

 qq the steps of Bidirectional Path-Tracing p35
 ---r1
 qq what is Ambient Occlusion
 qq what is global illumination?
 qq what is color bleeding
 qq what is radiosity
 qq what is mirror reflections
 qq Crepuscular Rays are volumetric scattering effects
 qq what is volumetric scattering

qq compare volumetric Subsurface scattering and volumetric scattering!
 qq describe the light transporting process
 qq basic observation about the light transport ??
 qq which Simplifications will be made to simulate the light transport ?? x2
 qq raytracing operator:
 qq what is the equ. in this light path??
 qq describe which parts are there in transport equation
 qq formula of RE !! [Immel et al 1986]
 qq Fredholm integral equation
 qq why we use Radiance? &h
 qq The SI unit of radiance??
 qq how can we parameterize the direction omega? op13
 qq what is brdf
 qq explain the rendering equ. each para. op11
 qq how total outgoing radiance can be solved in math view ??
 qq what if is constant C?
 qq RE in Surface Patches formulation, with integration over scene area and
 > visibility check, explain! op15
 qq mark omega y->x in this pic
 qq transform from the RE to the form of Lout!
 qq explain this equ. in a new form rendering equ.
 qq how can we do visibility test ?
 qq what is geometry factor ?
 qq write RE in operators formulation! gain insight on a higher level!
 > the operator form of the rendering equation
 qq write down those operators !! op17
 qq solving it? how can we? what is the meaning of each part?
 qq RT can be refined to L-DSM-E, what is the meaning?
 qq we can write a regular expression for that?
 qq write the path expression with a given pic!
 qq what's the regular expression of all paths? in a scene! op19
 qq compute Lout op17
 qq splitting of the BRDF into?? x3 parts!!!
 qq explain the regular expression syntax
 qq how can we represent diff. kinds of rays??
 > use a regular expression syntax?? how op18
 qq give the name of the paths! in this pic!! op19
 qq definition of diffuse, specular and mirror, difference??
 qq what is Sensor Efficiency?
 qq how can we compute the brightness of a pixel
 qq describe the simplified camera model, where is aperture? pixels?
 qq given cam. model. explain this measurement equ. componentwise ! op20
 qq describe rendering equation with spectral importance function
 qq for each sampling point in the scene, there is a corresponding weight? tw
 o
 qq the weights flow from the sensor to the light sources
 qq illu with a graph!
 qq what is spectral importance function
 qq how can you describe the RE, what phy. meaning does it have?
 qq two parameterizations of the rendering equation
 qq ray direction, which not accepted, will not make contributions to sensor?
 pixel value? y
 qq what is hemispherical reflectance
 qq each photon has characteristic?? x2
 qq what is the relationship bet. freq./wavelength and light speed? op24
 qq each photon carries a tiny amount of energy q?
 qq what is typical wavelength for lights?
 qq how can we know the energy given a graph? spectral graph!
 qq how can we compute the energy of a photon?? hv

qq range of wavelength??
 qq Spectral Energy Density
 qq what is emission spectrum of different light sources?? exanple!
 qq what is the diff. bet. irradiance and radiosity?? op27
 qq the area orthogonal to what?
 qq how brdf is defined?? op29
 qq what is total reflected radiance, how to compute?? op30
 qq what is directional hemispherical reflectance? its range??
 qq what if for a constant (diffuse) BRDF?
 qq is radiance constant along rays?
 qq how is albedo/ directional hemispherical reflectance defined?? op30
 qq The units of the BRDF ??
 qq what is bsdf
 qq what is bssrdf
 qq how many steradians for a hemisphere??
 qq radiance describes?? phy meaning of that??
 qq relations bet. radiance and irradiance
 qq what is the fact of volumetric scattering??
 qq expression of brdf?
 qq why lower then 1 ?
 qq when Integration over outgoing directionsq ??

 qq the idea of numerical solution strategies
 qq the case of Radiosity can be baked? why?
 qq the baken process of radiosity??
 qq derive system of linear equations in case of Radiosity baken!
 qq why double integral in 3d not trible? pp
 qq what is domega? paramiterization , omega can be para. to two angles !
 qq how can we solve the RE numerically?? the algo in course level?? op34
 *qq describe the process of bi-directional path tracing op35
 qq the baken process?
 *qq how can we describe and scan material property?
 qq monte-carlo integration techniques
 qq how monte-carlo integration techniques be used?? later, highlev
 pruf-re-ok- slides-5 CG3_05_Path-Based-Rendering
 ---REVIEW---

 qq what is caustics, draw to illustrate! envelop? incident rays? reflacted rays?
 qq illu. Path Tracing with Direct Lighting and Light Tracing with Eye Rays
 qq how light sampling can be connected to eye??
 > directly hit the eye position?? n
 qq always connect to the eye point?? n
 qq Light Tracing - Algorithm op08 large!
 qq how can we render caustics with lower variance?
 > how to choose the best renderer?
 qq is light tracing optimal?
 qq what benefits does light tracing have? x1
 qq compare light tracing and path tracing, good in which effect?
 qq how can a lower variance be achieved? what if we sample the same rays many times?
 qq should we reuse the light ray several times?? n
 qq what is the key point of a cache based method?
 qq the idea of Bidirectional Path Tracing?
 qq what is BPT in rendering
 qq show a ray path with x w notation! op14
 qq what is Overall average length?

qq what are possible sampling techniques?
 qq for BPT, there are still problems with which paths?
 qq calcu. Average path length
 qq which sampling techs do you know related to calculating path pdf? [open question]
 qq how can we compute path pdf, which variants are there?? xn ,
 &p pp op18 --> veach thesis!!!
 qq what is Image formation, how can we do this? algo.! op19
 qq show that The same path can be generated in several different ways illu.

 qq and this may intro. bais?? y
 qq explain the given picture/ image--pic notes
 qq how can we compute path pdfs?? op21 Path pdfs
 qq what does the last pdf mean? x2
 qq how can we sample directions??
 qq to support sampling of directions?
 qq why there is no visibility check in direct sampling?? op22
 qq the idea of BPT?
 qq how the path looks like with zy formation??
 qq what is s and t?
 qq how can we compute k from s and t? k is the number of edges
 ---REVIEW---

 qq special cases!
 > what does it mean if s=0? path tracing
 > and s = 1? direct light sampling
 > t=0? t=1?
 qq can we do MIS on one path? y what do we need as pre-requires?
 ---tobecontinue
 qq additional artefacts for BPT without MIS? why?

 qq why we set 1 to the first few vertices?
 qq how can we compute weights increamentally?? op29
 qq how can we do Russian Roulette in BPT?
 qq Efficient Sampling with path groups, how can we do this?
 qq are there Efficient Computation of Contribution? idea? x2
 qq what problems can bpt arise?
 qq what is the most app. advantages for caching??
 ---METROPOLIS LIGHT TRANSPORT
 qq idea of Metropolis Sampling?
 qq which scenes are best suitable for MLT?
 qq why markov process can be assumed?
 qq what is Markov property
 qq what is Markov process
 qq what is Markov chain.
 qq idea of PSSMLT
 qq how Markov Chain can be used for MLT??
 qq how simulate tempering can be used for MLT??
 qq the idea of Metropolis Light Transport
 qq MLT is best suitable for ? which kind of scene ??
 qq how to explain those numbers? later
 pruf-re-ok- slides-7 CG3_07_Cache-Based-GI
 ---REVIEW---

 qq how radius update work in ppm?

