
# Modeling Structural - Dynamics Systems in MODELICA/Dymola, MODELICA/Mosilab and AnyLogic

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# Working task

Given:

The problem definition of the constrained pendulum like in ARGESIM Comparison 7.

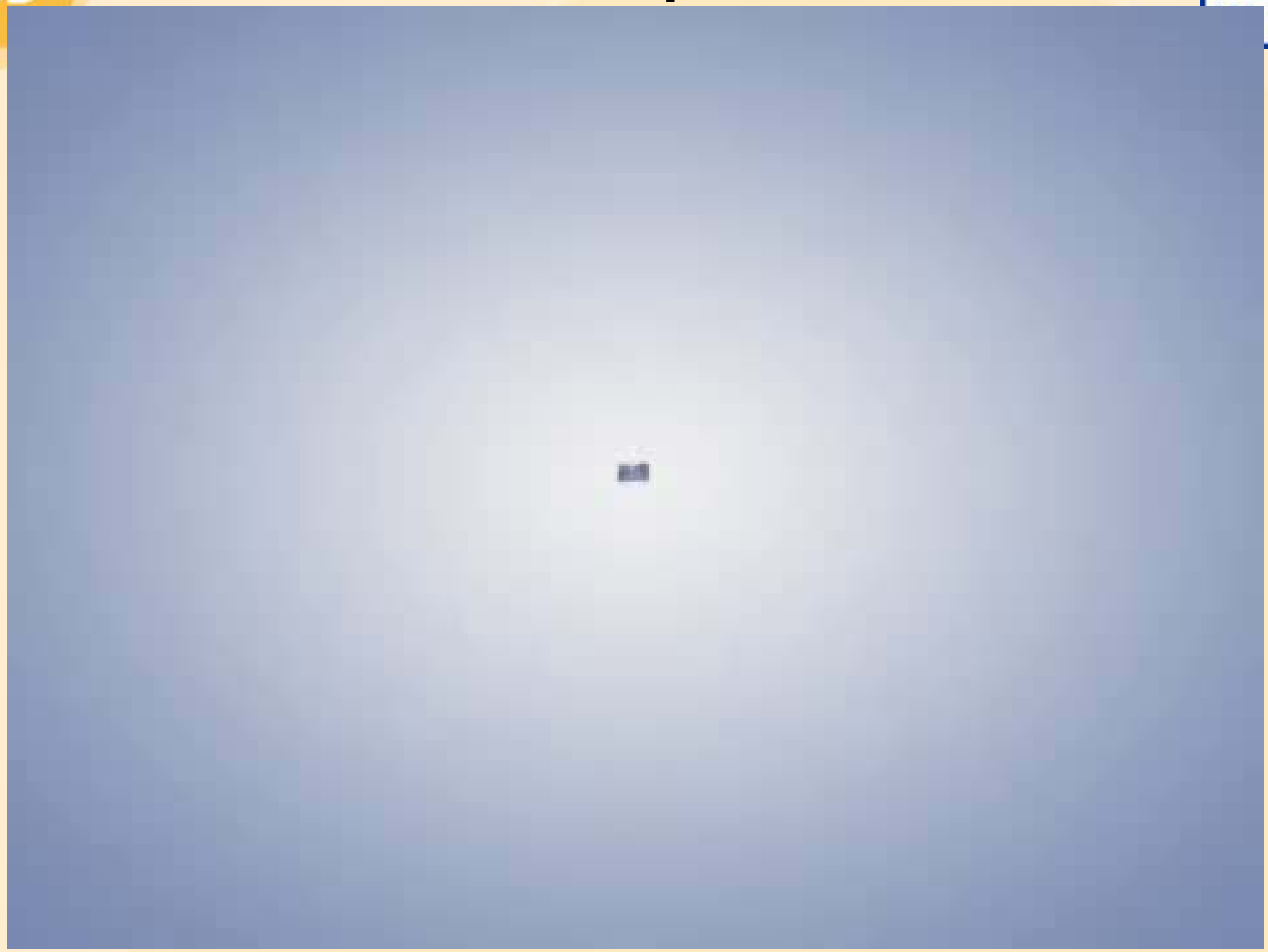
Wanted:

Capable simulation environment with an easy to use, object oriented interface.

