

INF585 - Computer Animation

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Team: Geometric & Visual Computing

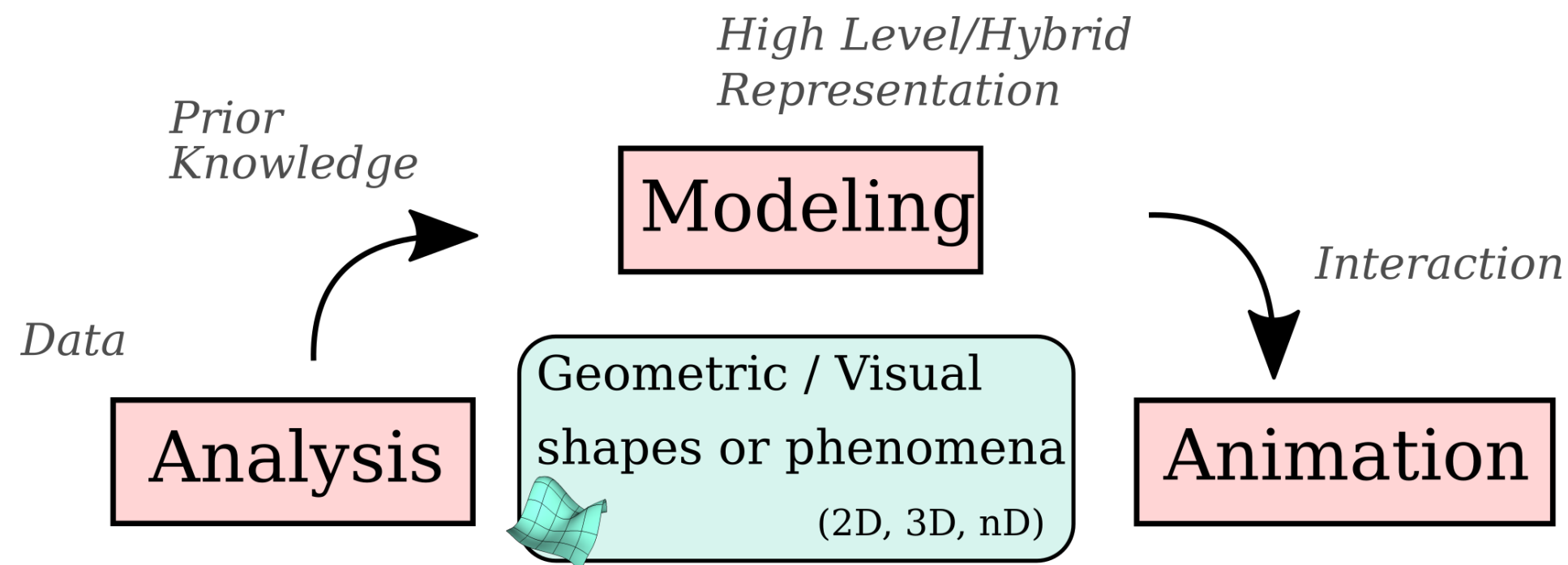
Area **Computer Graphics** et **Computer Vision**

Research in **Geometric and video analysis, Modeling** and **Animation**.

