Net Simulator for Debris Removal Mission

developed under ESA contract

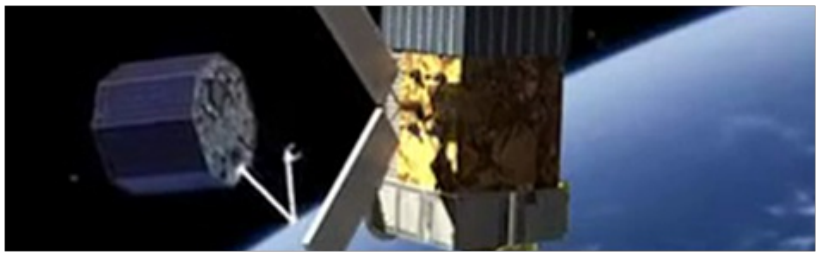
Net parametric characterization and parabolic test

Wojtek Gołębiowski

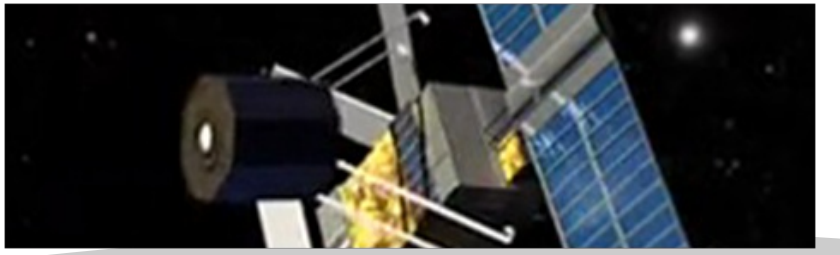
SKA Polska

Space Debris

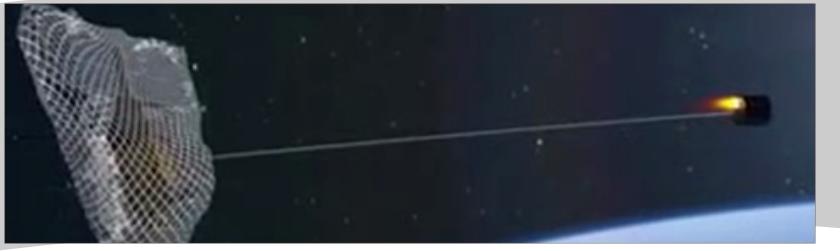
Robotic arm



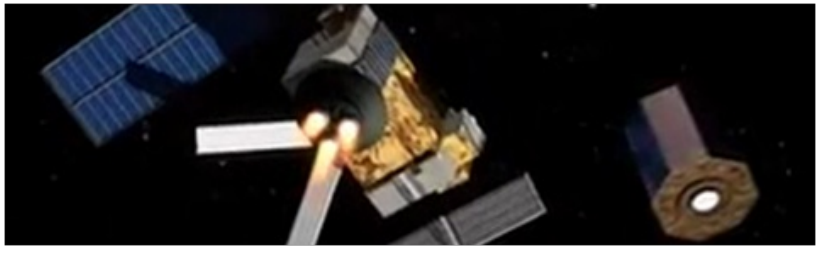
Tentacles



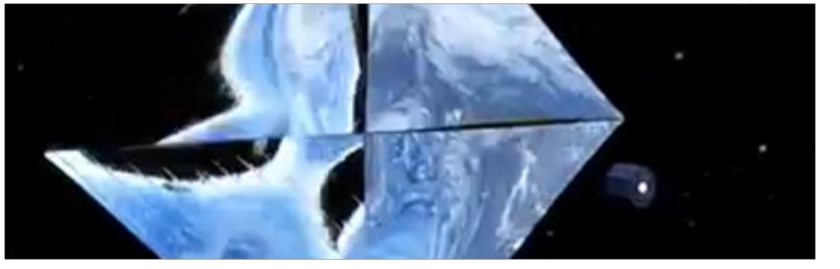
Net



Attached engine



“Solar sail”



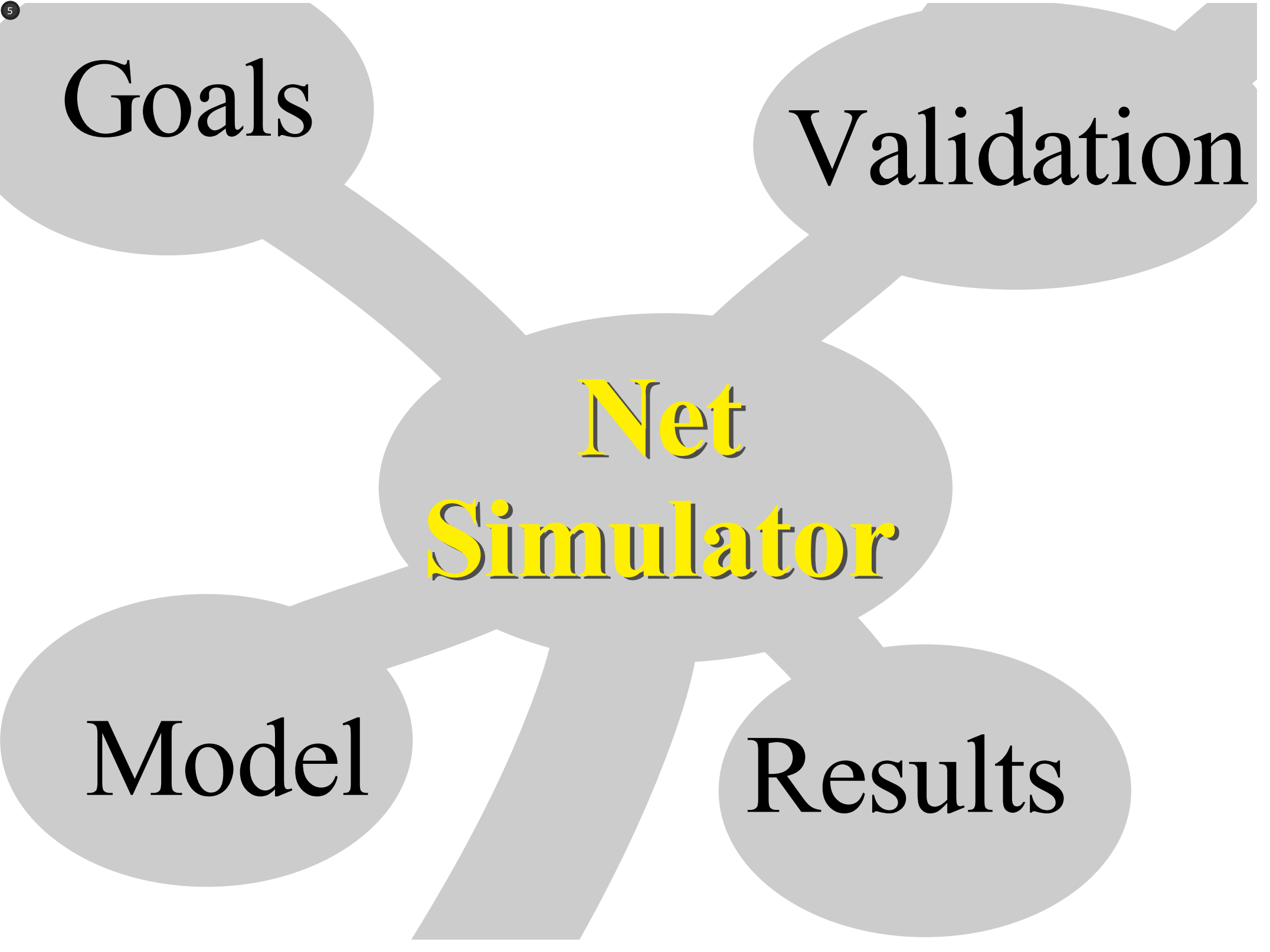
Ion engine

Nets pros

- Lower requirements for AOCS and rendezvous
- Better debris shape and attitude tolerance
- Lower cost

Nets cons

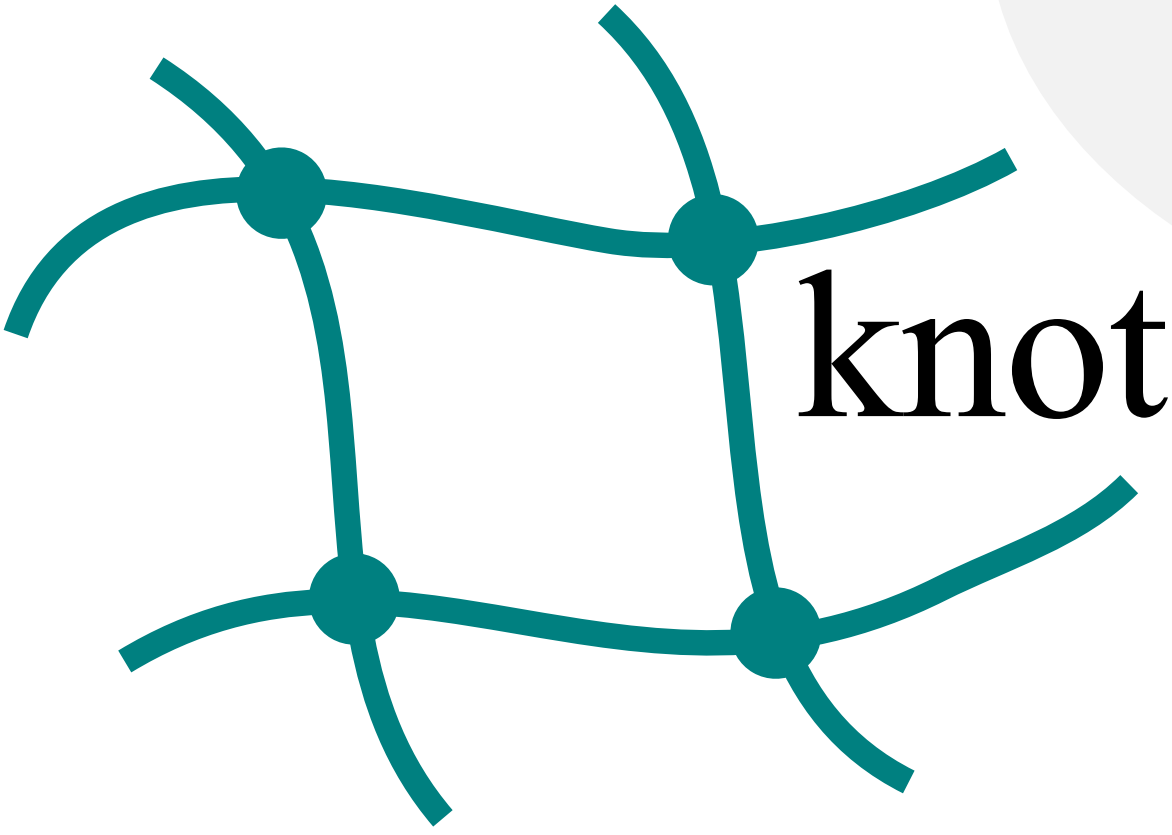
- One shot per net
- Limited number of nets
- Closing mechanism
- Thermal requirements for tether
- Uncertainty of flight


Goals
Validation
Net Simulator
Model
Results

Goals

- Nets applicability limit
- Capturing scenarios
- Mission specific net design
- AOCS of chaser
- Ground station support

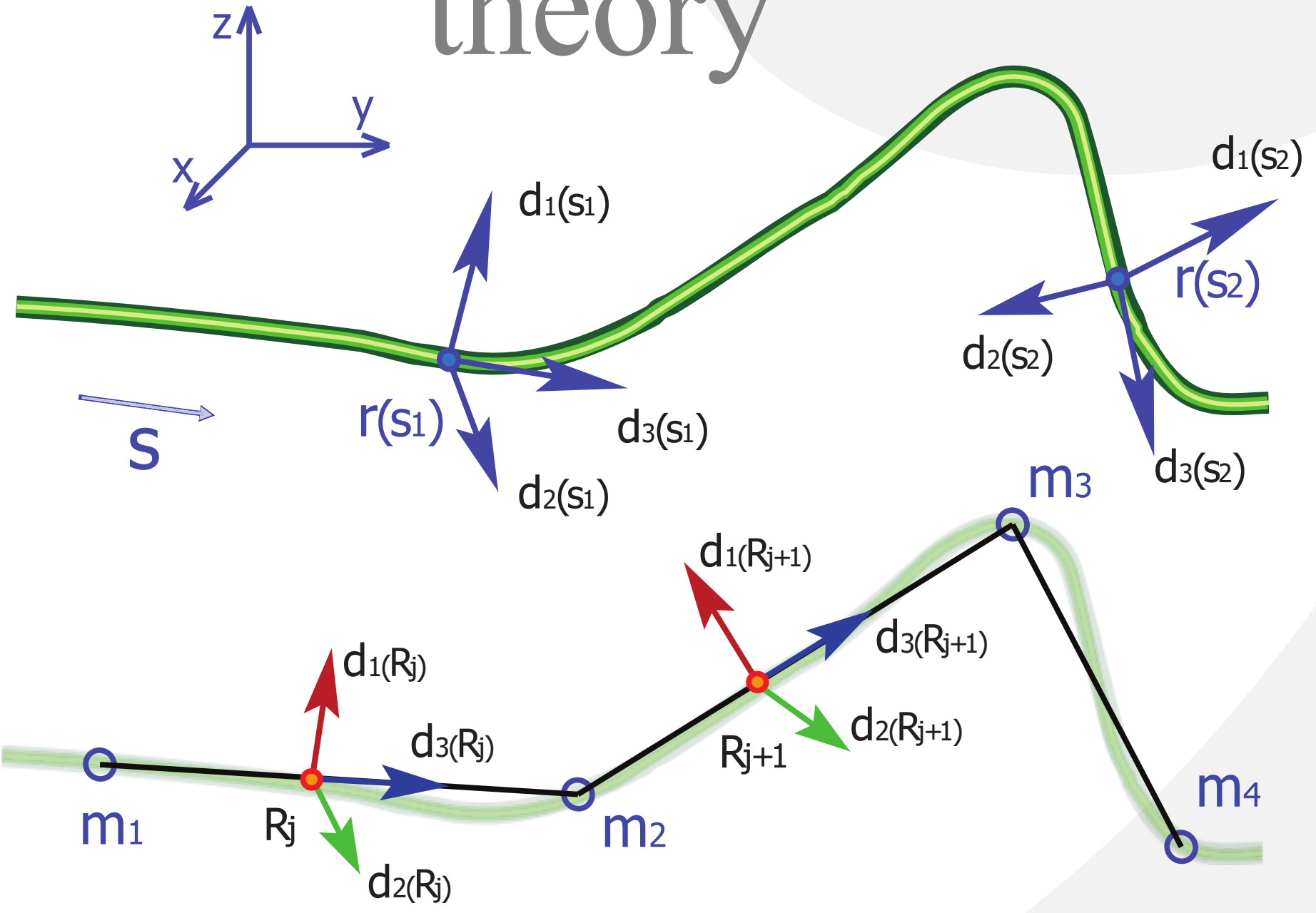
Model



knots + threads

rigid bodies

Cosserat rods theory Model



Results

Results

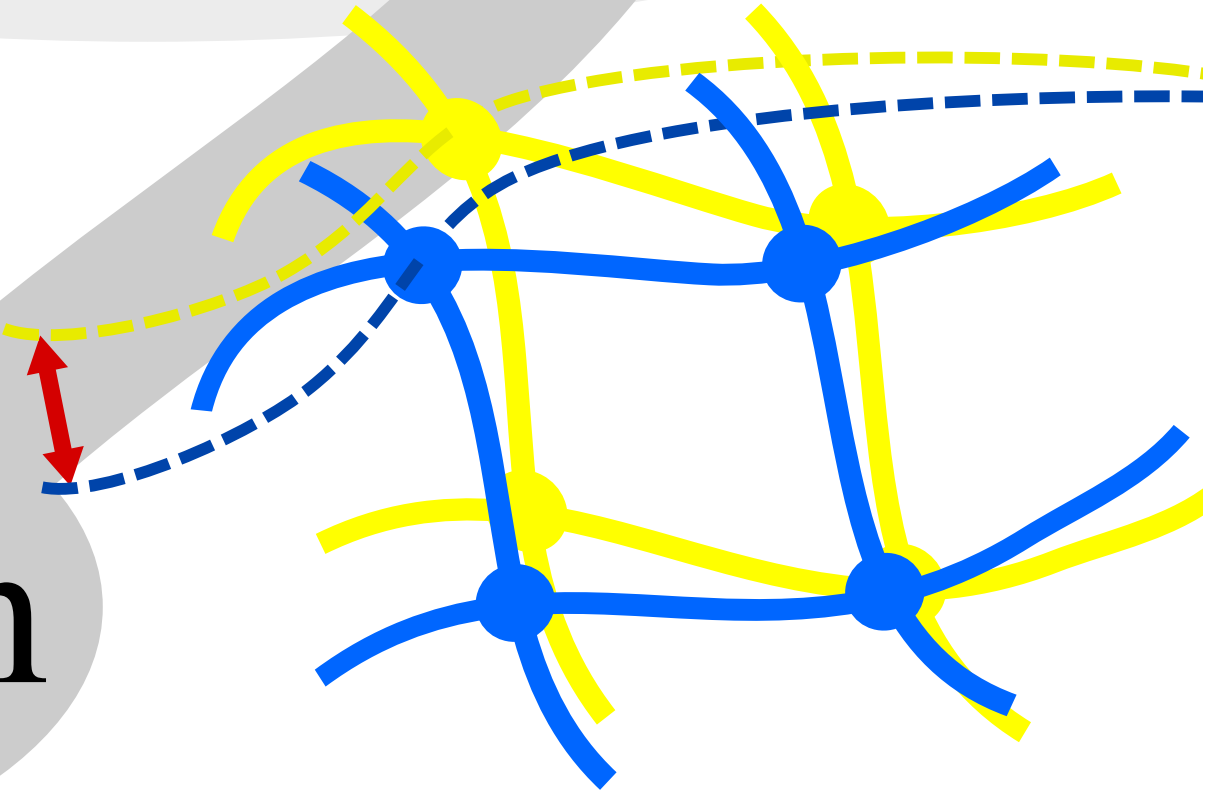
Results

Cosserat rods

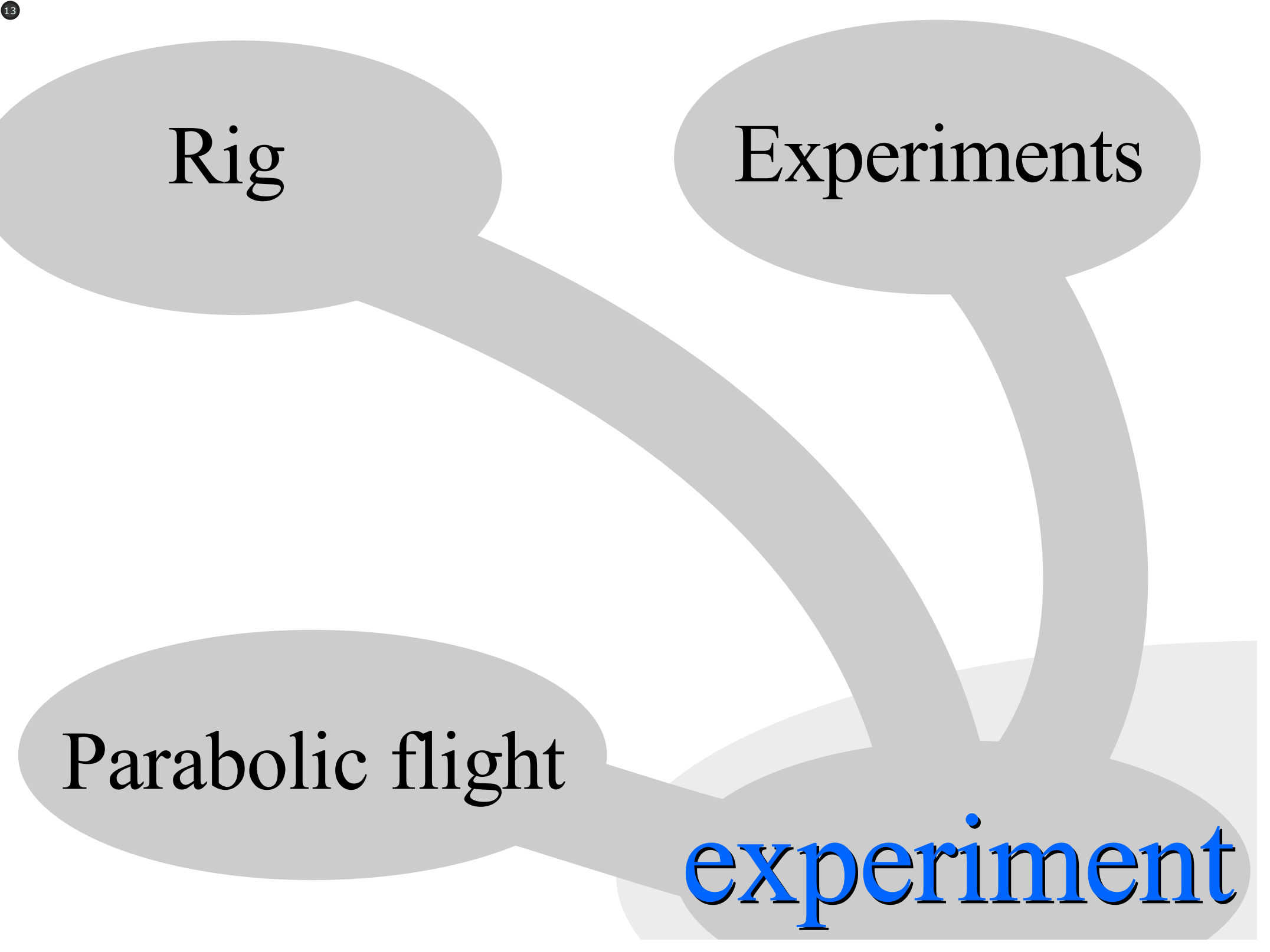
Abaqus

experiment – simulation

= error



Validation


Rig
Experiments
Parabolic flight
experiment

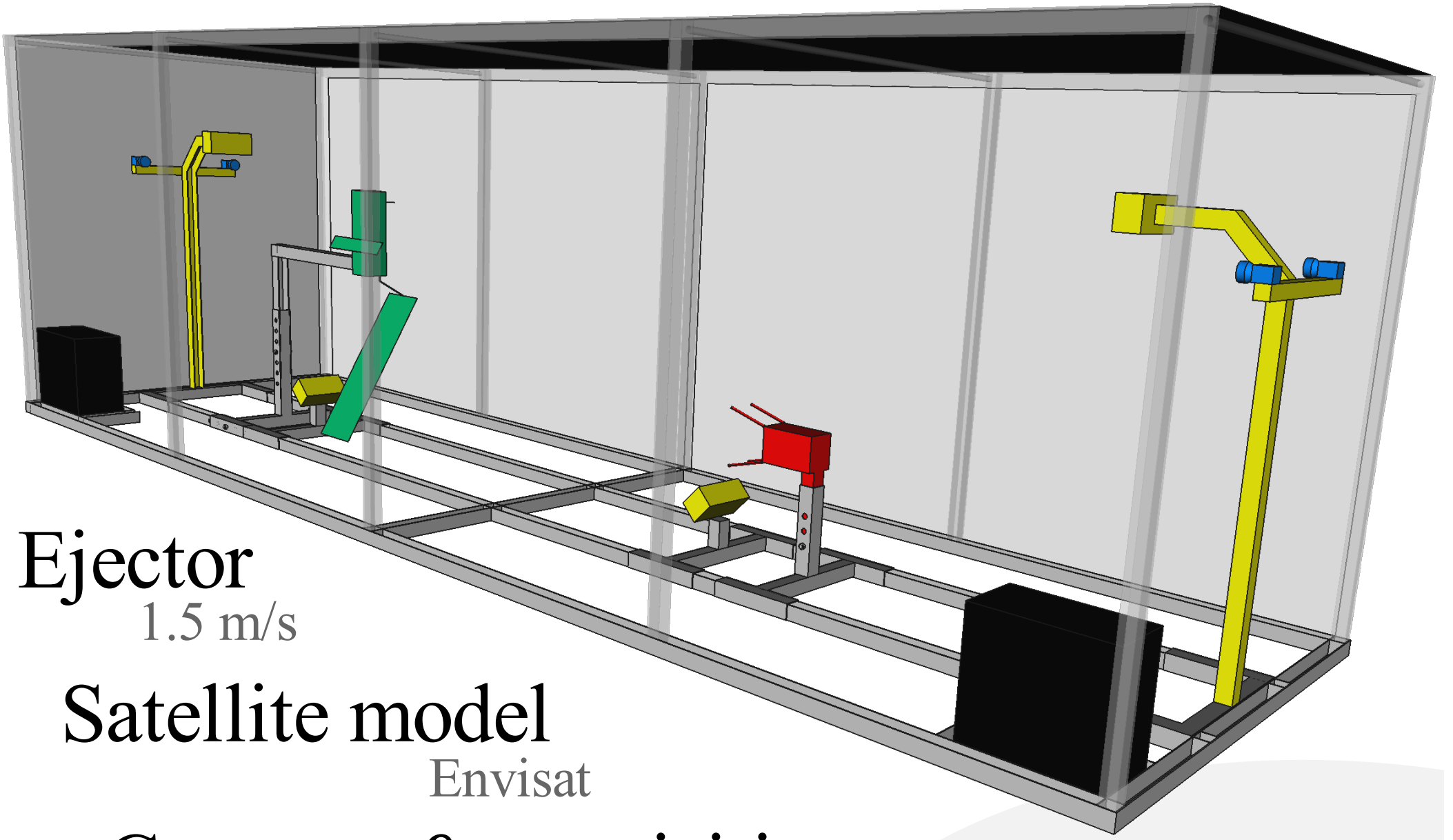
Parabolic flight

- 20 parabolas
- 18 s of zero-g
- ~6 x 3 x 2 m

scaling 1:25

similitude

- Cameras



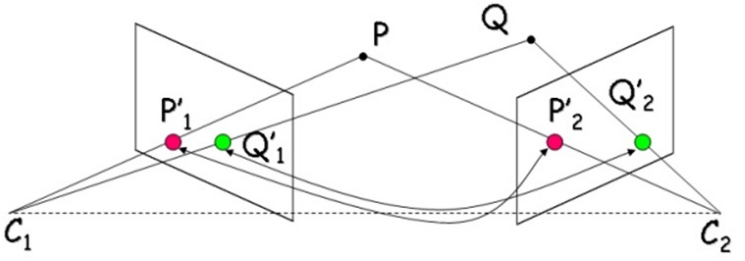
Ejector

1.5 m/s

Satellite model

Envisat

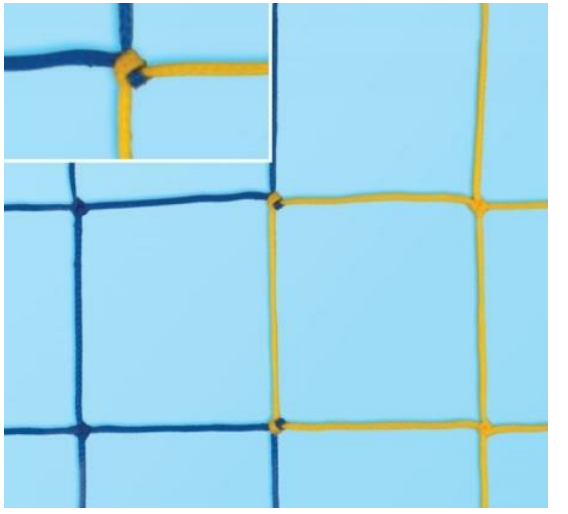
Cameras & acquisition

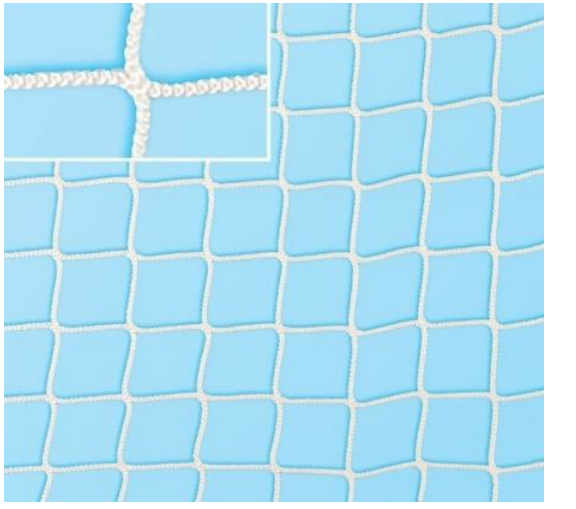


4 MPx
180 fps
4x 750 MB/s

Rig

2 nets

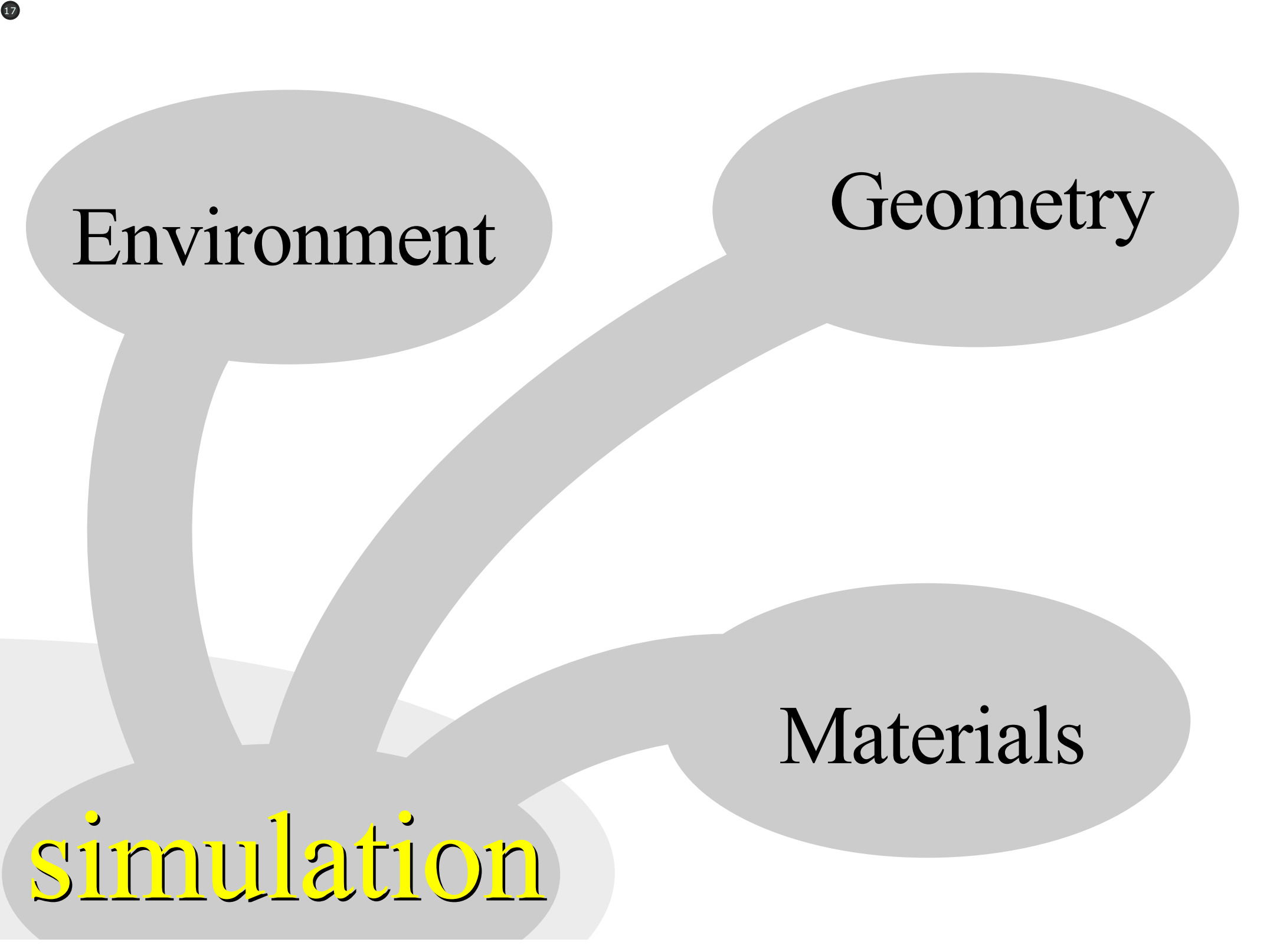




