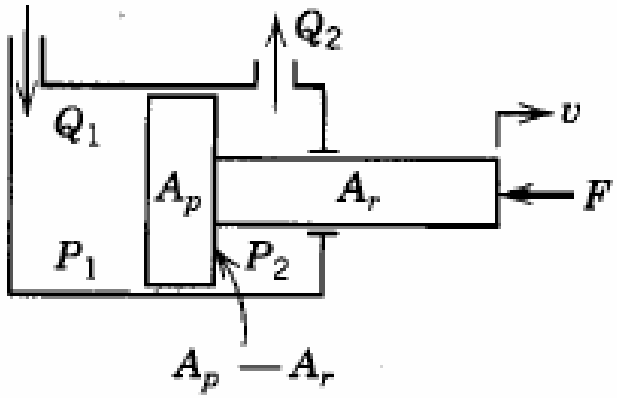
Modellierung (Fortsetzung)

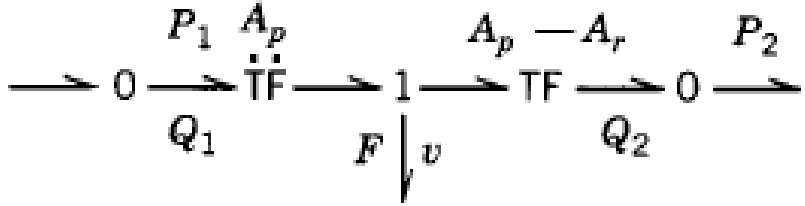
Modellierung kontinuierlicher dynamischer Systeme

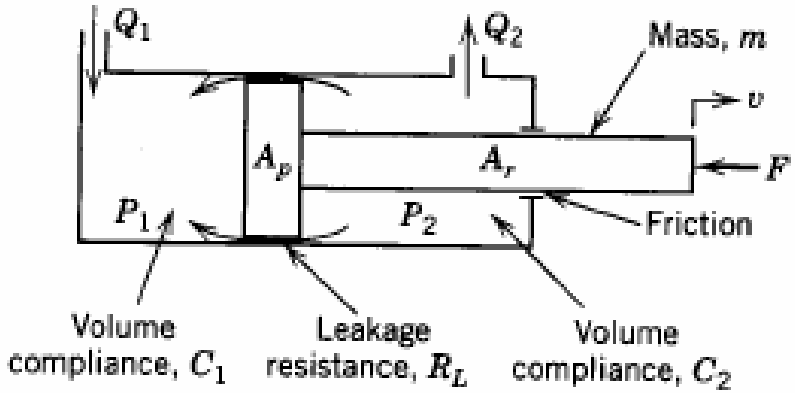
mit Simulatoren

20-Sim	Twente University
OmSim	Lund University

Beispiel Druckluft Zylinder1



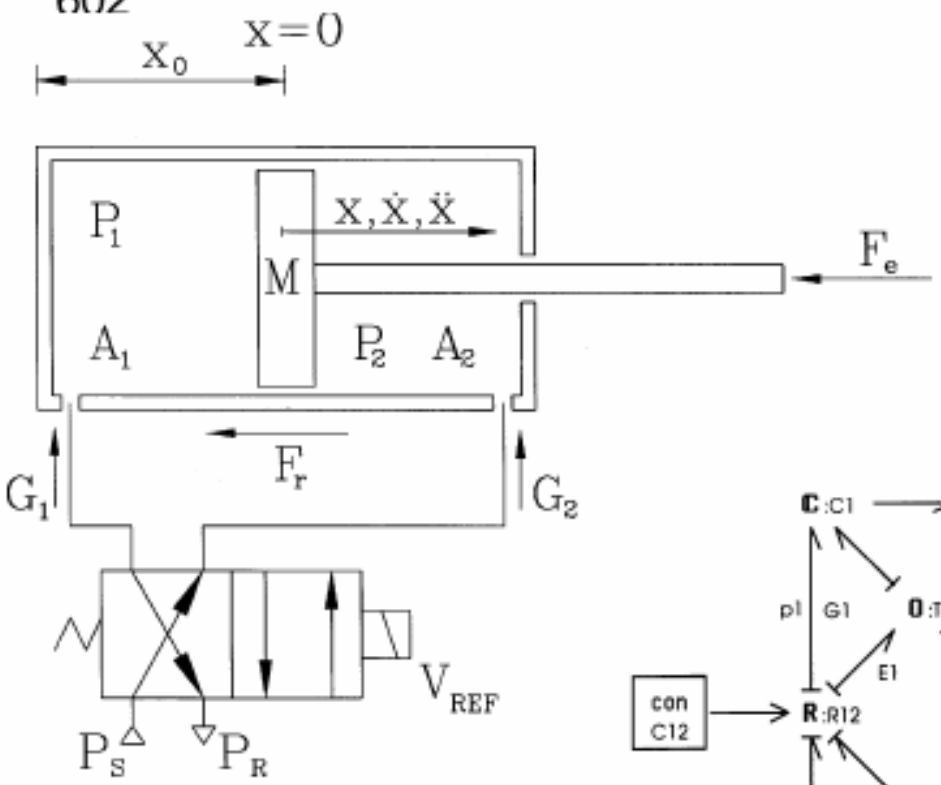


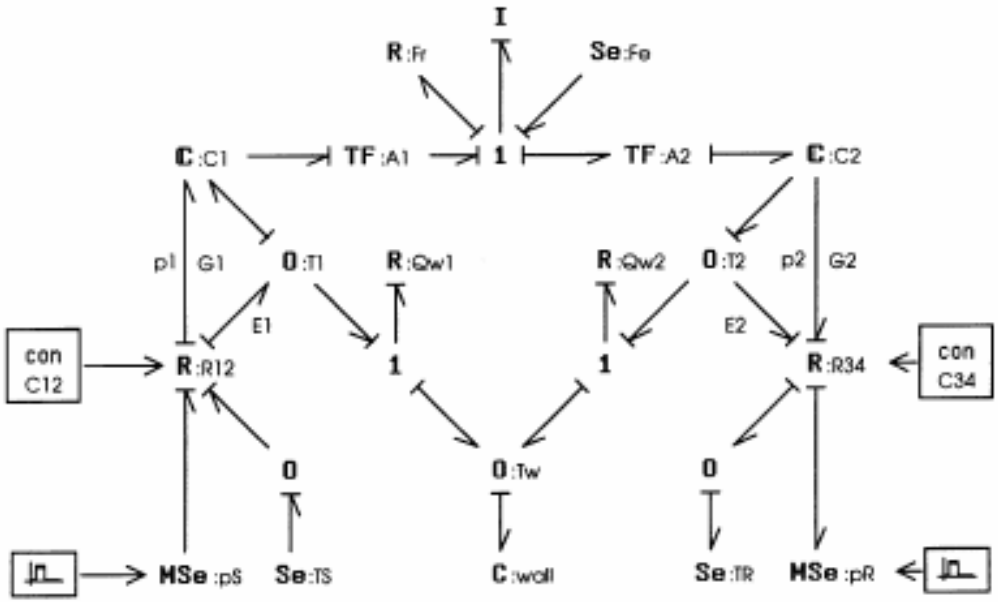


Sh

Modeling Example: Pneumatic Actuators

• M. Sorli, L.Gastaldi, E.Codina, S.de las, Heras. “Dynamics Actuators of Pheumatic Actuators” , Simulation practice and theory, vol 7, (1999), pp 589-602

