
UMEÅ UNIVERSITET

Visual Interactive Simulation 2015

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Course web (and schedule):
http://www.cs.umu.se/kurser/5DV058/HT12/

Mailing list:
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Overview

- Schedule
- Lectures and guest lectures
- Lab projects
  - Particles
  - Spring-and-damper cloth
  - Constraints
  - Rigid bodies
  - SPH
  - Integration
- Written exam

- MSc project… ☺
- PhD project…

Goals

- Review of basic physics

- *Learn* about .e.g: rigid body mechanics, interacting particles, particle fluids (SPH), constraints, numerical integration, geometric interference and contact sets, solving linear systems with complimentarity conditions, computational aspects, parallelism.

- *Skills* in implementing the above, in a bare bones physics engine. Understand the structure of a physics engine. Know about *other physics engines*, and how they work.

- Understand how visual interactive simulation can be used in *science* and *industry*, and how to bring new *ideas* into these areas!

- *Understand* how to relate to and *activate* in the *science* of this field. Be able to read research papers.

Course information

Timetable and readings:
http://www8.cs.umu.se/kurser/5DV058/VT15/5dv058sched.html

How to pass and get good grades:
http://www8.cs.umu.se/kurser/5DV058/VT15/info.html#grading

Application of physics sims

Computer games, e.g. PhysX, Havok, Bullet, Box2D.

Enables realism, and gameplay, aka Angry Birds!

Simulators and VR

Enables realism, training effects, efficient modeling.

E.g. CMLabs (Vortex), Algoryx (AGX), Oryx, Kongsberg, SurgicalScience,..

VFX, animation, design

Exotic Matter, RealFlow, SideFX (Houdini), Autodesk (Max, Maya etal), Blender, Cinema4D.

Engineering, design (CAD/CAE)

Mathworks/Matlab, Modelica, AGX, Siemens, LMS, Autodesk, ANSYS, Dassault, MSC, Wolfram, Maple, PTC, ABB RobotStudio...

Model-Simulate-3D-print

Examples

PhysX
https://www.youtube.com/watch?v=1o0Nuq71gI4

Oryx
https://www.youtube.com/watch?v=baEDS283fWE

AgX Dynamics for Spaceclaim by Algoryx:
https://www.youtube.com/watch?v=4Uz_5H16AHQ

Surgical Science
https://www.youtube.com/watch?v=Rx5tsd4UdHI

RealFlow
https://www.youtube.com/watch?v=WD_K0Koi1MU

Model-simulate-3D print
https://www.youtube.com/watch?v=laKIZ-WL9Go

VRlab, UmU, Anders Backman
Physics based interaction
https://www.youtube.com/watch?v=-vNEFmSTGIw

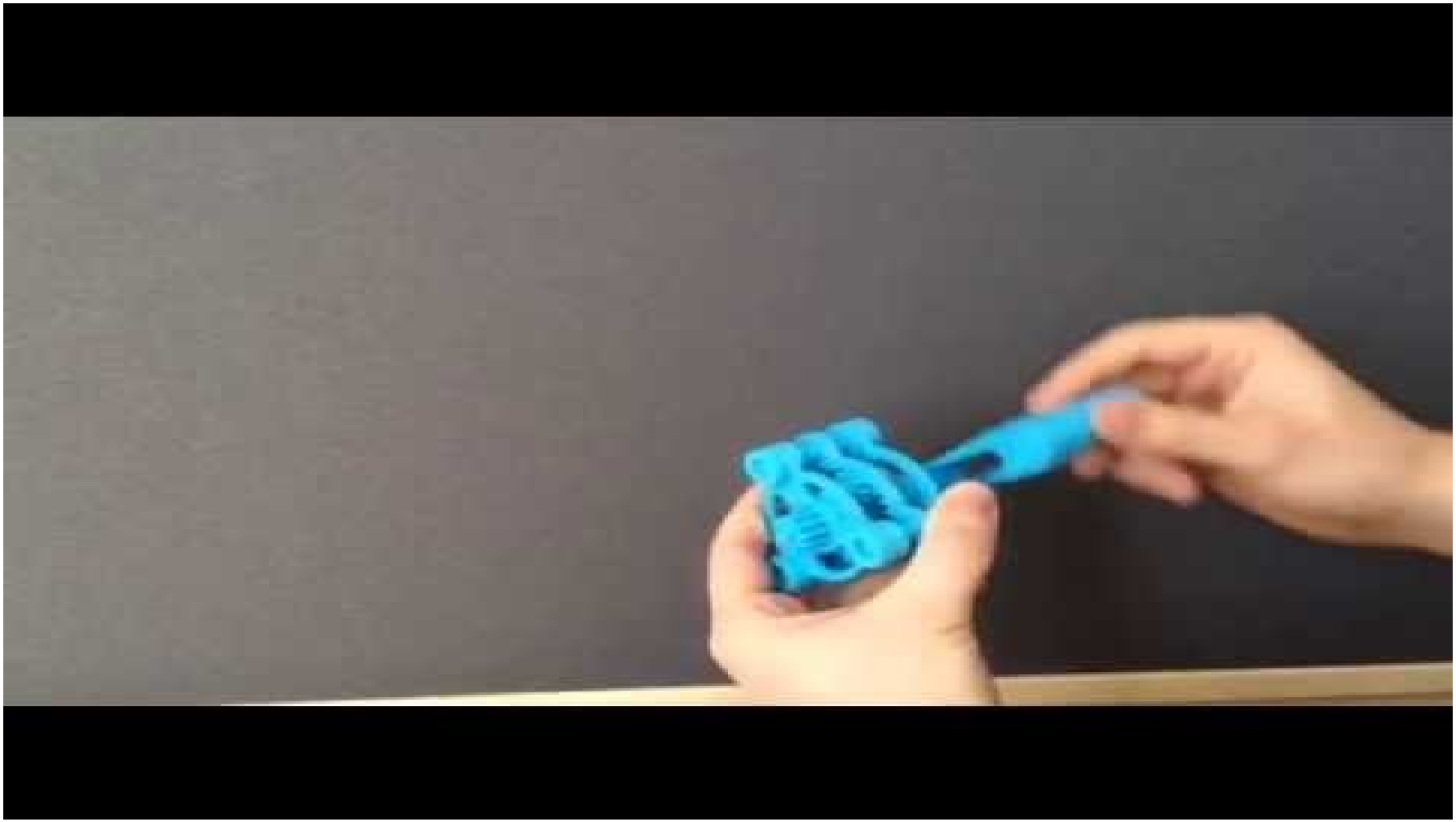
UMIT, for many examples, and local research.
http://www.org.umu.se/umit/english/


Global
Render
Dynamics
NVIDIA
GAMEWORKS


Place basket in green area and lift the hook of the machine.
Support the machines weight by placing the back of the basket on the green marker and lifting the front end of the tractor off the ground.


Dynamics for
SPACECLAIM
With great Power, comes
great User-Friendliness
algoryx


REALFLOW
2014



http://www.popsci.com/technology/article/2012-11/video-largest-most-hi-res-cosmological-simulations-known-universe#ooid=FnZ2UxYjrghuy-iKaz0b0FFTJ1iR5FSl


Succé

Application of physics sims

Convergence is coming to a device near you!

Games, science, engineering – getting closer and closer.

Democratization of physics simulation is an in-thing!

It means that not only specialists can simulate, but just about everyone!

- Every student, pupil, teacher, doctor, engineer, designer, …
- But why? And how to make it accessible?

What is simulation?

No single definition is appropriate.

However, most agree that you:

- need a mathematical model
- need a method and computer program to simulate the model
- often run the simulation step-by-step