qq Bidirectional Path Tracing is very bad for?? good for??
 qq idea of Photon mapping: op08 x4
 qq where do we store photons in the scene?
 qq when do we store a photon to caustic photon map? what is the criteria? and when global photon map?
 qq how can we enforce the caustic probability?
 qq when gathering, which hits are accepted?
 qq what is a photon filter?
 qq Radiance Estimation? draw a graph to illustrate op11
 qq how can we estimate radiance in photon mapping?? op11
 qq describe the process of Photon Emission op12
 > how can we compute photon power??
 > location and direction of each photon emitted?
 qq does each photon distribute the complete light into the scene?
 qq illu. the radiance estimate process with a graph
 qq why normalize?? op13
 qq how can we support several light sources?? op13
 > compute total light emitted from the light source, photon power in this case!
 qq what is pixel estimates in PM?
 qq how can we sample reflected direction??
 > how can we update the power of each photon after refraction?? op14
 qq describe Photon Tracing process (part of algorithm, detail view) op14
 qq what kind info. is stored in photon structure?? op15 basic terms x3
 qq how to accelerate the collection of photons
 qq what is cone filter? why use it??
 qq which Different Approximations can be used in rendering pass
 > of photon mapping?? op17
 qq which Two Photon Maps?? diff?
 qq why do not store first diffuse
 qq compare those two photon maps:
 > caustic photon map and global photon map! the diff.??
 qq why we need caustic photon map??
 qq why not store first diffuse in global photon??
 qq how can we do importance sampling in both cases?
 > caustic photon mapping and global photon mapping?? !
 qq when we terminate paths in both maps?
 qq Photon Mapping Discussion, advantages of photon mapping x4x1
 qq pro cons for photon mapping when compared to bpt
 ---inversed PM
 qq the computation time of PM? Inversed PM??
 qq the computational demand for both cases??
 qq the idea of reverse photon mapping?
 qq reverse photon mapping algo? x4
 qq how to estimate photon influence radii in reversed pm?? op23
 qq how can we measure the influences of reverse photons??
 qq the complexity for this?
 qq Pseudocode of the inversed photon mapping algorithm op24

 qq why Photon mapping (PM) is biased??
 qq what is KDE?? why can it introduce bias in PM
 qq PM is not a convergent method??
 qq the idea of PPM? Progressive Photon Mapping
 qq which three important PPM approaches are there?
 qq such three methods have the same radius update? op28
 qq How to store KDE radius that can be updated per iteration??
 qq How to combine the results of photon mapping iterations?? op29
 qq how can we reduce low frequency noise in realistic rendering?
 qq does ppm use reverse photons?? y

qq draw a graph to illu. the PPM algorithm
 qq draw a graph to show SPPM algorithm
 qq the diff. bet. PPM and SPPM?? number of passes can be written as an equ.?

 qq what is randomly gen. hit point? how it affects the rendering result??
 qq in what kind of scene is best suitable for SPPM??
 qq the pipeline for each method -re
 qq hwo can we measure rendering quality?? use
 qq year of SPPM, ProbPPM?