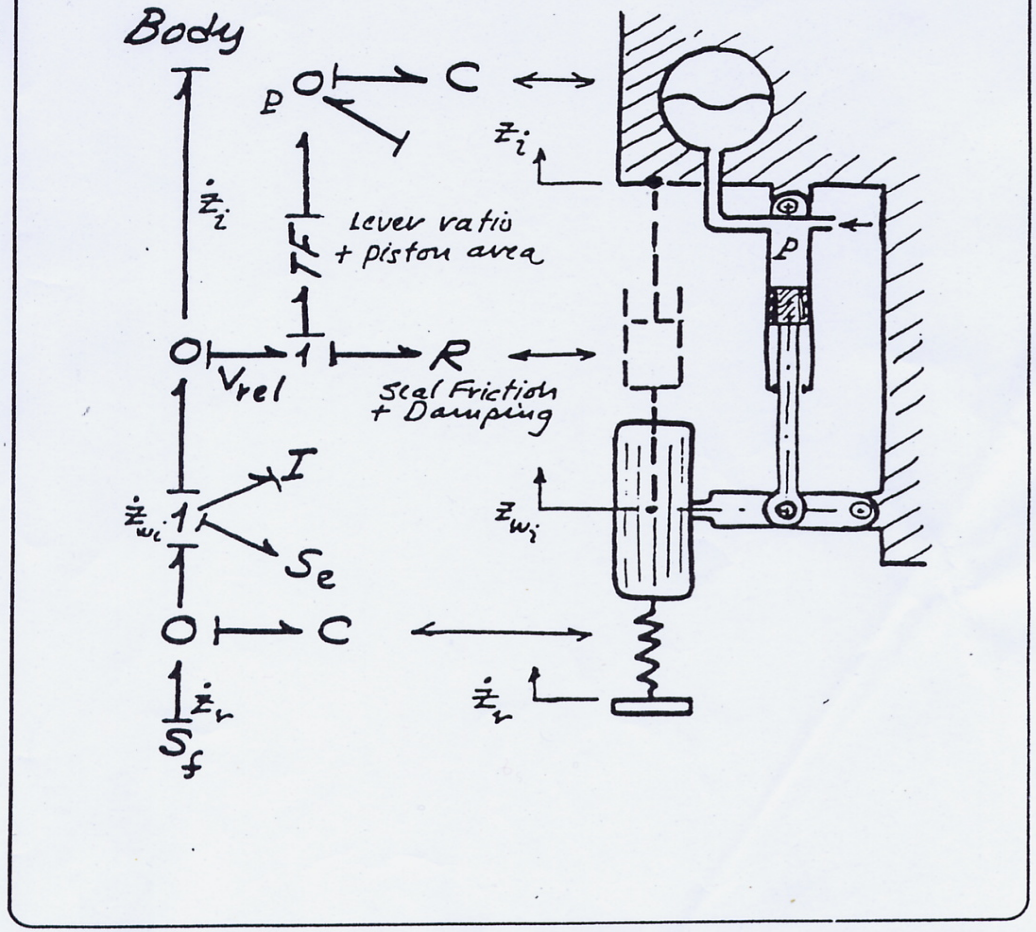




W. Bruns, 2006

EUROSIM Nr. 7, 1993

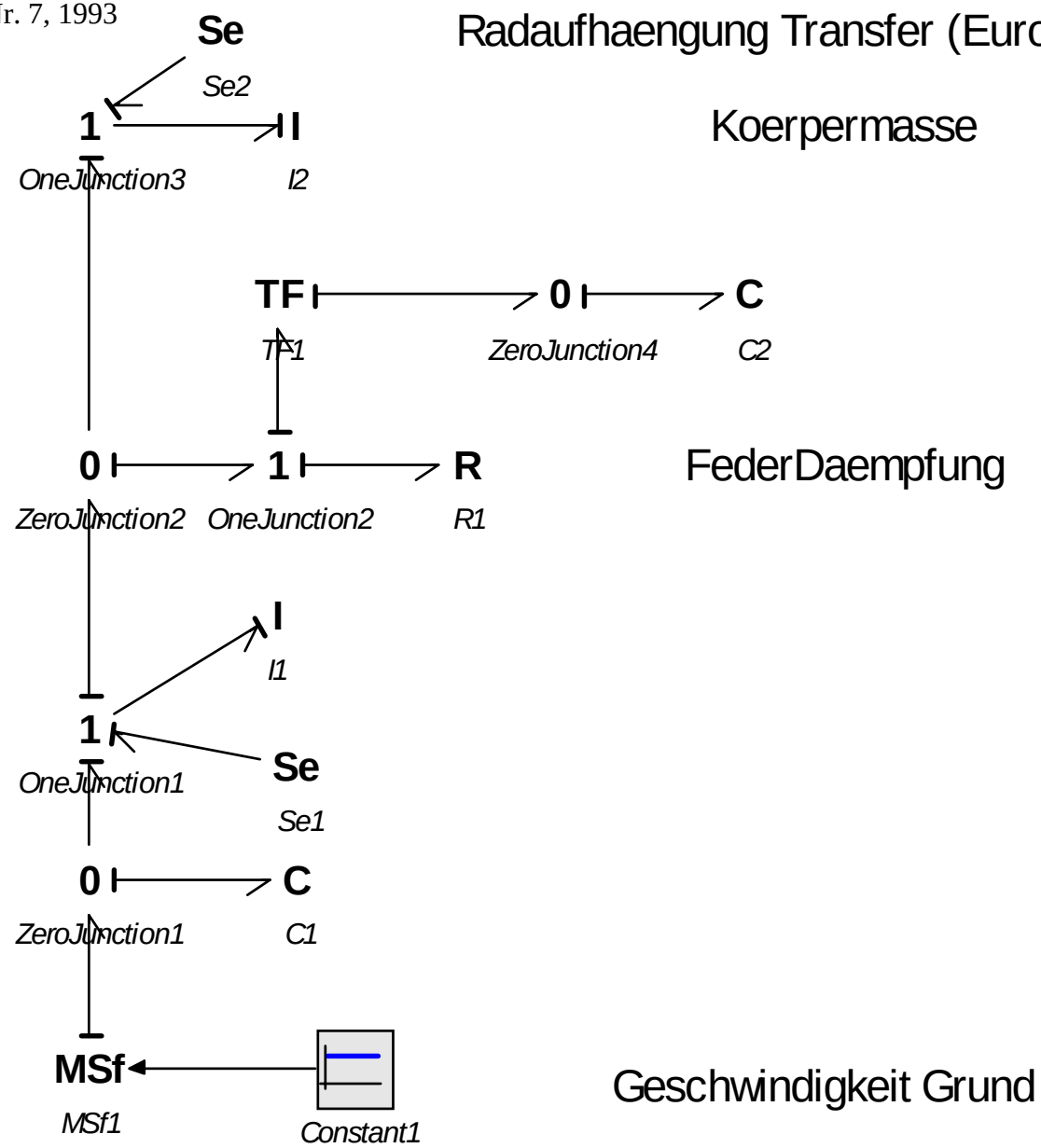
EUROSIM
Simulation News Europe
Number 7 A European Forum on Simulation Activities March 1993



W. Bruns, 2006

Radaufhaengung Transfer (Eurosim 1993)

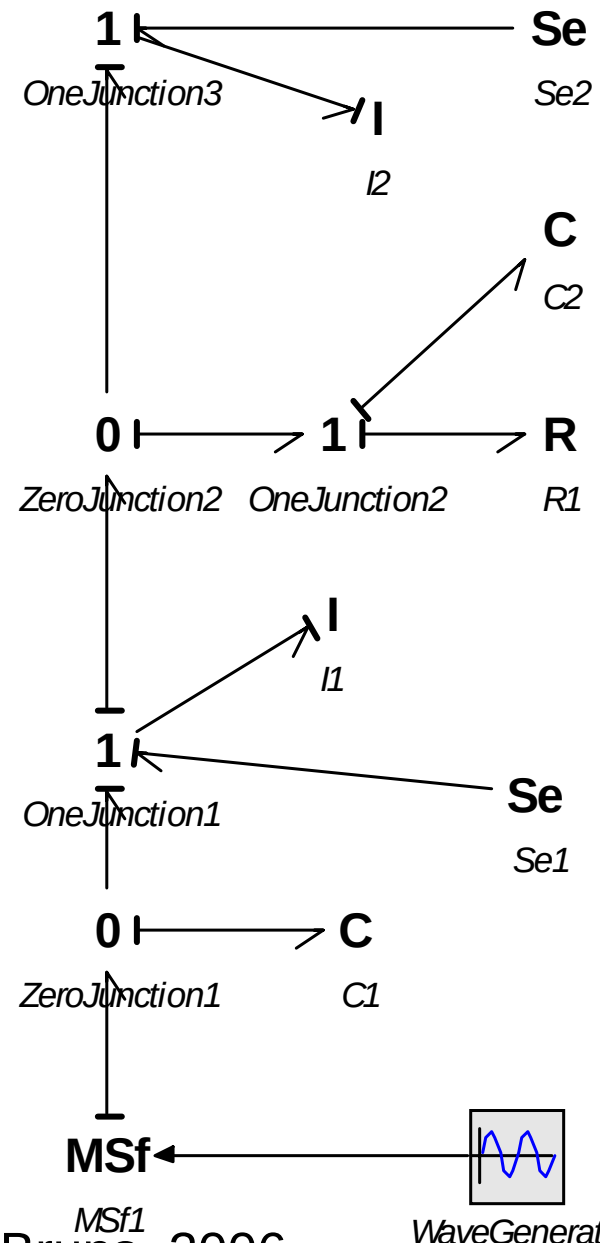
20-Sim



EUROSIM Nr. 7, 1993

Radaufhaengung (Eurosim 1993)

Model1



Erdanziehung

Fahrzeugmasse

Feder

Daempfer

Radmasse

Erdanziehung

Reifenelastizität

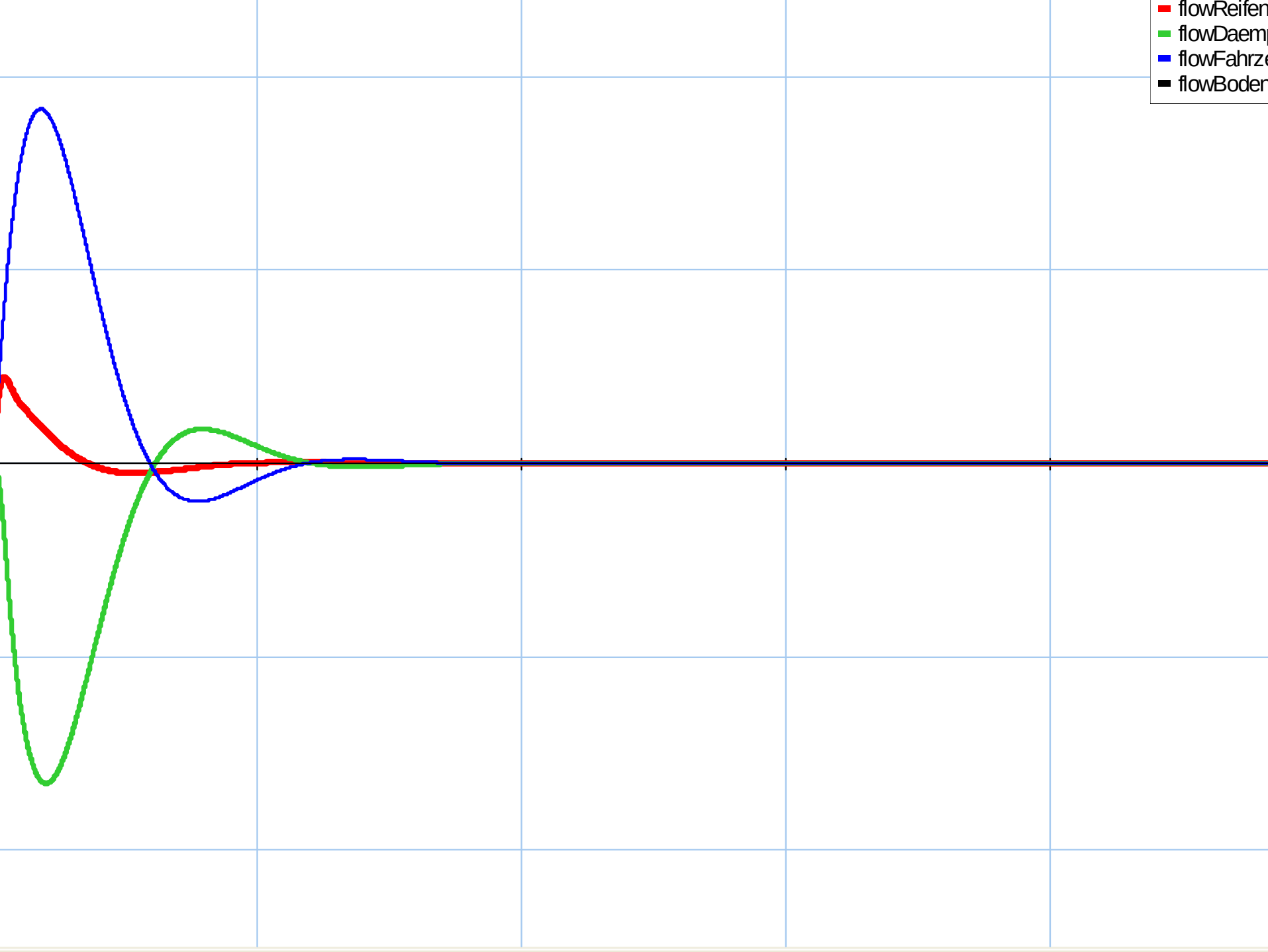
Geschwindigkeitserregung durch Grund

W. Bruns, 2006

20-sim Experiment Description

==========

C1\c 0.0001
I1\i 10
R1\r 400
Se1\effort 10
Se2\effort 100
C2\c 0.001
I2\i 100
WaveGenerator1\amplitude 0 {}
WaveGenerator1\omega 1 {rad/s}


flowReifen
flowDaemp
flowFahrze
flowBoden

Experiment2

Parameters:

==========

C1\c 0.0001

I1\i 10

R1\r 400

Se1\effort 10

Se2\effort 100

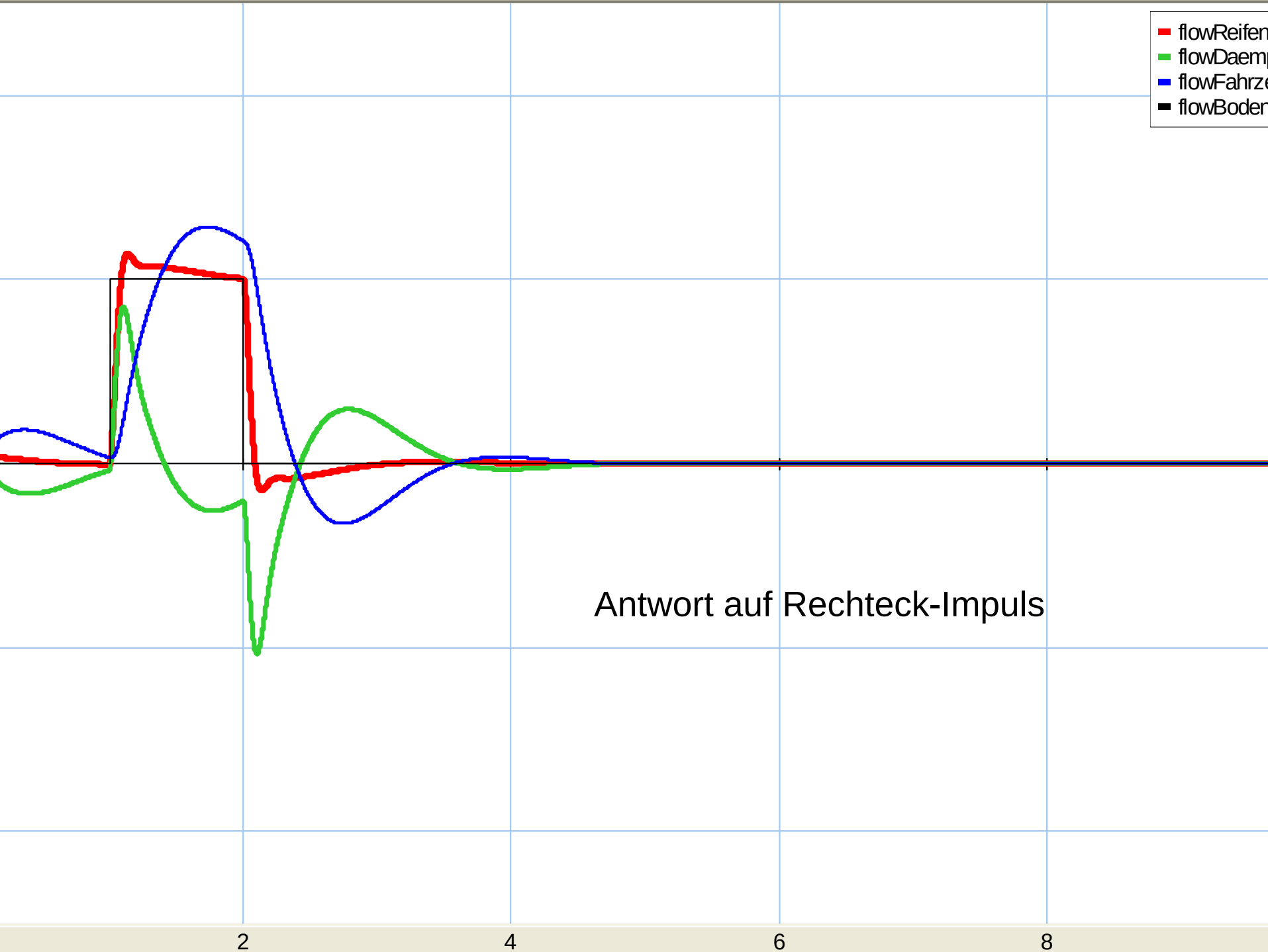
C2\c 0.001

I2\i 100

SignalGenerator1\start_time 1 {s}

SignalGenerator1\stop_time 2 {s}

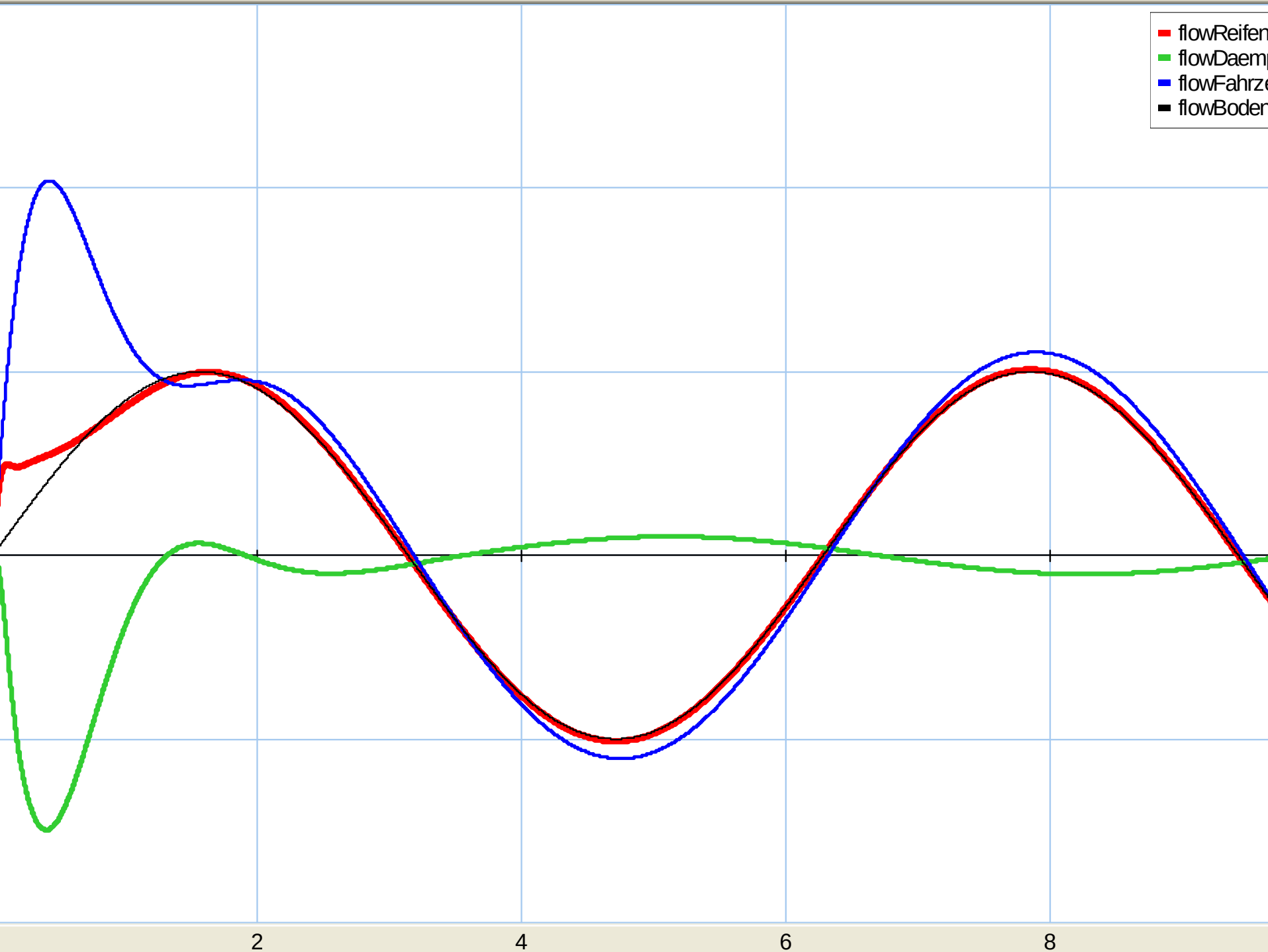
SignalGenerator1\amplitude 1 {}


flowReifen
flowDaemp
flowFahrze
flowBoden
Antwort auf Rechteck-Impuls
2
4
6
8

20-sim Experiment Description

==========

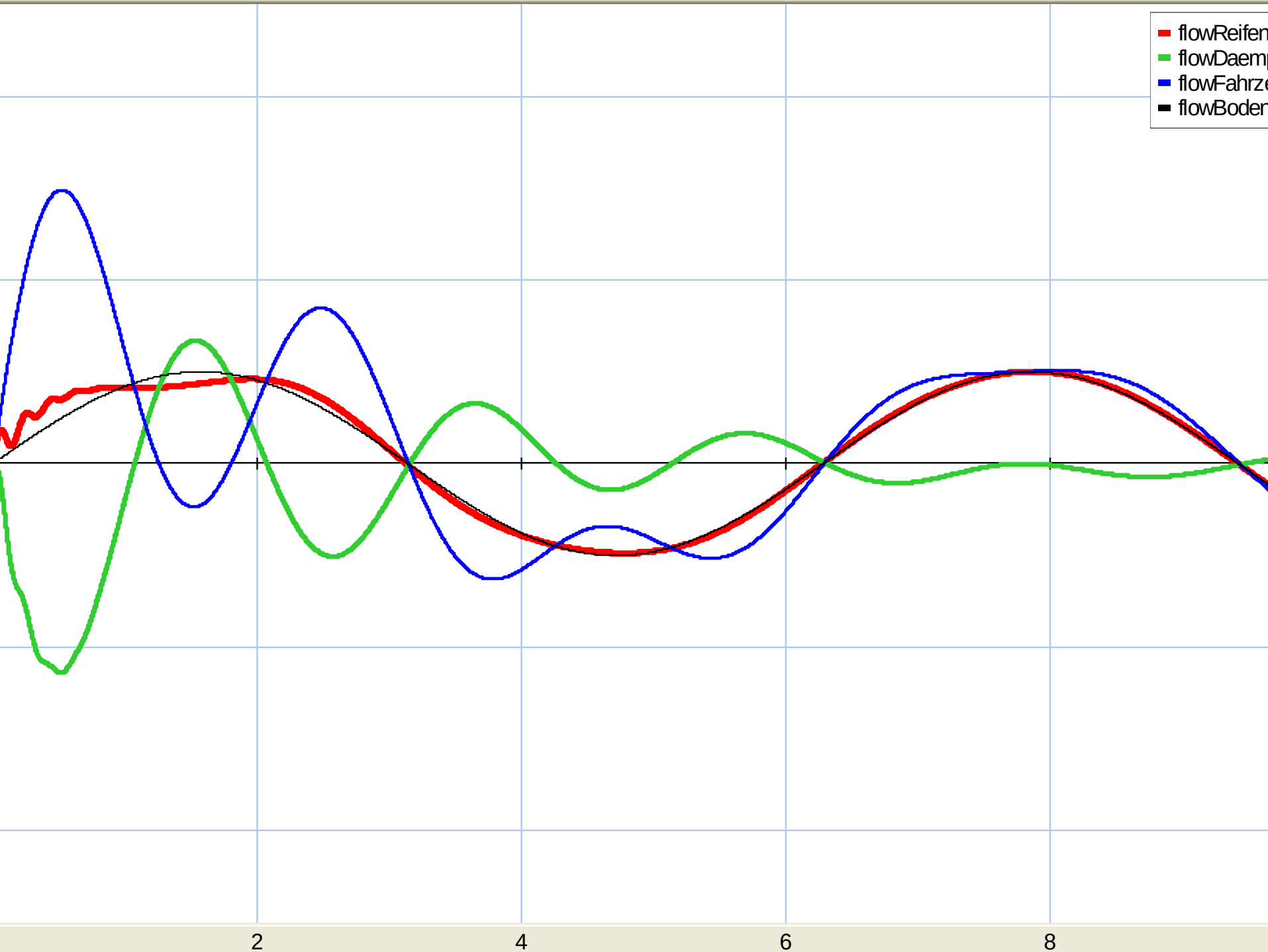
C1\c 0.0001
I1\i 10
R1\r 400
Se1\effort 10
Se2\effort 100
C2\c 0.001
I2\i 100
WaveGenerator1\amplitude 0.1 {}
WaveGenerator1\omega 1 {rad/s}

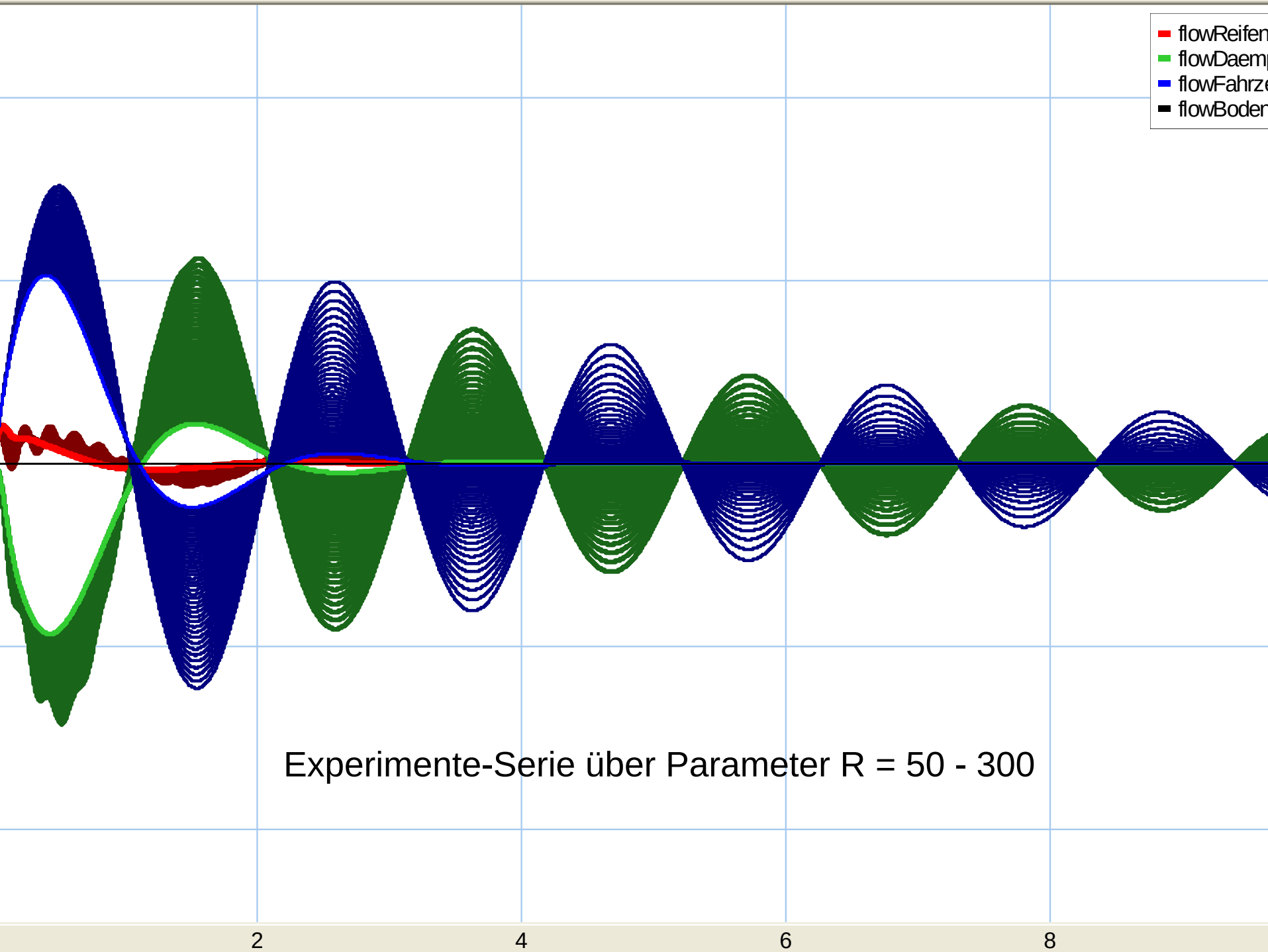

flowReifen
flowDaemp
flowFahrze
flowBoden
2
4
6
8

20-sim Experiment Description

==========

C1\c 0.0001
I1\i 10
R1\r 100
Se1\effort 10
Se2\effort 100
C2\c 0.001
I2\i 100
WaveGenerator1\amplitude 0.1 {}
WaveGenerator1\omega 1 {rad/s}


flowReifen
flowDaemp
flowFahrze
flowBoden
2
4
6
8


flowReifen
flowDaemp
flowFahrze
flowBoden
Experimente-Serie über Parameter R = 50 - 300
2
4
6
8

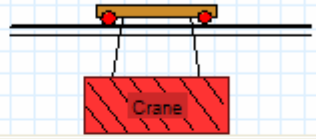
Edit View Insert Model Drawing Tools Help

Hierarchy :

- mode
  - cable_length
  - crane
  - ForwardMoti
  - Hoist_down_
  - Hoist_up_Vc
  - Lissajou
  - ptch
  - skw
  - swg
  - swg_dot
  - vc
  - vt
  - xc
  - xt
  - yaw

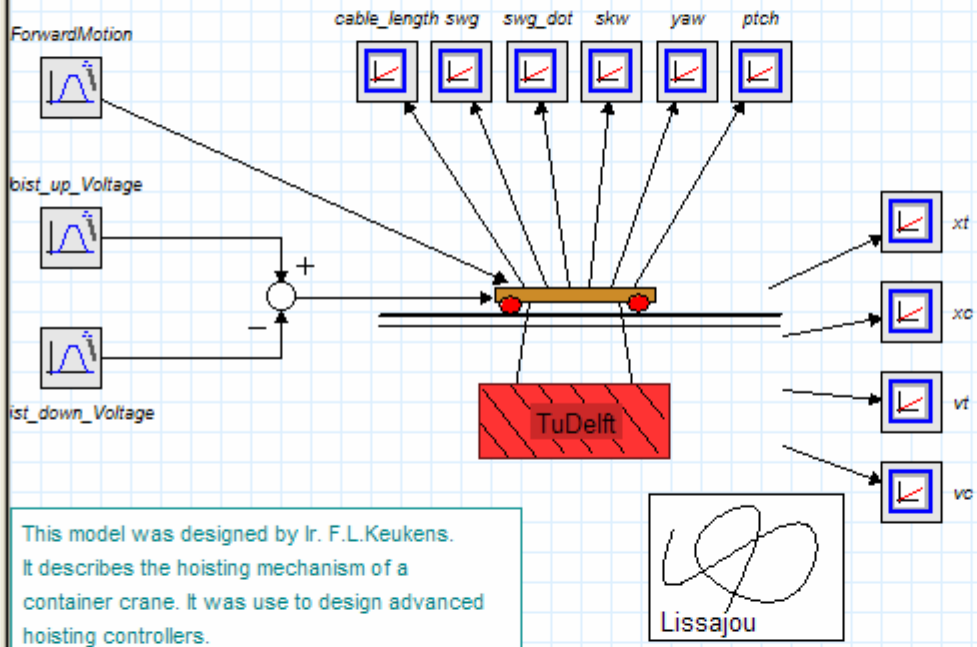
Type : Mainmodel

Icon :



Implementation :

Container Crane



Use the camera button image missing to insert your own bitmap files.

This model was designed by Ir. F.L.Keukens.
It describes the hoisting mechanism of a container crane. It was use to design advanced hoisting controllers.

You can inspect the model by clicking submodels in the model tree (tree at the left) or select a model and clicking the Go Down button.

Open a simulation to see the model running in 3D Animation.