2 velocities

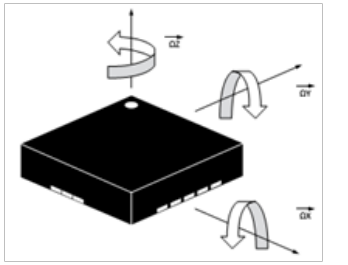
5 repeats

Experiments


Environment
Geometry
Materials
simulation

Coriolis force

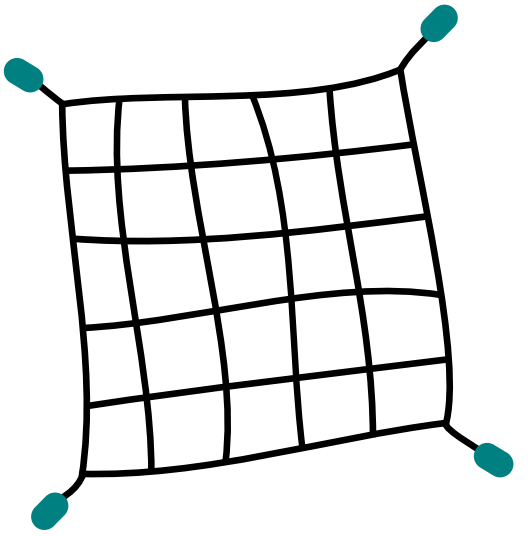
pseudo-gravity



Air drag

Environment

Net Ejector Satellite



Geometry

Model

Linear density

Stretching
stiffness & damping

Bending
stiffness & damping

Torsion
stiffness & damping

Materials

Linear density

Stretching
stiffness & damping

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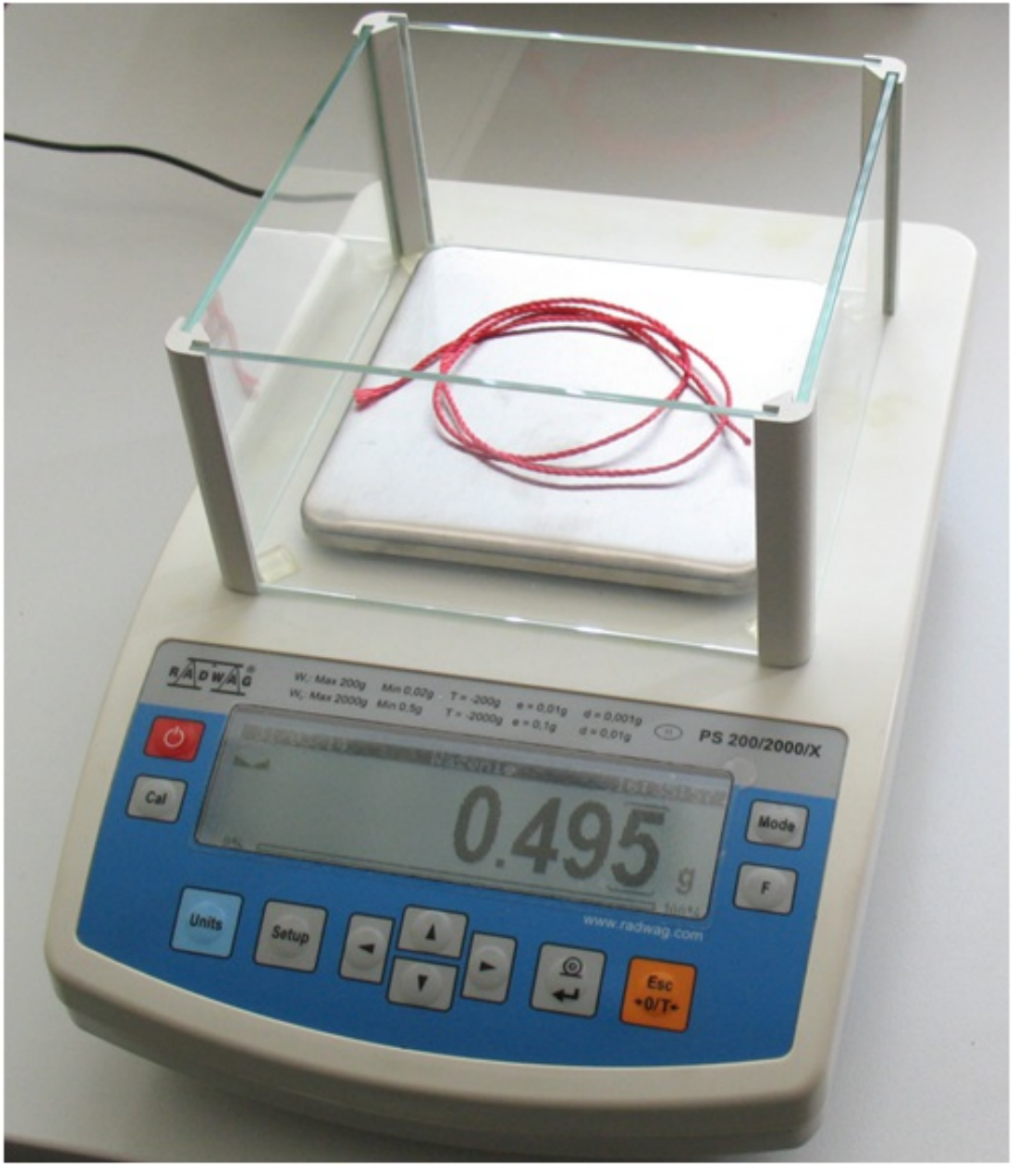

Linear density

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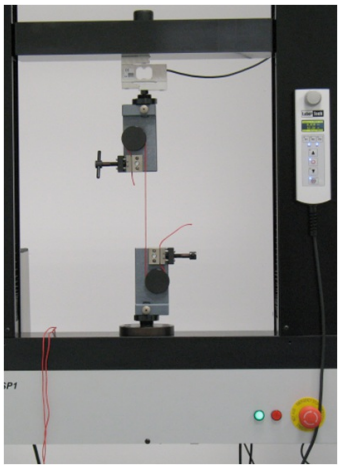
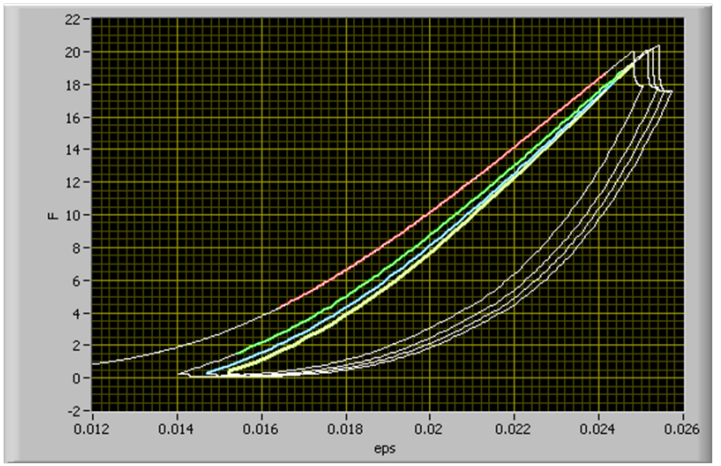
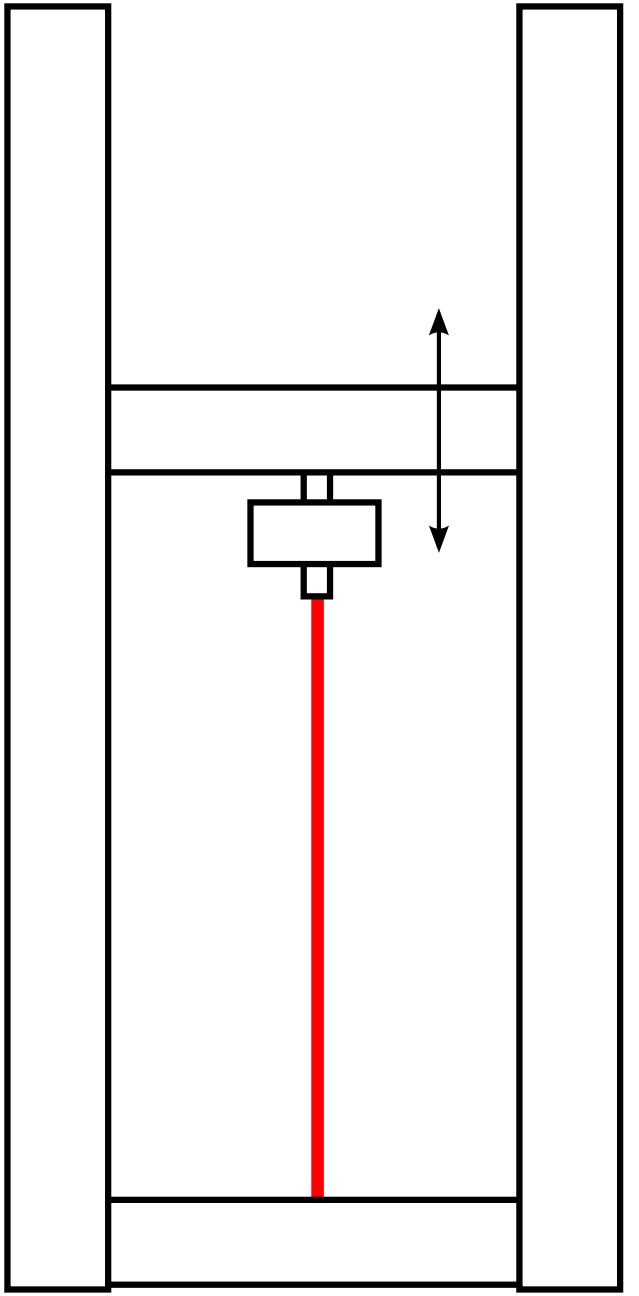
stiffness & damping