# Problem definition

- What is standard in advanced modeling and simulation?
- Where are the problems?
- How to deal with them?
- Is there a standard test example?

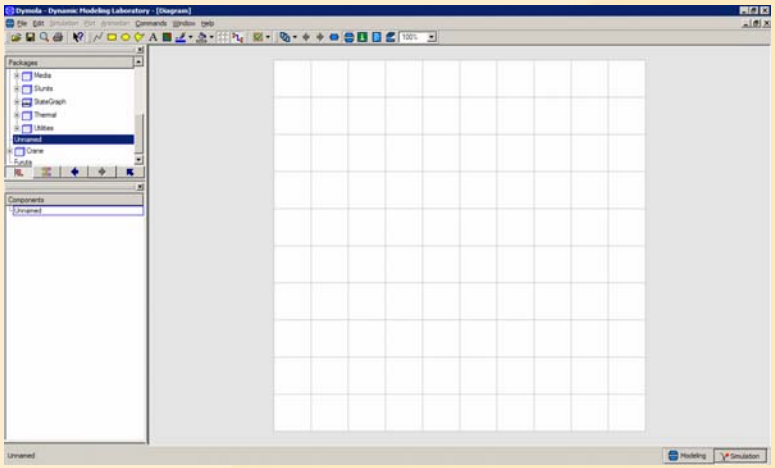