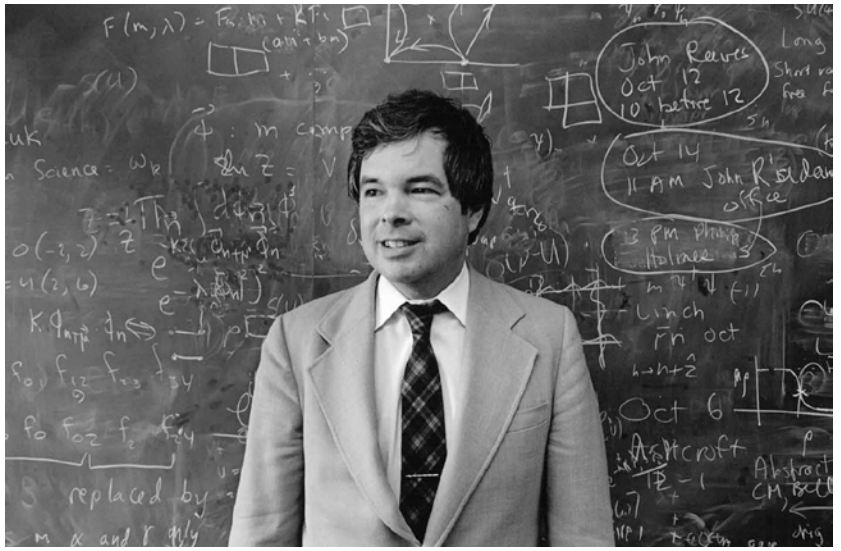
The model can attempt to model the real world, or something artificial. The model may be a differential equation, or e.g. an agent model.

Ref: Stanford Encyclopedia of Philosophy
http://plato.stanford.edu/entries/simulations-science/

Third paradigm

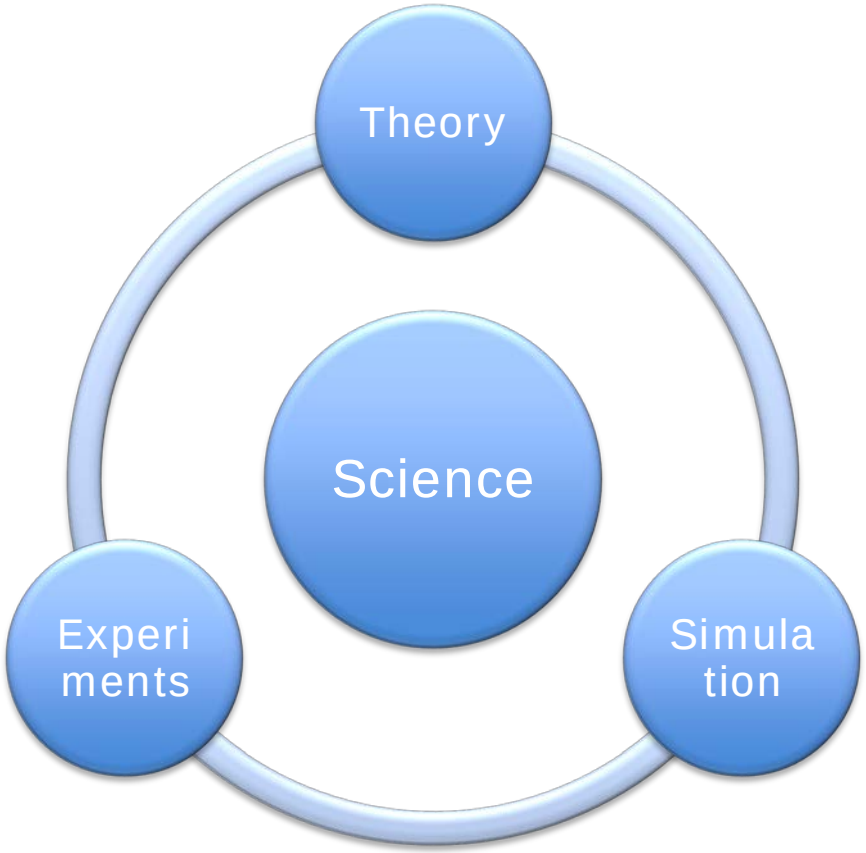
"Computational science is now the **third paradigm** of science, complementing theory and experiment."