Torsion
stiffness & damping







Linear density

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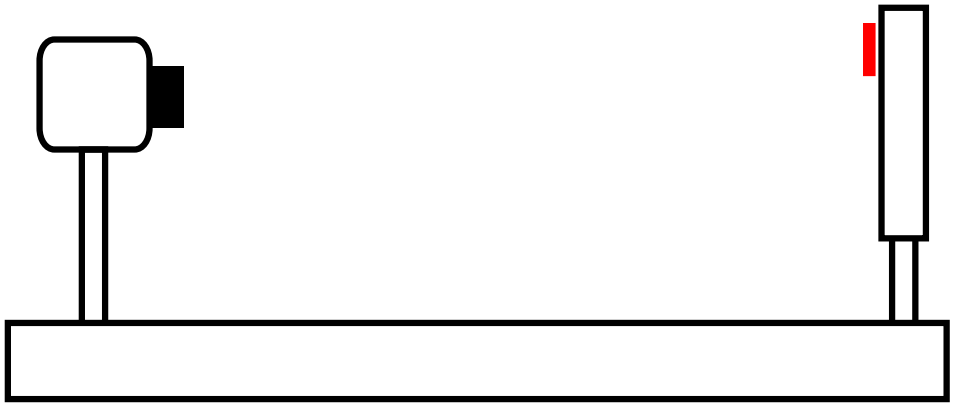
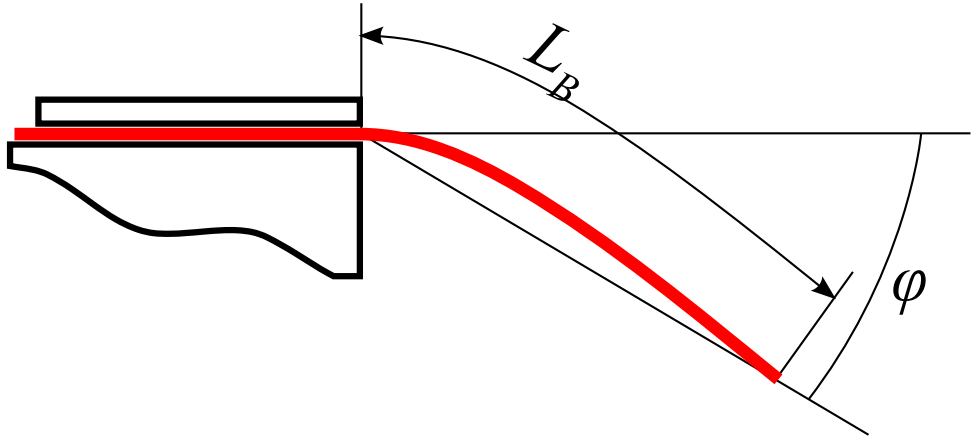
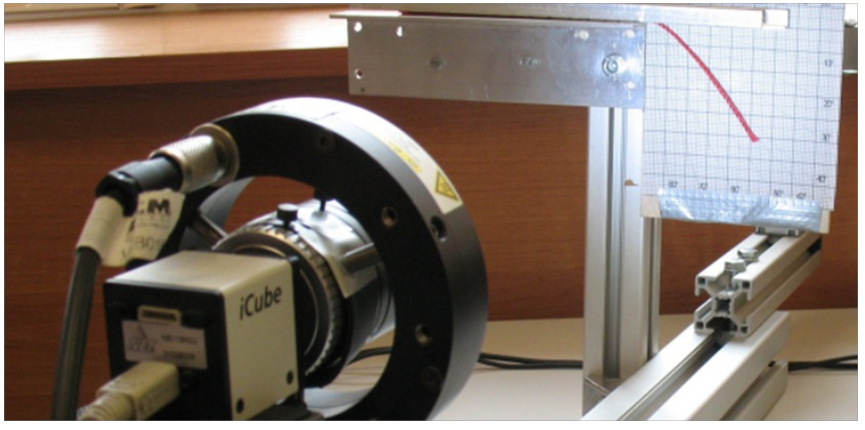
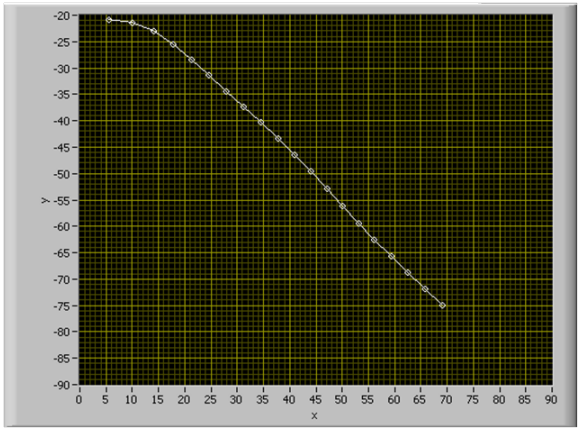
stiffness & damping









