

What is modeling?

- Models describe the natural world using idealizations that
 - simplify ...
 - capture ...
 - match ...
 - enable predictions that can be tested against experimental data

Which idealized systems do you remember from your physics classes?

- simple pendulum
- ...
- In which way were they idealized (what was neglected, what was retained)?
- How did you work with these models? How did you find solutions?

Simulations provide an alternative to exact or approximate solutions. They are often used

- for complex systems, where exact solutions are not available and approximations difficult to find
- to test analytical solutions and approximations
- to explore a system and find out where “interesting things” happen
- as an alternative to costly experimentation

What are simulations?

An untypical example: Simulation of traveling waves with the aid of a crowd in a stadium.

How would you instruct the spectators in a stadium to simulate a pulse traveling along a string?

How would you tell them to simulate a traveling wave, a standing wave?

How would you simulate a two-dimensional plane wave or a spherical wave?

Simulations require

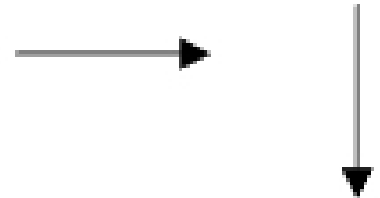

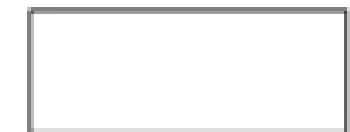


- a model, i.e. a representation of the physical system
- a set of instructions

Examples for simulation techniques:

- Monte Carlo
- Molecular dynamics
- Finite element methods
- Variational methods
- Finite difference methods
- Spectral methods

Flow diagrams (flowcharts)

Elements:

flow line	connector	statement	question	input/output
				

Structures:

