

DM815

**Computer Game Programming III:
Physics**

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Spring 2009

Goals for Today's Lecture

Introduction to course:

- Context and contents of course
- Textbook
- Tentative courseplan
- Formalities of course
- Intro to collision detection and physics simulation
- Bounding volumes

Part of Course Sequence at Imada

Fall 2008, 3rd quarter:

Computer Game Programming I: Graphics

Fall 2008, 4rd quarter:

Computer Game Programming II: AI

Spring 2009, 1st quarter:

Computer Game Programming III: Physics

Spring 2009, 2nd quarter:

Computer Game Programming IV: Project

(Other possibilities: DADIU, bachelorproject.)

Subjects covered in course sequence

- GPU pipeline [Course I]
- 3D geometry (transformation, projection) [Course I]
- Rendering (color, textures, lighting and shading) [Course I]
- Acceleration techniques (culling, level of detail, spatial data structures) [Course I]
- Image based techniques (skyboxes, billboards, . . .) [Course I]
- Game AI (path finding, chasing and evading, fighting, flocking, . . .) [Course II]
- Collision detection [Course III]
- Physics modeling [Course III]

Not covered in course sequence

- Graphics APIs (self-study)
- Software engineering, testing (known)
- Game engines (a bit in AI course)
- Level editors, scripting (a bit in AI course)
- Modeling
- Animation
- Sound, music
- Gameplay, narrative, study of genres

Course III Teaching Material

Book:

Real-Time Collision Detection

By Christer Ericson

Published by Morgan Kaufmann, 2005

ISBN 1558607323, 978-1558607323

Notes:

Physically Based Modeling

Noteset by David Baraff and Andrew Witkin

SIGGRAPH Course Notes, 2001

Maybe a few handouts from:

Dynamic Simulations of Multibody Systems

By Murilo G. Coutinho

Published by Springer, 2001

ISBN 0-387-95192

On the Teaching Material

Textbook:

Comprehensive, structured, theoretically solid, and has a well-organized focus on real life issues such as numeric robustness, geometric robustness, and efficiency. Author is both well educated in computer science, and has experience from game industry.

Notes:

Nice coverage, good price. Dense, heavy math.

Extra handouts:

Could add a few details to the notes.

Course Plan

Subject	Lectures
Collision detection	8-9
Physics simulation	5-6

Programming project period: from 3rd week of course to start of next quarter.

Reading Plan, Textbook

- Ch. 1-2: Intro to Collision detection [all]
- Ch. 3: Math and geometry fundamentals [by need (20%?)]
- Ch. 4: Bounding volumes [all]
- Ch. 5: Basic primitive tests [some (30%?)]
- Ch. 6: Bounding volume hierarchies [all]
- Ch. 7-8: Spatial partitioning, including BSP [all]
- Ch. 9: Convexity-based methods [none]
- Ch. 10: GPU assisted collision detection [all]
- Ch. 11-13: Robustness and optimization [none]

Total \approx 260 pages

Reading Plan, Notes

Will cover all parts except sections 4 (quaternions) and 7 (collision detection):

Simulation basics, non-penetration constraints, collision response (colliding contact, resting contact).
First particle, then rigid bodies.

Total \approx 50 pages

Formal Course Description

- Prerequisites:** Programming (DM502+DM503), algorithms and data structures (DM507), and some math (MM501) is a necessity. Knowledge of Linear algebra (MM505), numerical analysis (MM518) and basic 3D programming (DM809) helps.
- Literature:** Textbook and notes
- Evaluation:** Implementation projects (pass/fail), oral exam (7-scale)
- Credits:** 5 ECTS
- Course language:** Danish or English

Time and Place

Mostly:

- Tuesdays 12.15-14.00 (Imada seminar room)
- Fridays 12.15-14.00 (U49E)

A few:

- Mondays 10.15-12.00 (U49B)

No examinatorier (programming projects take up the time).

Project

Small project (in groups of 2–3) must be passed to attend the oral exam:

Try out one collision detection techniques and moderate physics simulation.

Example programs, or a continuation of previous project from DM809.

Must run without problems on either Imada machines (Linux), or on Windows XP or Vista.

On the Course

- Algorithms and data structures
- Math
- Depth
- Includes (technical) programming

Some sweating can be expected. . .

(Please note: it is a graduate course.)