# Constrained pendulum

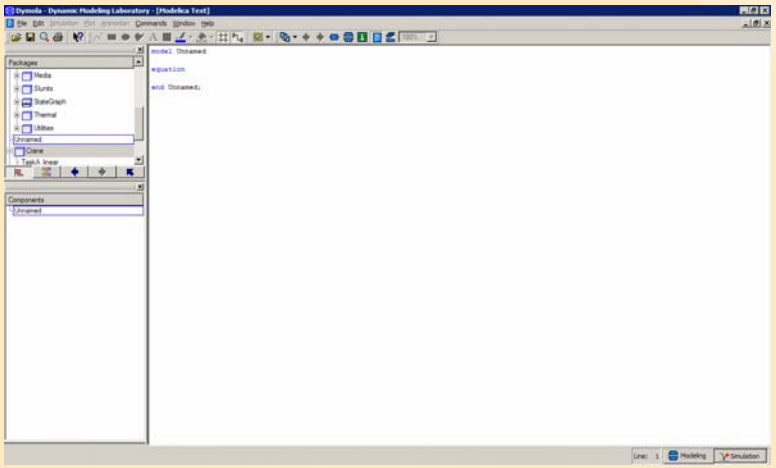


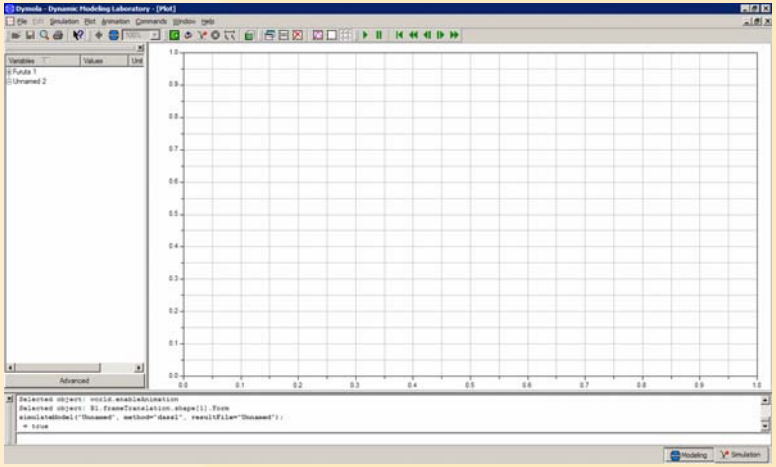
# Basic formulars

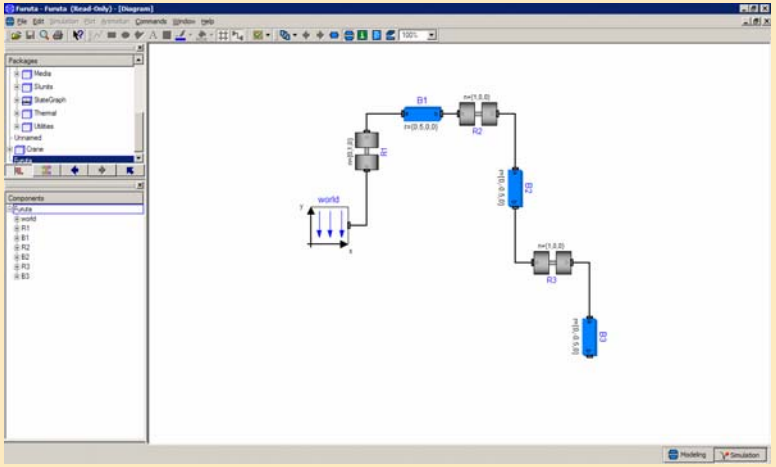
$$\dot{\varphi} = \frac{v}{l}, \qquad \dot{v} = -g \sin \varphi - \frac{d}{m} v$$