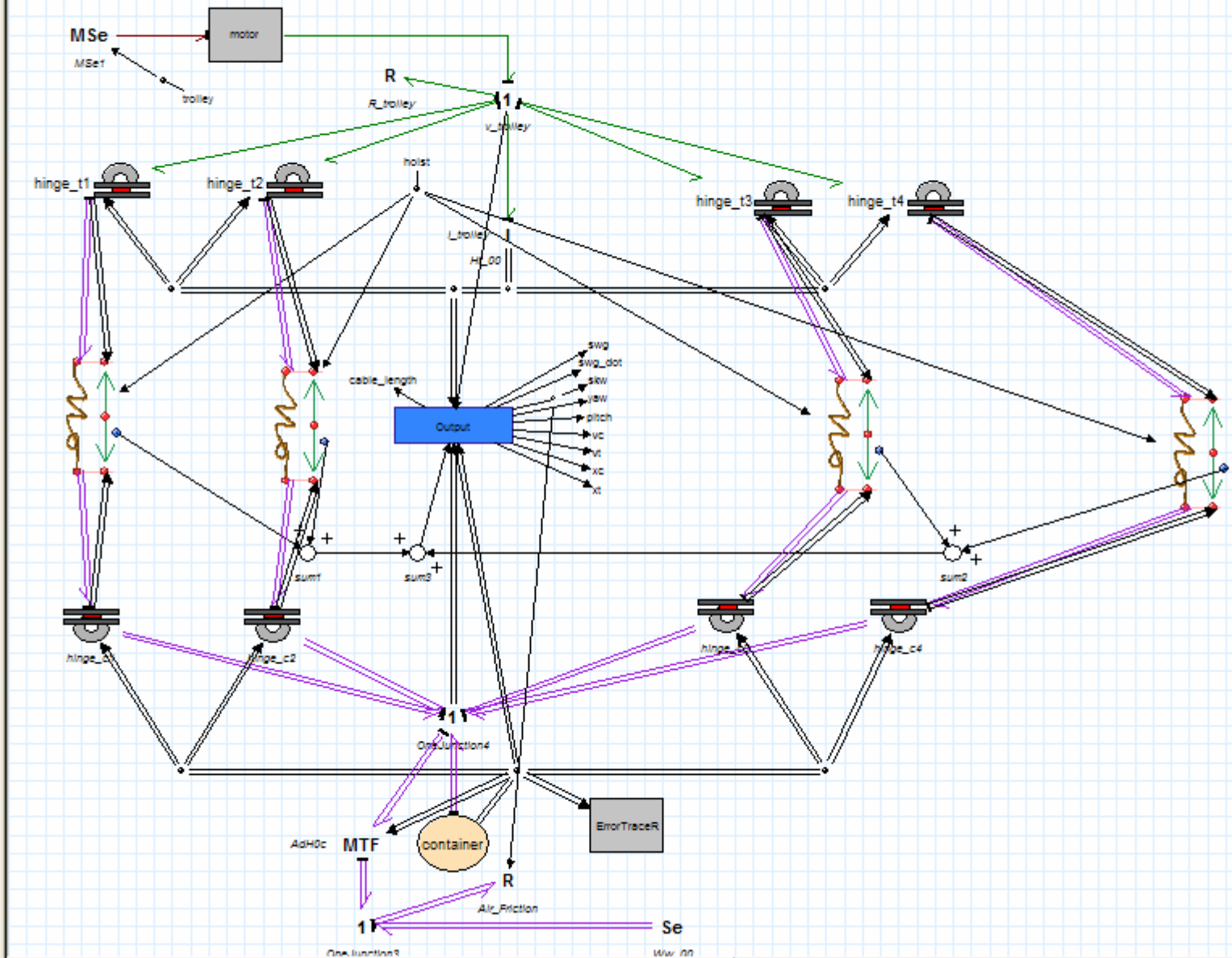
ened

Edit View Insert Model Drawing Tools Help

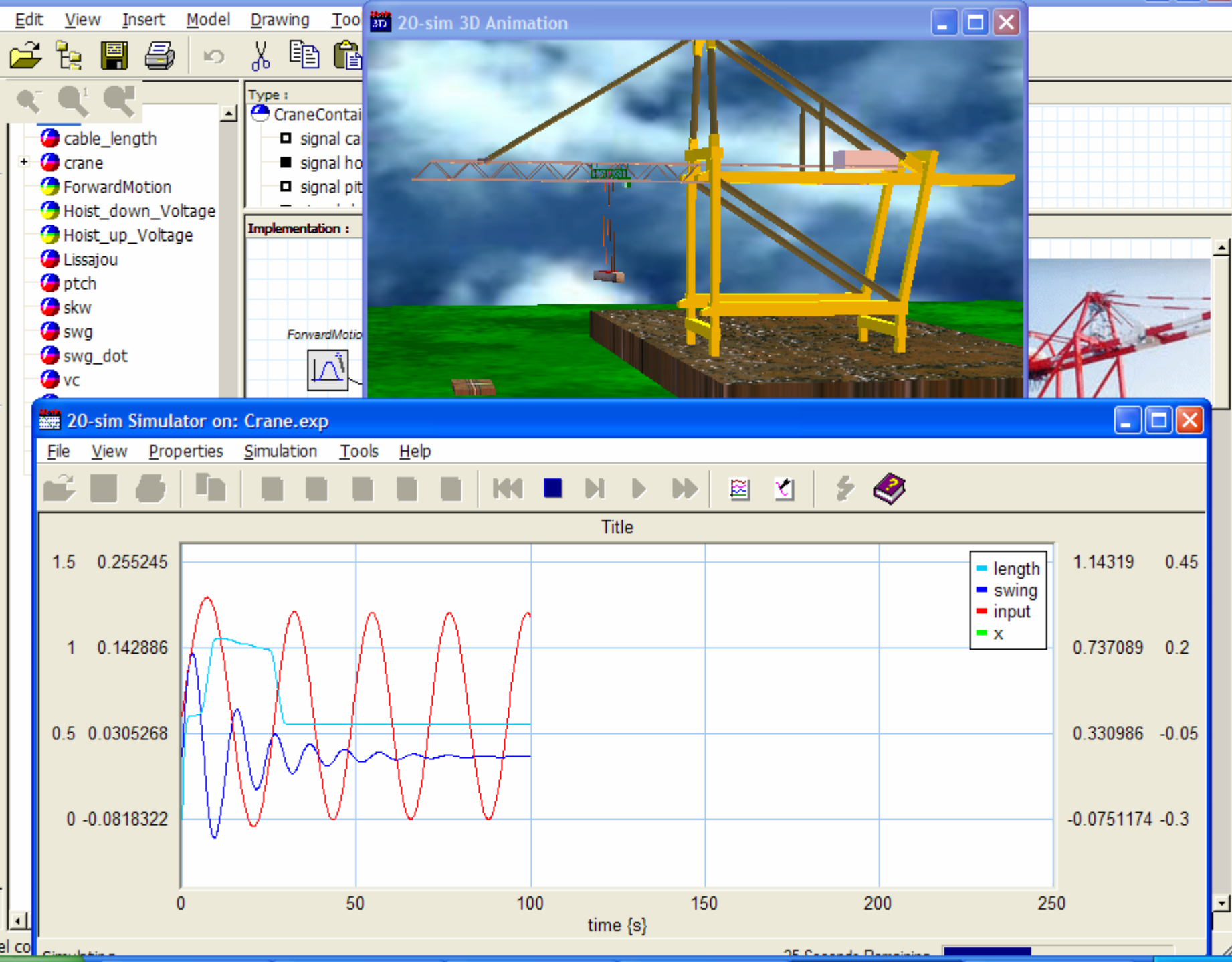
Hierarchy :

- model
  - cable_length
  - crane
  - ForwardMoti
  - Hoist_down_
  - Hoist_up_Vc
  - Lissajou
  - ptch
  - skw
  - swg
  - swg_dot
  - vc
  - vt
  - xc
  - xt
  - yaw

Implementation :



\motor translational ->| crane\v_trolley p7


Edit View Insert Model Drawing Too
20-sim 3D Animation
cable_length
crane
ForwardMotion
Hoist_down_Voltage
Hoist_up_Voltage
Lissajou
ptch
skw
swg
swg_dot
vc
Type :
CraneContai
signal ca
signal ho
signal pit
Implementation :
ForwardMotio
20-sim Simulator on: Crane.exp
File View Properties Simulation Tools Help
Title
1.5 0.255245
1 0.142886
0.5 0.0305268
0 -0.0818322
1.14319 0.45
0.737089 0.2
0.330986 -0.05
-0.0751174 -0.3
length
swing
input
x
0 50 100 150 200 250
time {s}

Edit View Insert Model Drawing Too

Hierarchy :

- mode
  - cable_length
  - crane
  - ForwardMotion
  - Hoist_down_Voltage
  - Hoist_up_Voltage
  - Lissajou
  - ptch
  - skw
  - swg
  - swg_dot
  - vc

Type :

- CraneContai
  - signal ca
  - signal ho
  - signal pit

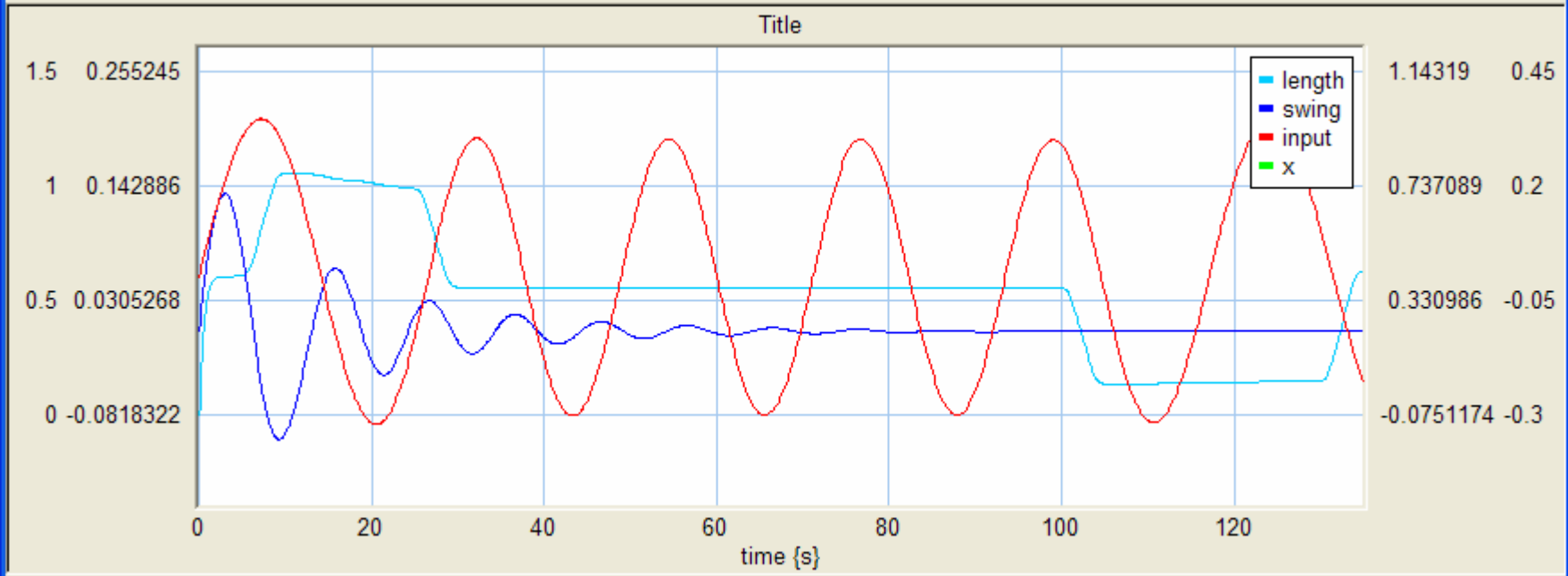
Implementation :