Linear density

Stretching
stiffness & damping

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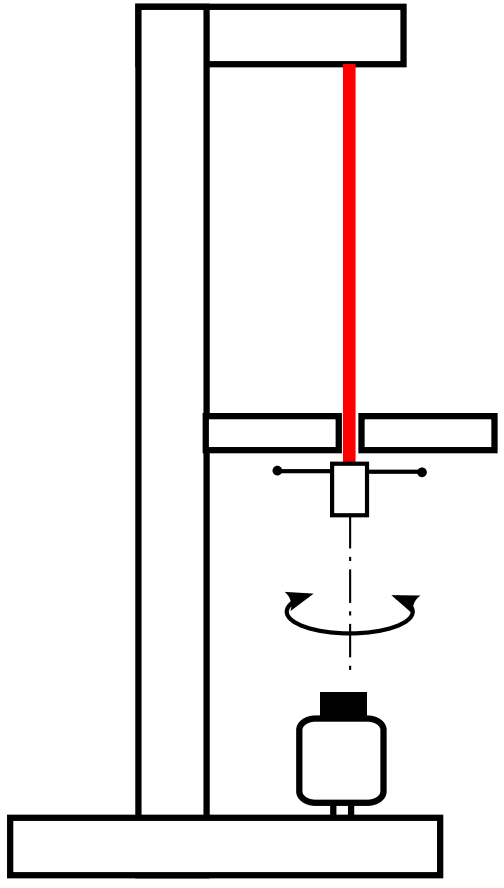
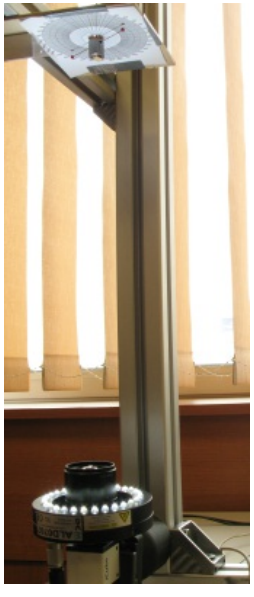
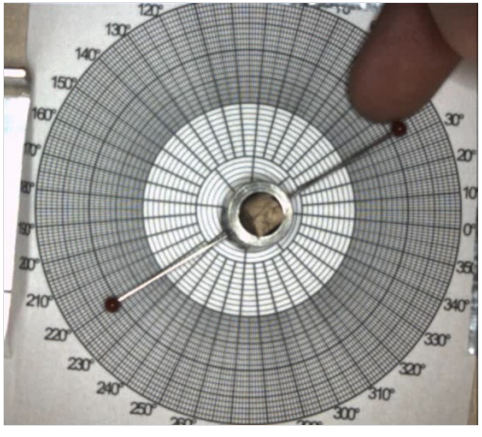
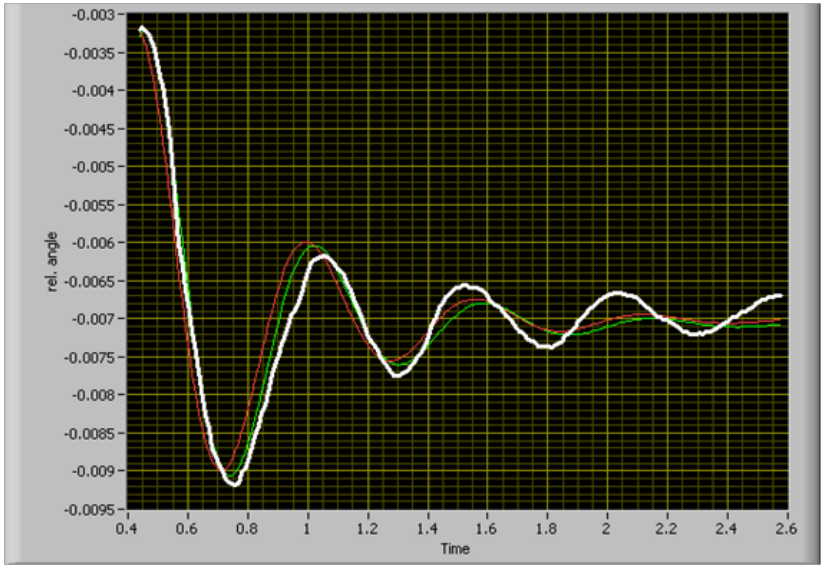
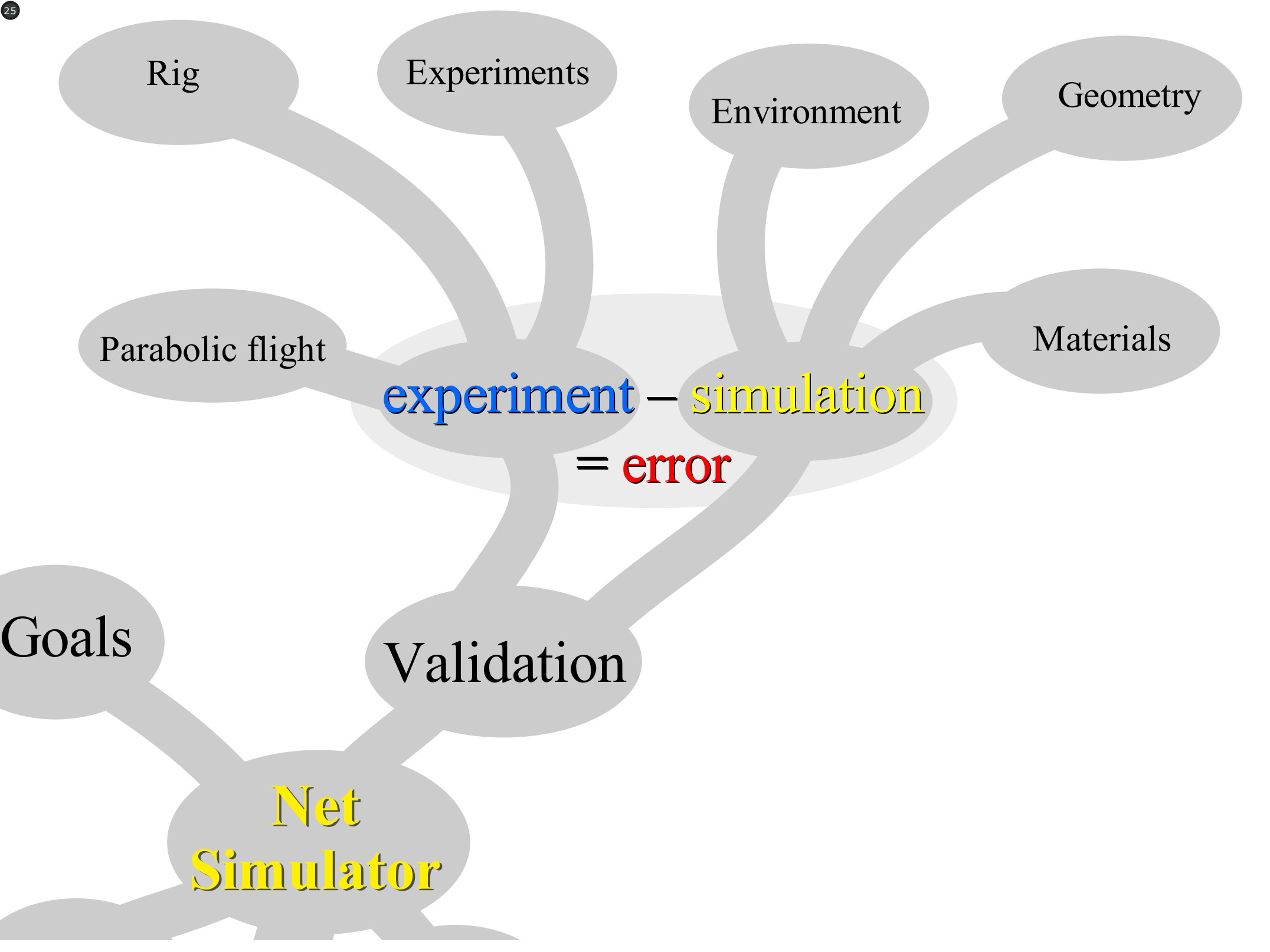
stiffness & damping










Rig
Experiments
Environment
Geometry
Parabolic flight
Materials
experiment – simulation
= error
Goals
Validation
Net
Simulator

Consortium

SKA Polska

Stam

optiNav