# Simulator - Dymola

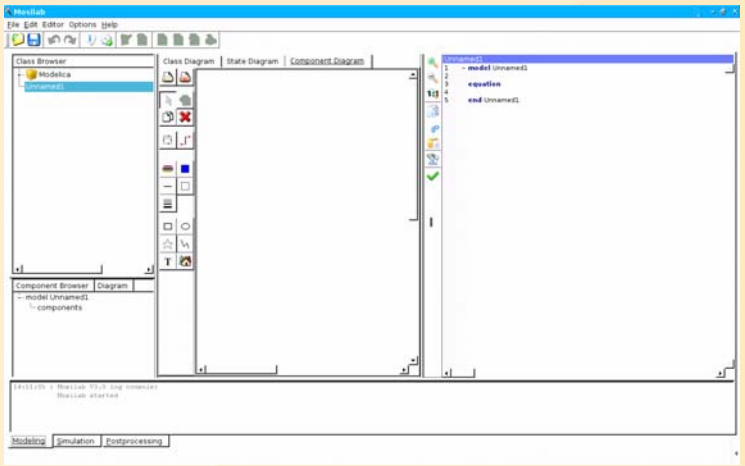


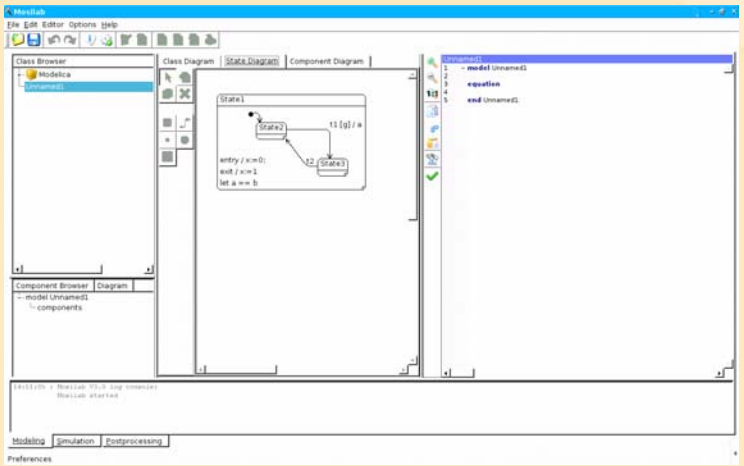


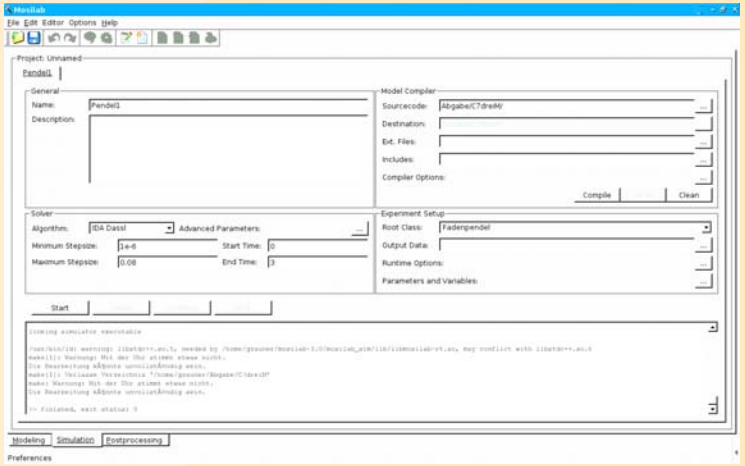


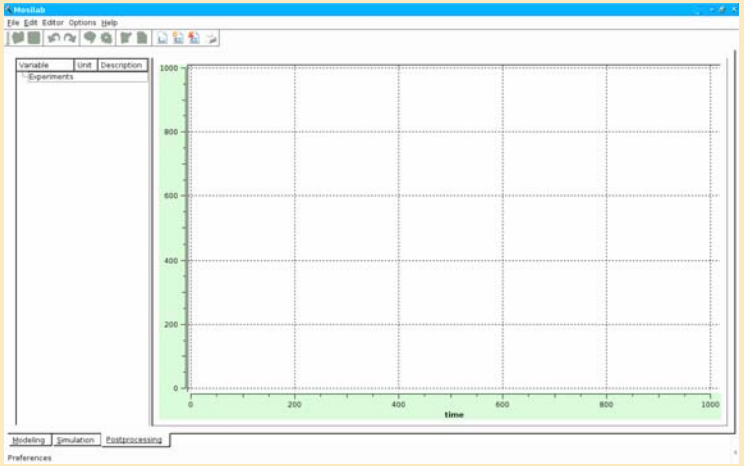


# Simulator - Mosilab

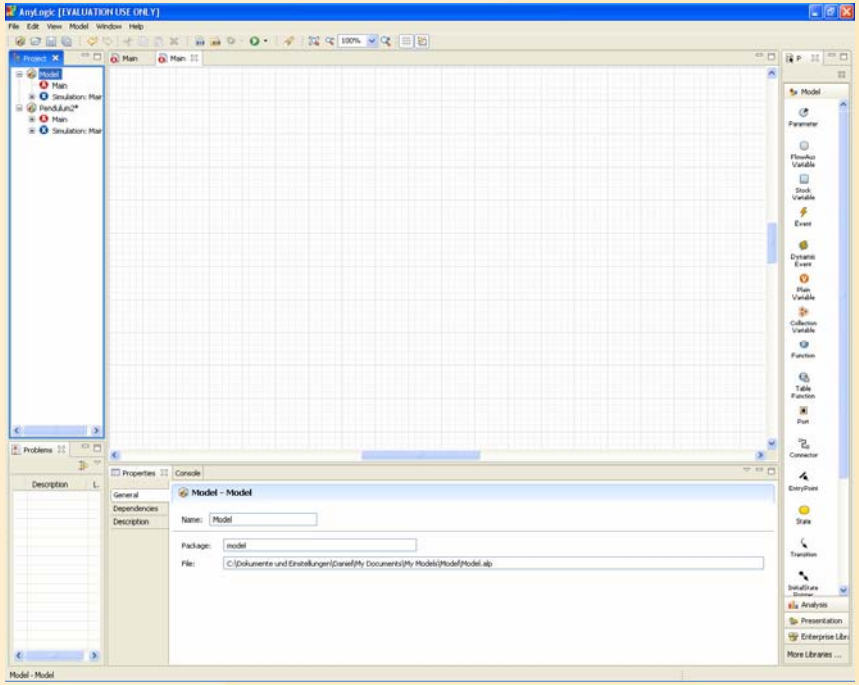


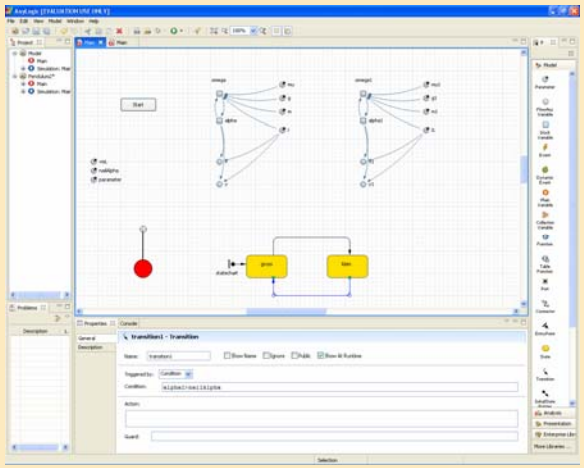


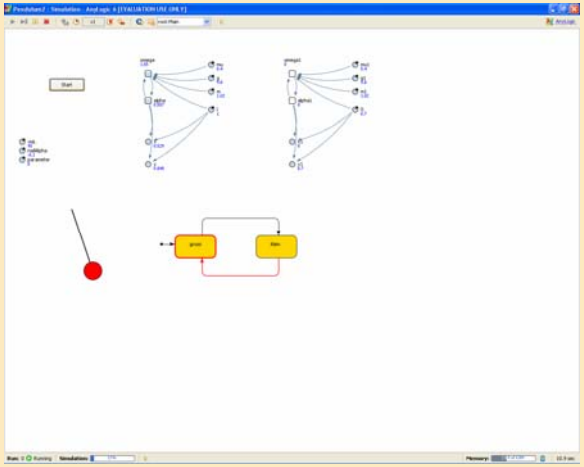




# Simulator - AnyLogic





# Solution methods

- Algorithm section
- Parameter state event
- Model switching
  - two instances of one model
  - two separate submodel definitions

# Algorithm section

Benefits:

- Modelica standard notation (Dymola, Mosilab, OpenModelica, …)
- Fast modeling

Disadvantages:

- No graphical interface
- Limited applicability

```
algorithm
  if (phi<=phipin) then
    length:=ls;
  end if;
  if (phi>phipin) then
    length:=l1;
  end if;
```