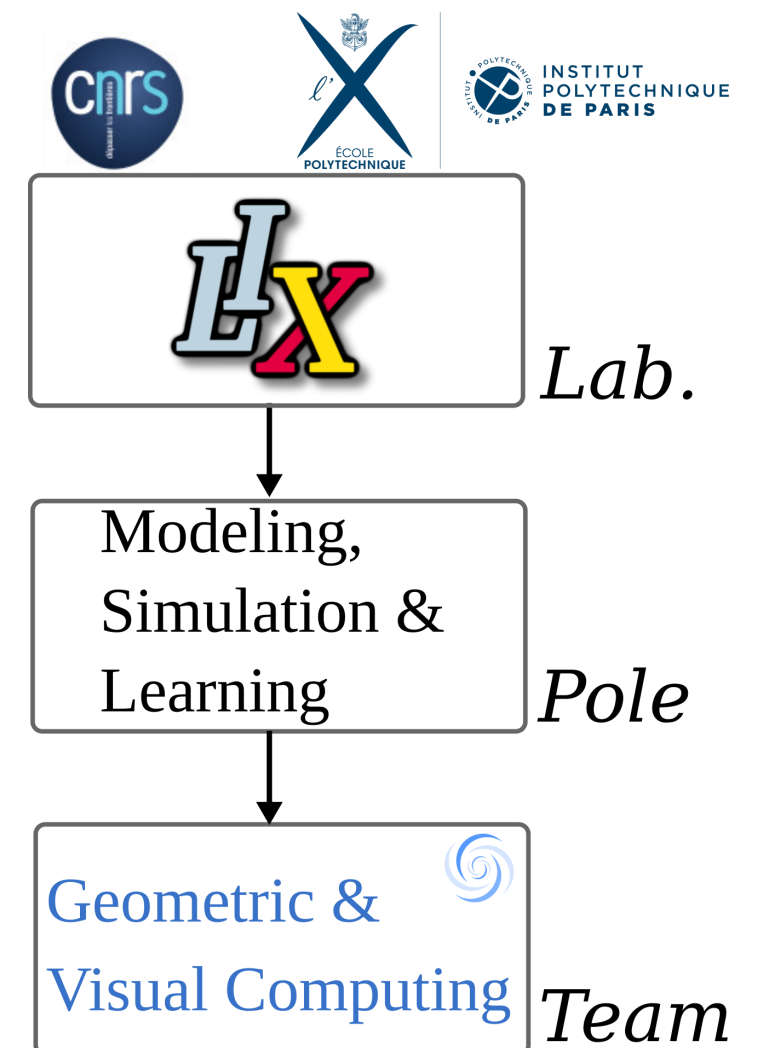
www.lix.polytechnique.fr/geovic/

Part of **LIX** (Laboratoire d'Informatique de l'Ecole Polytechnique), CNRS/X, IP Paris

Pole "**Modeling, Simulation & Learning**"



Underlying tools: Computational geometry, Learning, Optimisation, Mathematical Modeling, etc.



Course objectives

Provide general knowledge on 3D Computer Animation in **Computer Graphics** (CG) field

- **Shape deformation**
- **Geometric animation**
- **Physically-based animation**

Mostly **application oriented** course

- Get use to **CG programming** (C++, OpenGL)
- **Interactive**, real-time, oriented lab class

Knowledge of the main approaches used

- in standard industry (movie production, video games)
- in research

Be able to implement several approaches in interactive CG context.

Prerequisites

You are expected to have followed *INF443* (Graphique 3D) or equivalent

- 1- Base of CG (surface representation, projection, 3D geometry, mesh structure)
- 2- Basic C++ knowledge
- 3- Basic understanding of OpenGL

If you don't have the pre-requisites

- There will be some short reminders for CG knowledge within the class
- Tutorial you can follow to start: C++, OpenGL (but in your own time)

Note:

- You can survive with very few OpenGL knowledge
- C++ is however crucial for the lab class!

Take care if you are not used to it, it will go fast. (application oriented class)

Grading

Project ($2 \times 4\text{h}$ in class) $\simeq$ 60% grade.

Single or in pair.

Hand out: Your code + video + written report (no oral).

To be refined: Short tests/Quizz (1 or 2) during class

In person or at distance/Moodle depending on the evolution of the situation

Note: Lab classes are training exercises (not graded, solutions can be provided)

- You may go to your own speed, organize as you wish
- There should be a minimal/expected objective

It is ok to stick to the minimal objectives for those who are less familiar with graphics and C++.

Lecture / Lab class organization

Provisional schedule for

- 7 × ~2h **class** + ~2h **TD** (programming)

- 2 last class ⇒ 4h **Project**

Maybe an external intervention

Remote organization:

Lectures:

1. Pre-recorded videos + slides

Sometimes: questions in the lectures

2. Discussion about the questions in the lectures (not all the time)

Lab Class:

- Subjects are available online

- You code on your own computer (when not at school)

- Teachers (Maud Lastic, Jiayi Wei, myself) will be available during the 2h:

- > No general Zoom meeting: only individual ones.

- > Discord channel to discuss: INF585 <https://discord.gg/YsyFaMCD3u>

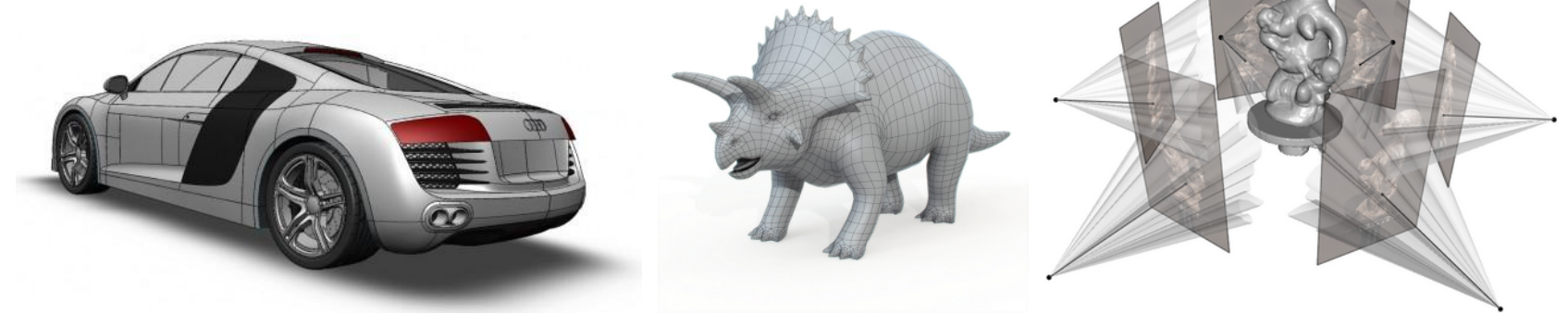
Please register to it so that we can follow you.

- > **Online waiting list**: please add your name on it when you have a question.

Computer Graphics main SubFields

Modeling

How to create static shapes



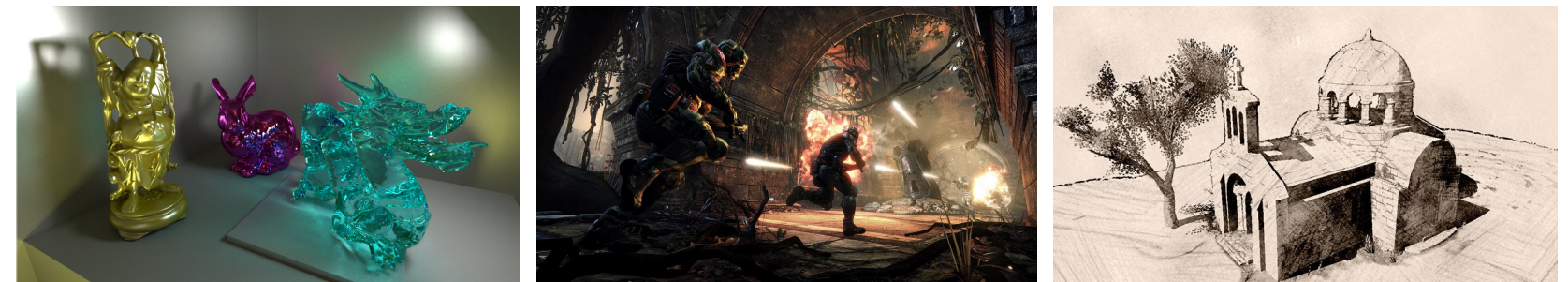
Animation

How to create and author time varying shapes



Rendering

How to generate 2D images from 3D data

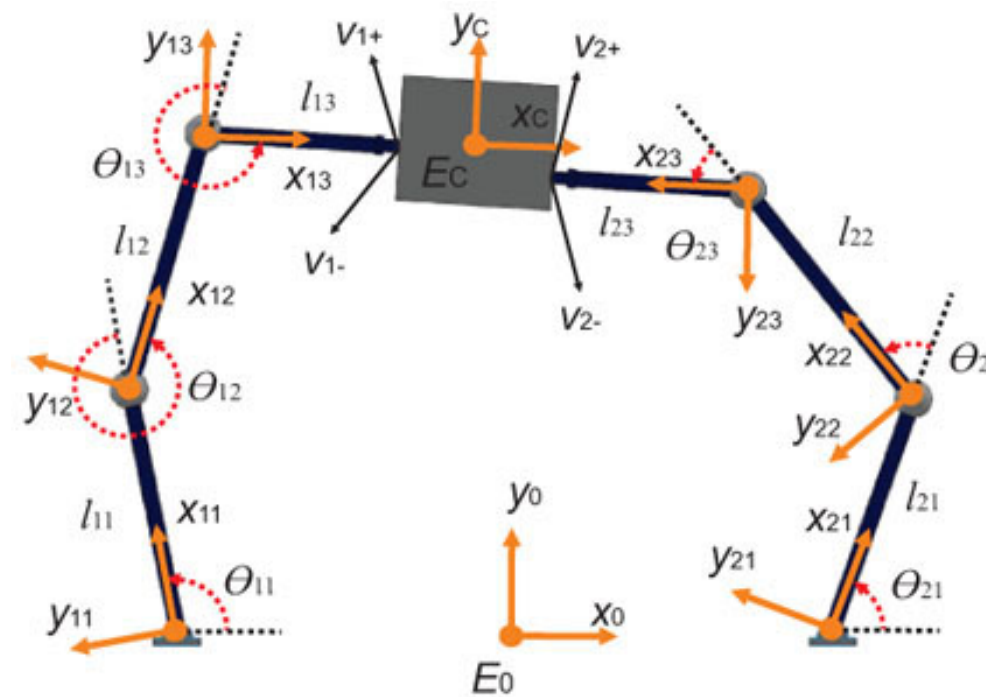


Animation in Computer Graphics

Two main ways to describe animation

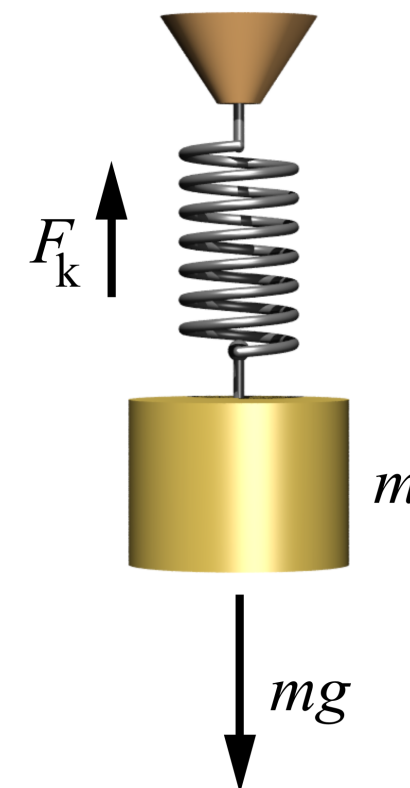
1- Kinematics

Shape deformation/motion without knowledge of the physical cause of the motion



2- Dynamics

Motion through forces acting on shapes (ex. physically based simulation)