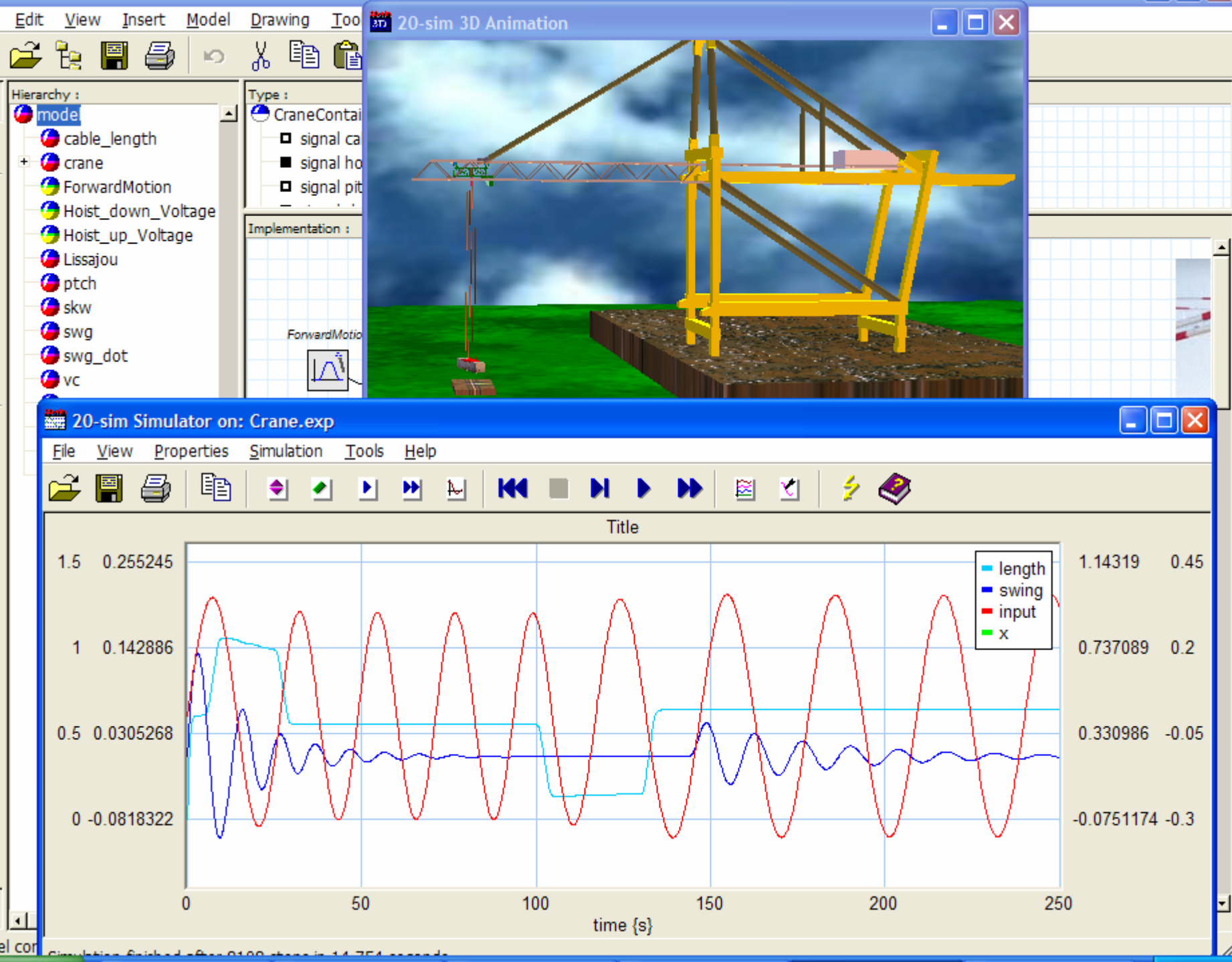
ForwardMotio

20-sim 3D Animation

20-sim Simulator on: Crane.exp

File View Properties Simulation Tools Help




Edit View Insert Model Drawing Too
Hierarchy :
mode
cable_length
crane
ForwardMotion
Hoist_down_Voltage
Hoist_up_Voltage
Lissajou
ptch
skw
swg
swg_dot
vc
Type :
CraneContai
signal ca
signal ho
signal pit
Implementation :
ForwardMotio
20-sim 3D Animation
20-sim Simulator on: Crane.exp
File View Properties Simulation Tools Help
Title
1.5 0.255245
1 0.142886
0.5 0.0305268
0 -0.0818322
1.14319 0.45
0.737089 0.2
0.330986 -0.05
-0.0751174 -0.3
length
swing
input
x
0 50 100 150 200 250
time {s}

Edit View Insert Model Drawing Tools Help

Hierarchy :

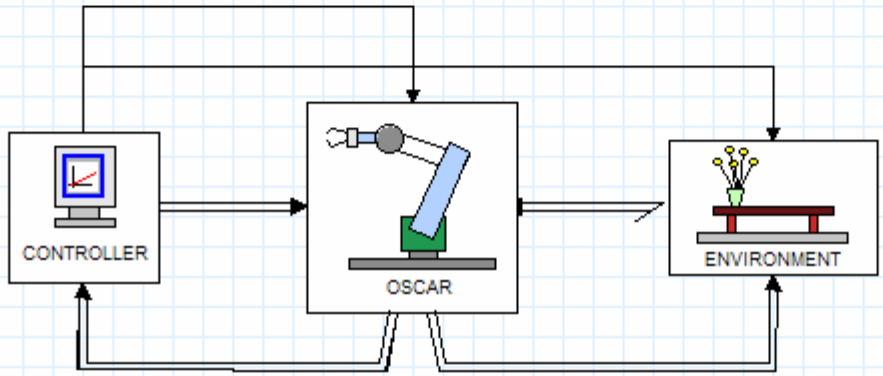
- Oscar_PIH1
  - environment
  - Robot_Model
  - Steer_Impedance

Type : Mainmodel

Icon :

Implementation :

Complex Robot



3D Animation

1) Do a complete check of the model (Model menu).
2) Open the Simulator (the experiment is automatically loaded).
3) Perform a simulation run.

Now for a fast simulation

1) Perform a Brute-Force simulation.
2) Replay Real-Time 3D Animation.