# Parameter state event

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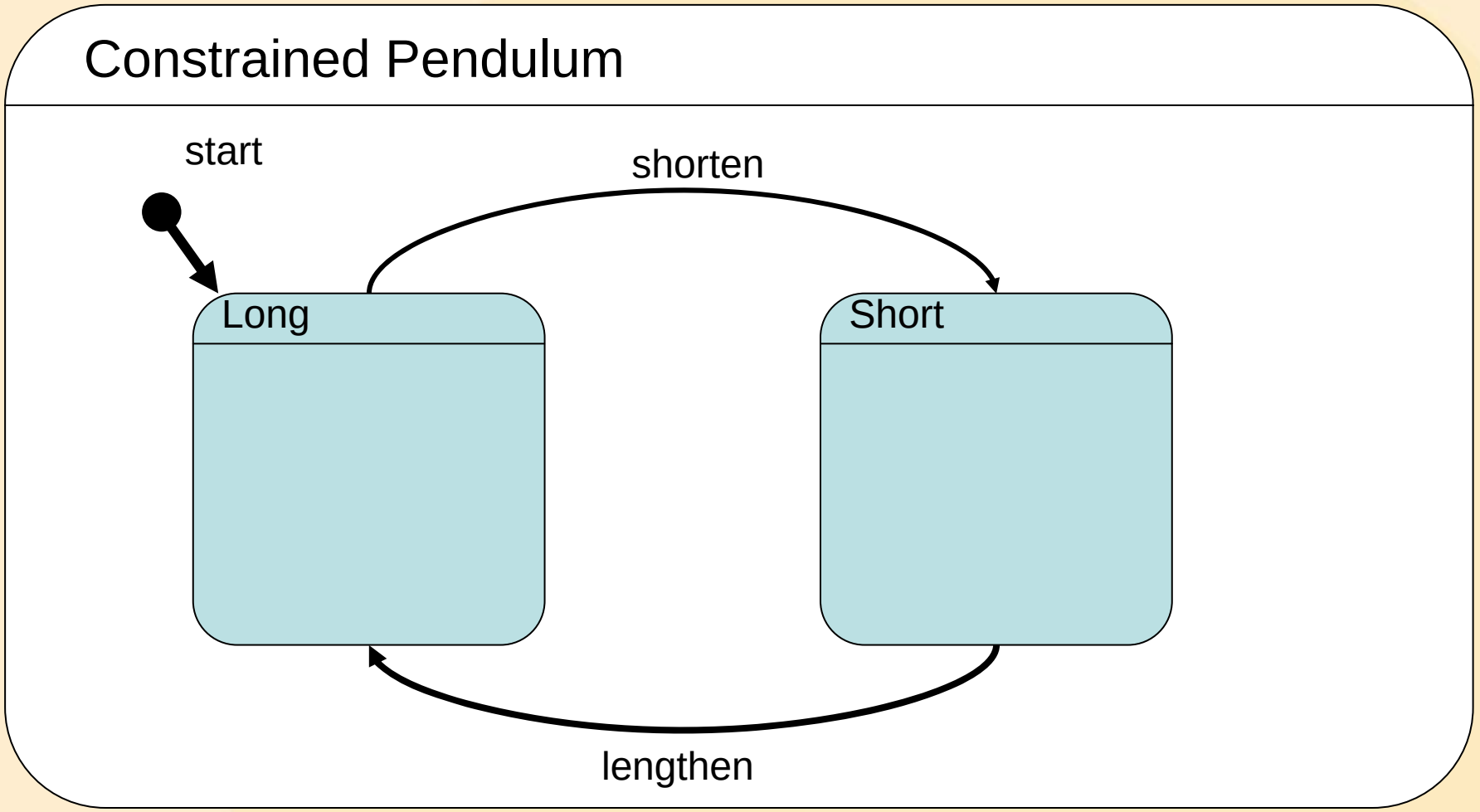
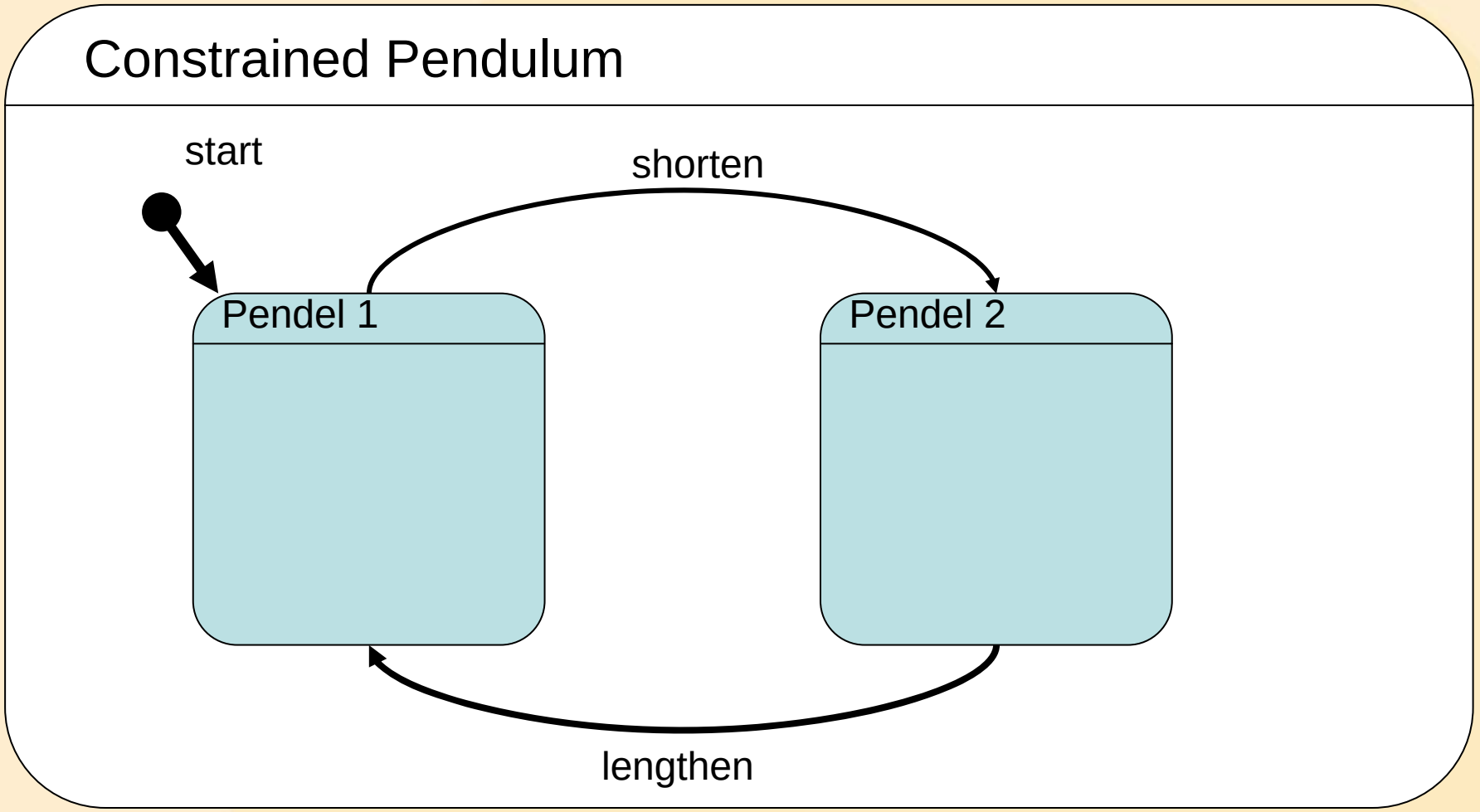
```
equation
lengthen=(phi>phipin);  shorten=(phi<=phipin);
..  here /*pendulum*/  -equations
statechart
state  LengthSwitch  extends  State;
          State  Short,Long,Initial(isInitial=true);
transition  Initial  ->  Long  end  transition;
transitionLong->Shortevent  shorten  action
          length  :=  ls;
end  transition;
transitionShort->Longeventlengthen  action
          length  :=  l1;
end  transition;
end  LengthSwitch;
```