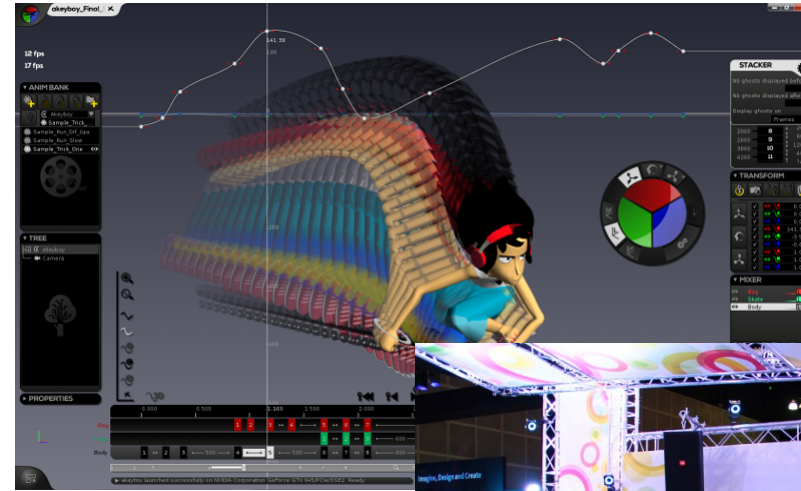


Animation in Computer Graphics

Ways to generate animation

1- Descriptive animation

Fully designed trajectory



2- Motion tracking

Real data acquisition



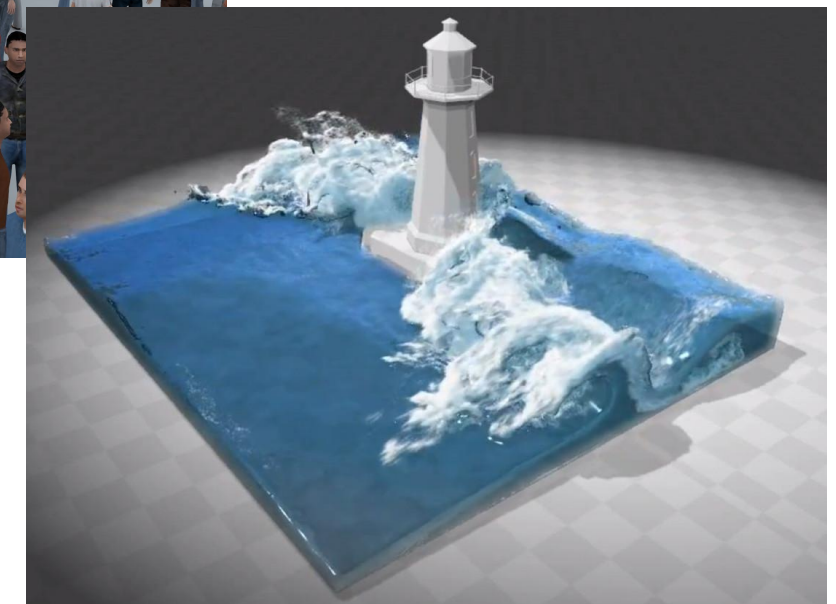