(This view is criticized by some, but it still indicates the impact of computational science)

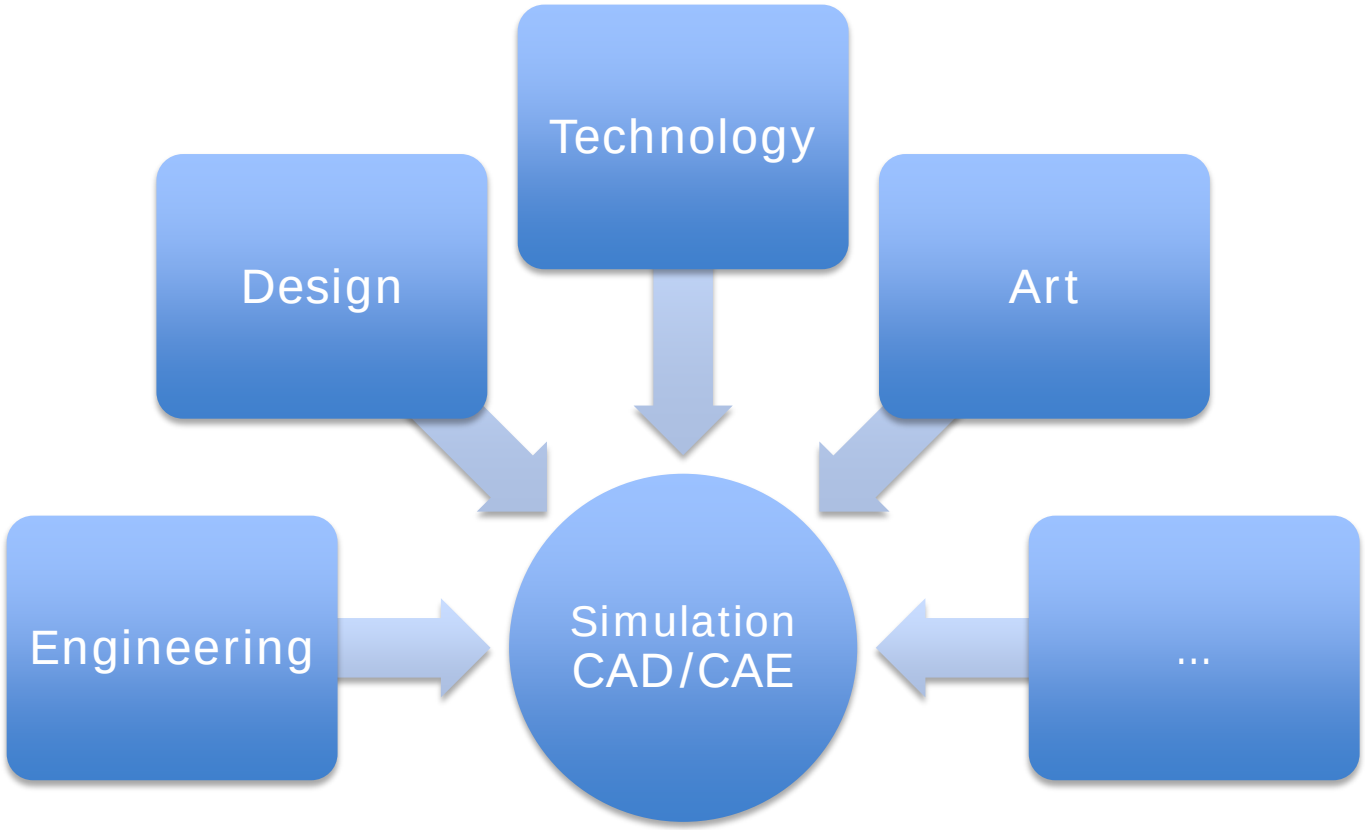


Kenneth G. Wilson, 1936-2013
Nobel Prize in Physics 1982

Computational Science



Computer Aided Engineering



Mega Trends

Mobility
Interactivity
3D-visualization
Democratization
Parallelism
The Cloud

Simulation to become a cognitive tool, that enhances our mind.

See also the national agenda:
http://www.liu.se/forskning/syssimagenda?l=sv

Future capacity of simulation

What is the sci-fi of physics + computer graphics + interaction?

10 years?

100 years?

1000 years?

How many interacting bodies (or ”degrees of freedom”) is it possible to simulate in realtime on a modern PC? 1000, 1M, 10M?

In the cloud? In 10 years and 100 years?

Democratization of CAE

Right now around 5-10 million engineers use simulation on a regular basis and are skilled using simulation tools. Around 0.5 millions engineers are specialized on simulation as their main area of competence.

Assume 50-100 million engineers are regular users of simulation in 15 years from now. What would enable this? What would software look like? What do they do and how? What difference will it make?