 qq major new contribution of probPPM?
 qq the idea of probPPM -re
 qq what is the main contribution of it?? probPPM! -re
 ---VERTEX CONNECTION AND MERGING (VCM)
 qq idea of Vertex Connection and Merging x2
 qq the MIS formulation of VC and VM
 > light to eye!!! so use MIS in between!
 ---REAL-TIME PM
 qq bsdf = ? + ?
 qq what is the parameter of brdf?
 qq what is the diff. bet. brdf and btdf?
 ---ql pruf-official--with answer
 <> Explain algorithmic techniques
 qq path, light and bidirectional path tracing x4 + x4 + x2
 qq idea of multiple importance sampling according to brdf and L_in x2
 qq what is MIS? +igen
 qq idea of multiple importance sampling in BPT
 qq direct and indirect light sampling
 qq final gathering x2
 qq photon mapping x4
 qq reverse photon mapping x4
 qq progressive photon mapping x1
 qq vertex merging
 qq general idea of gamma-ton tracing x3
 qq idea behind boids
 qq how to simulate a piece of cloth with a particle system?
 qq Why do stiff springs cause problems?
 qq How to model hysteresis in cloth simulation? x2
 qq How can one avoid collisions in a rigid body simulator?
 qq What is contact point and what kind of non-degenerate contacts exist for
 polygonal meshes?
 > 2 non-degenerated contact types?
 > degenerated cases
 <> Explain math
 qq integration over solid angle
 qq Monte Carlo (MC) estimation of integral
 qq variance, bias
 qq why do we need variance in solving rendering equ.? + igen
 qq when is MC better than Rieman Integration?
 qq MC estimation of reflection integral
 qq idea of importance sampling
 qq Russian Roulette
 qq Nusselt's analogon
 qq uniform, rejection, N-rooks, transformation sampling
 qq What parts of the reflection integral in directional form can be importan
 ce sampled?
 qq what is a differential equation? + igen
 qq ordinary and partial differential equations
 qq give some examples of ODE and PDEs?

```

qq reduction to order one system of ODEs, order reduction in phy?
qq explicit, implicit, symplectic Euler
qq what is time evolution function?
qq A-stable
qq what means stiff for a DE?
qq general idea behind step width adaptation
qq how to find the best integrator for a given problem?
qq what is numerical dissipation and how does it influence numerical methods
    for solving incompressible
> Navier Stokes equations?
qq what is the splitting trick when solving ODEs?
qq how can the advection step be approached in a semi-Lagrangian manner? x3
qq how does the pressure update work for incompressible fluids?
qq what are the different boundary conditions used in fluid simulation?
qq how do we interpolate attributes in SPH simulation?
<> Explain physics
qq unit, idea of non-dimensionalization
qq Noether's theorem
qq radiometry: energy, power, radiosity and irradiance, radiance (incoming v
    s outgoing), brdf, albedo(Diffuse BRDF),
> potential, spectral quantities
qq rendering equation in directional, area formulation and operator form, li
    ght path regular expressions
qq geometry factor and visibility
qq emitted radiance of light source, sensor efficiency and measurement equat
    ion
qq brdf properties: Helmholtz reciprocity, energy conservation
qq how to make Phong and Blinn-Phong brdfs physically plausible?
qq explain microfacet models on a coarse level, what are the individual pa
    rts?
qq what do the Fresnel coefficients describe?
qq what is an anisotropic brdf, what an isotropic?
qq how to measure a brdf?
qq how to represent a measured brdf efficiently?
qq What is a bsdf?
qq quantities: mass, acceleration, momentum, (conservative) force. energy (
    kinetic, potential)
qq what different forces do you know? x4 x2
qq inertia moment, inertia tensor, vector representation of angular velocity

> angular acceleration, torque,
> rotational kinetic energy
qq the idea of the Sequential impulse loop/ algorithm + igen, i wrote
qq how can pose of rigid body be described
qq how does pose evolve over time without friction?
qq how does orientation change in dependence of angular velocity?
qq how do forces applied to a point on a rigid body act on its linear and an
    gular velocities?
qq what is a "Kraftstoß" and how does it help to compute the change in momen
    tum during a rigid body simulation
qq what are kinetic and dynamic viscosity?
qq what are incompressible fluids?
---+ql picture notes!
---story mode
---
> angular acceleration, torque,
> rotational kinetic energy
---
---summ. active mode

```

---problems
---extended, from tt slides ref papers
qq what is a radiosity algorithm?
qq which three classes of gi algorithms are there?
qq how can we evaluate the direct illumination part in both cases? approximate and accurate
qq how can we evaluate Caustics part of the reflected integral?
qq the photon map structure is completely separated from the geometric representation? how to understand this?
qq three main types of GI?
qq what is the prob. of this pic? it lacks the fine detail in the illumination
qq what is the biggest advantage of progressive photon mapping??
qq what is Progressive Radiance Estimate
qq In MLT, each path is generated based on?
qq what is nearest neighbor density estimation
qq why the density estimation process can be considered as a way of loosely
> connecting paths from the eye to the light?
qq the final quality of PM is often limited by?
qq two conditions to ensure the convergence of the PM method?
qq how can we model motion blur and depth of field in GI algos? x2
qq Global illumination is computationally expensive for several reasons?
---re-考试复习