3- Procedural generation

Automatic synthesis



4- Physically based simulation

5- Learning-based synthesis



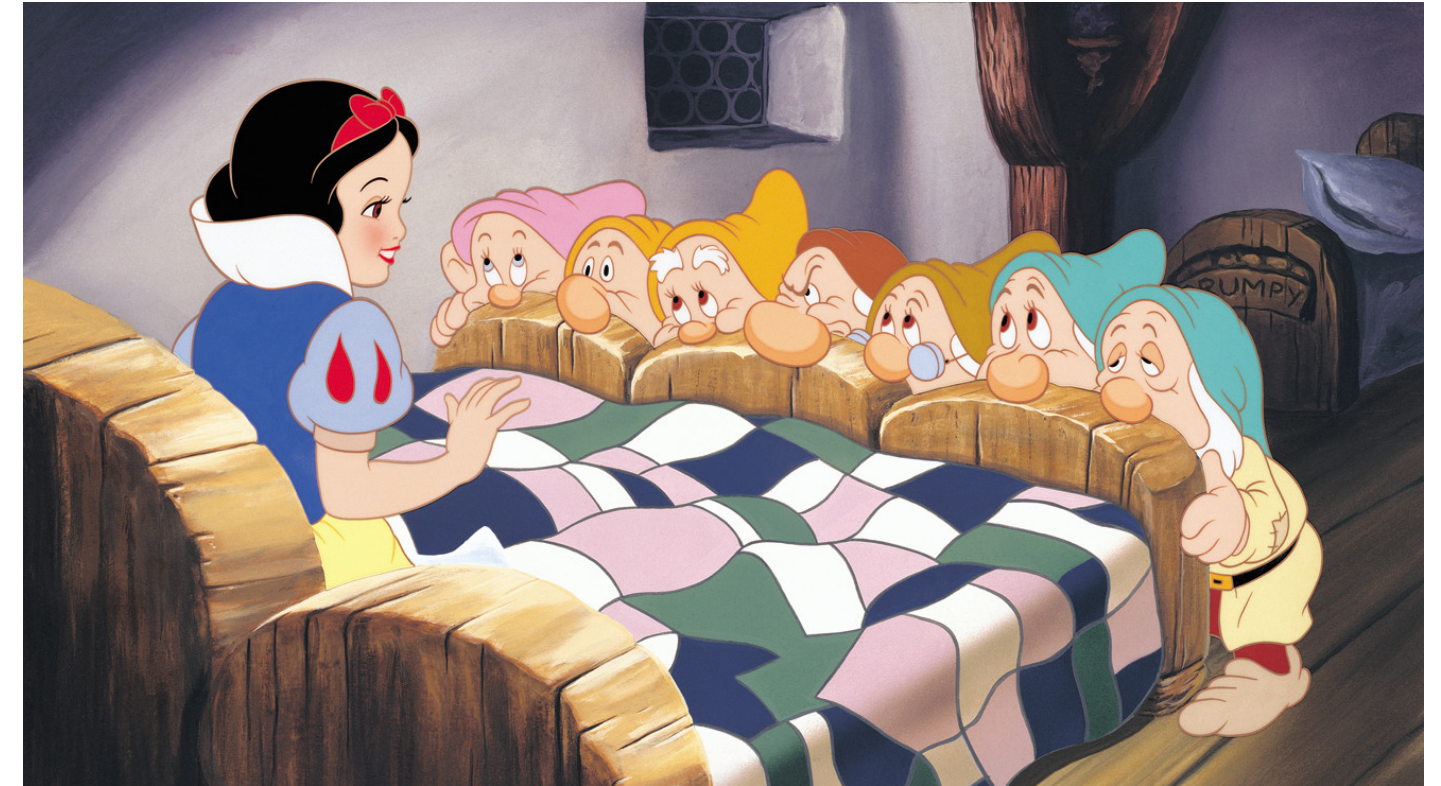
History of CG Animation

First production of animated films (Disney)