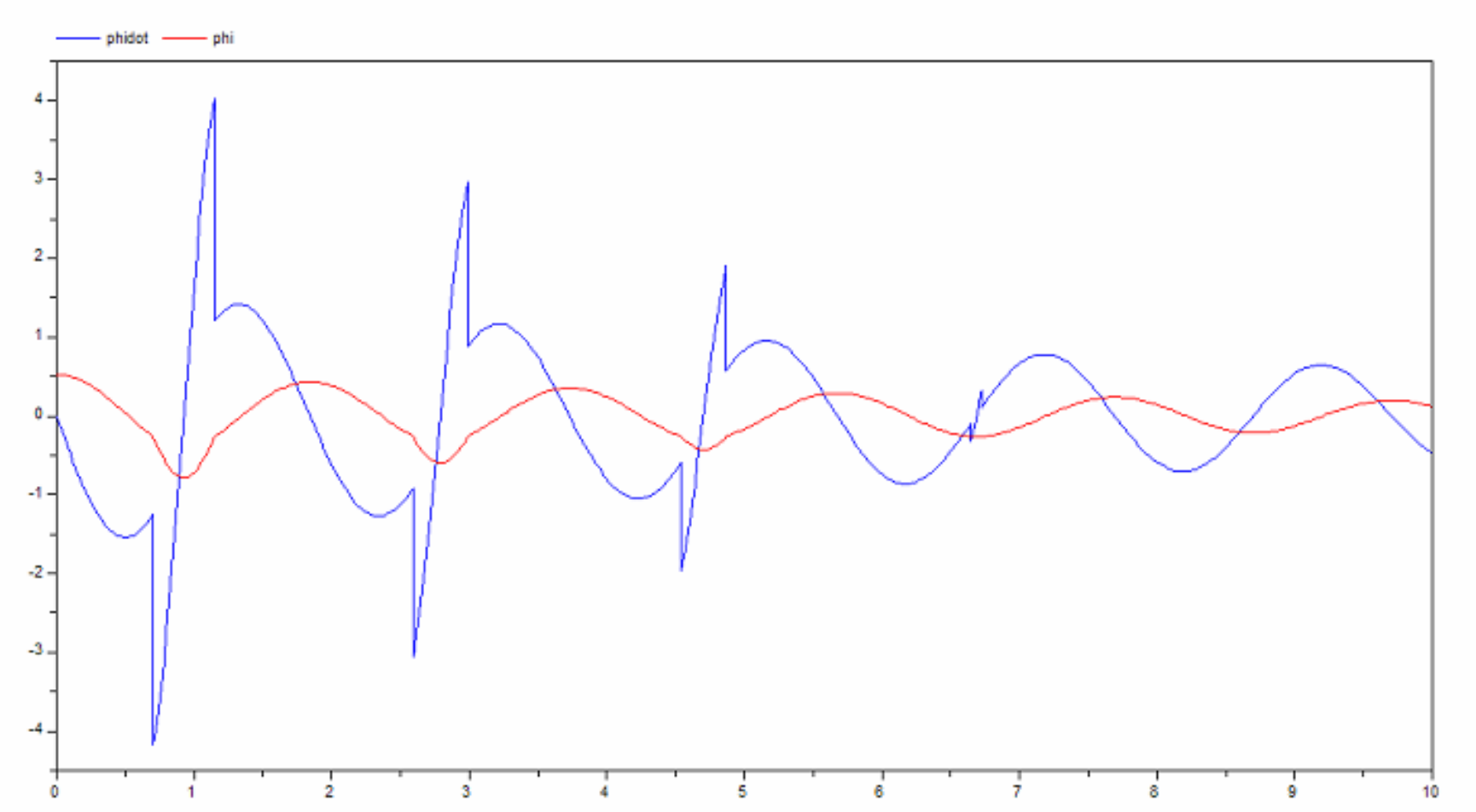
# Model switching



# Model switching



# Results



# Results

| Simulator | Time point | Method |
|---|---|---|
| Dymola/Modelica | 6.72198 | Dassl<br>500 intervals |
| Mosilab/Modelica<br>Switch models | 6.7204 | IDA Dassl<br>Min. step 1e-6<br>Max. step 0.08 |
| Mosilab/Modelica<br>Pure Modelica | 6.7199 | Impl. Trapez<br>Min. step 1e-6<br>Max. step 1e-4 |
| Mosilab/Modelica<br>Parameter<br>switching | 6.7224 | IDA Dassl<br>Min. step 1e-6<br>Max. step 0.08 |
| AnyLogic | 6.725 | No influence<br>Step size 0.001 |

# Conclusion

- What is standard in advanced modeling and simulation?
  - Modelica standard for model exchange
  - UML
  - combination of both

- Problems in solution generation:
  - limited state event handling (Dymola)
  - restriction in the choose of simulation methods (Mosilab)
  - no state event finding, fixed solution method (AnyLogic)


# THANK YOU FOR YOUR ATTENTION!