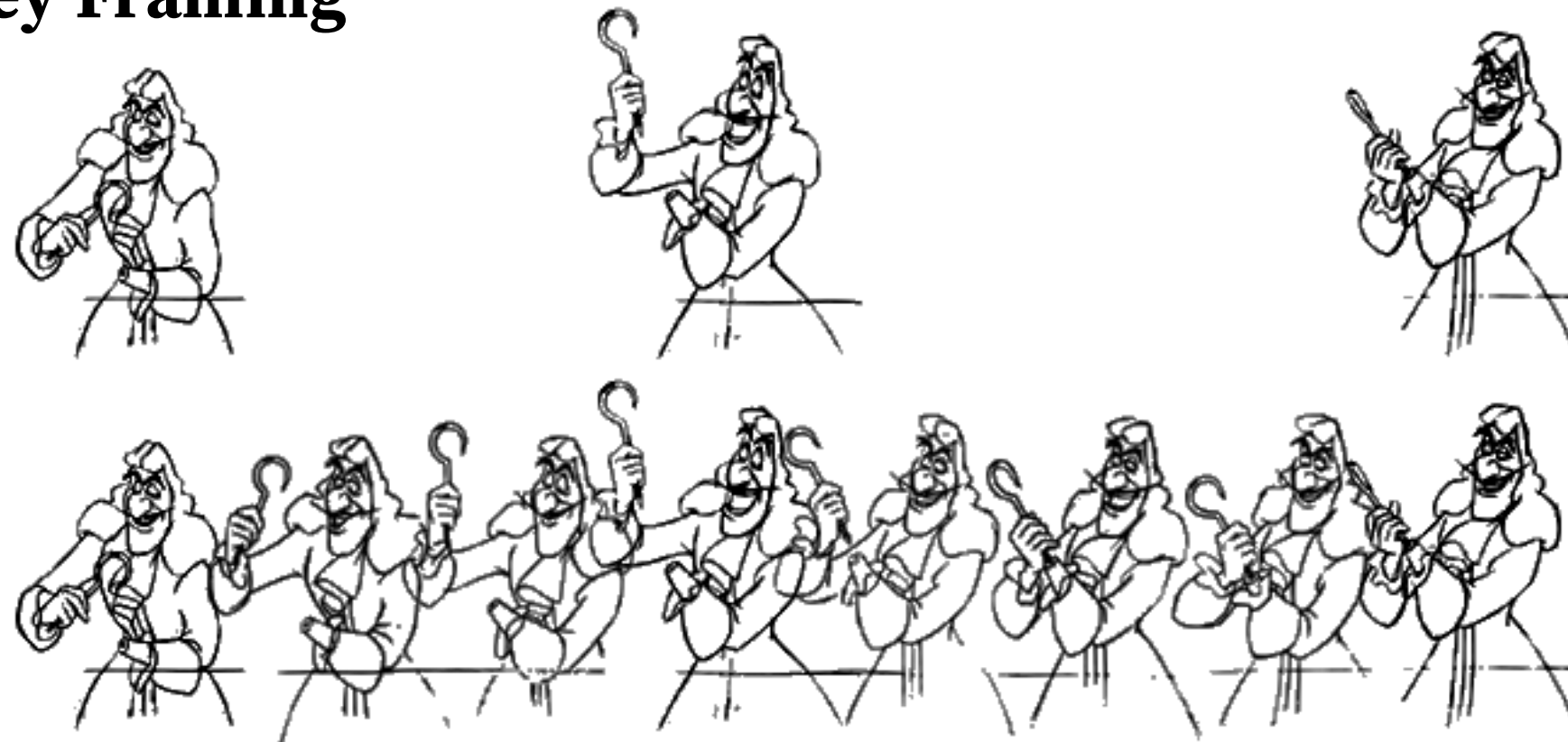
- 30 drawings / sec

Principle

- *Animator in chief*: Create **Key Frames**
- *Assistants*: Fill the *in between* (secondary drawings)



=> Principle of **Key Framing**



(c) Walt Disney Company, from "The Illusion of Life"

Key Framing in CG

- Create *manually* a set of **Key Frames** at specific time steps
- Compute automatically intermediate frames (30 fps) using **interpolation**



Topics schedule

Geometric Deformation and Kinematics Animation

- Introduction to Procedural Animation - particles, noise
- Interpolation positions and affine transformations
- Interactive deformations: volume-based, surface-based
- Animation Pipeline in Production
- Character Animation

Physics-based Animation

- Simulation models
- Hard spheres
- Mass-springs cloth simulation
- Rigid and elastic bodies
- Fluid simulation (Stable Fluids, SPH)