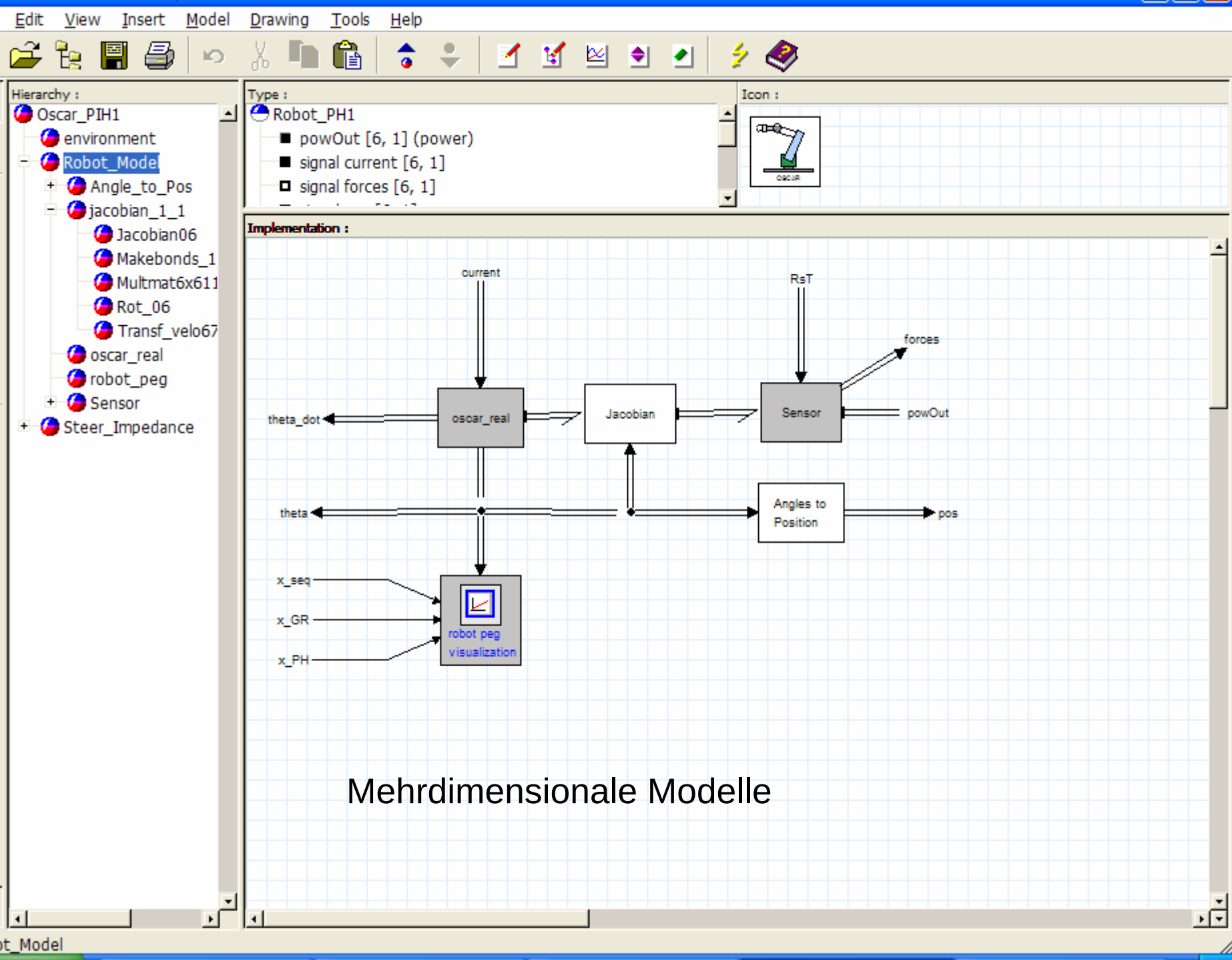
Different cameras

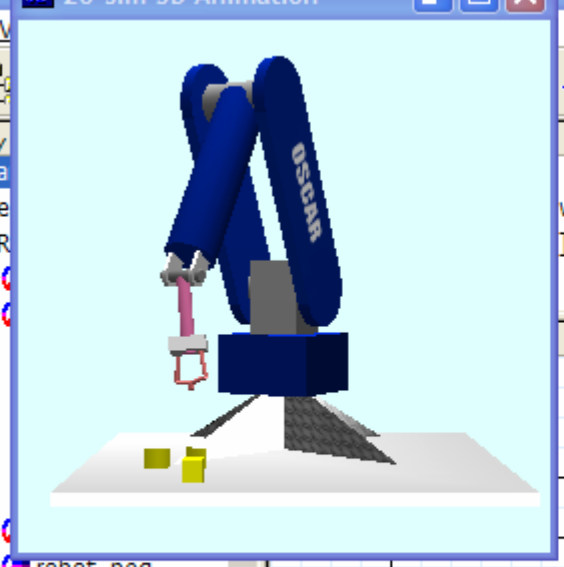
1) Open the animation properties (right mouse menu).
2) Click on Next Camera (there are several).
3) Perform a real-time replay.

Synchronized plot windows

1) Open Numerical Values from the Graph Plot.
2) The 3D Animation is synchronized with the selected values.

opened


Edit View Insert Model Drawing Tools Help
Hierarchy :
Oscar_PIH1
environment
Robot_Mode
Angle_to_Pos
jacobian_1_1
Jacobian06
Makebonds_1
Multmat6x611
Rot_06
Transf_velo67
oscar_real
robot_peg
Sensor
Steer_Impedance
Type :
Robot_PH1
powOut [6, 1] (power)
signal current [6, 1]
signal forces [6, 1]
Icon :
Implementation :
current
RsT
forces
theta_dot
oscar_real
Jacobian
Sensor
powOut
theta
Angles to Position
pos
x_seq
x_GR
x_PH
robot peg visualization
Mehrdimensionale Modelle



Edit V

Hierarchy

Osca

e

R

wer)

]

Icon :

Complex Robot

20-sim Simulator on: ComplexRobot.exp

File View Properties Simulation Tools Help

Complex Robot

Fx [N]
Fy [N]
Fz [N]

2 18
0 10
-2 2
-4 -6
-6 -14
-8 -22
-10 -30
-12 -38

20
16
12
8
4
0
-4
-8

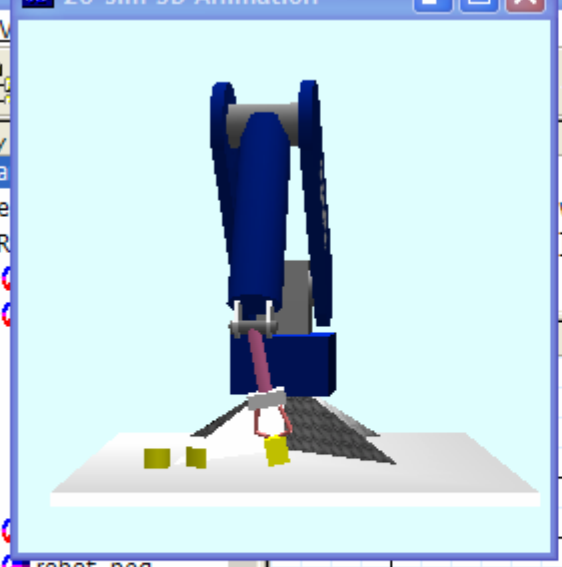
0 5 10 15 20

time {s}

Simulation finished after 1173 steps in 0.86 seconds

2) The 3D Animation is synchronized with the selected values.

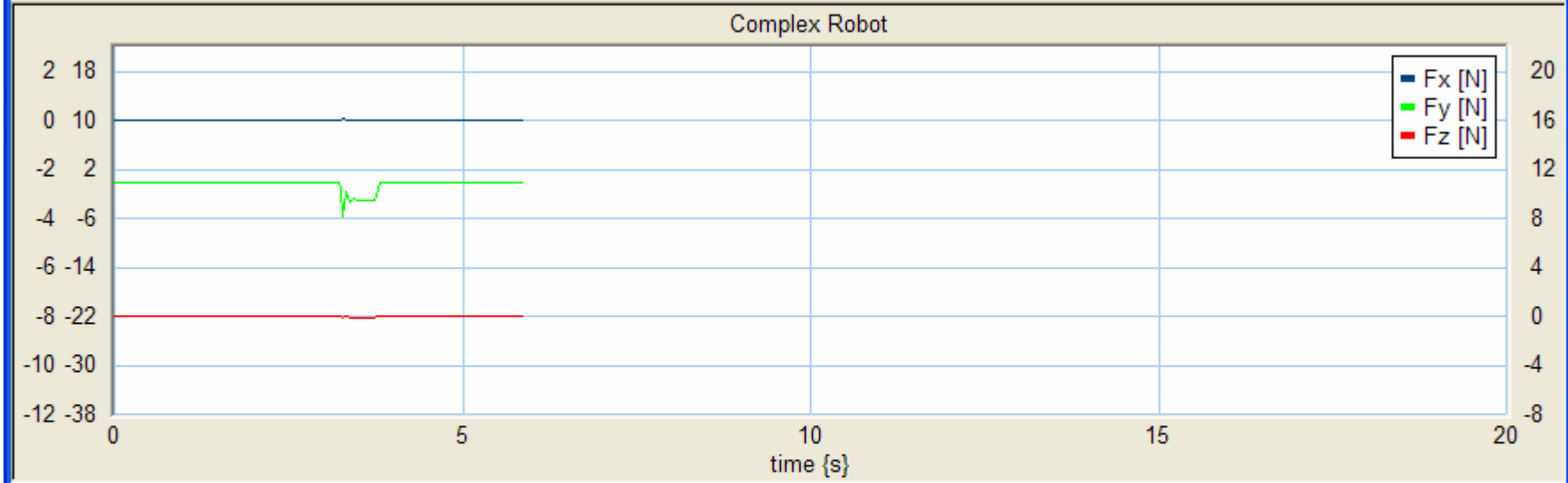
el completely checked.



Complex Robot

20-sim Simulator on: ComplexRobot.exp

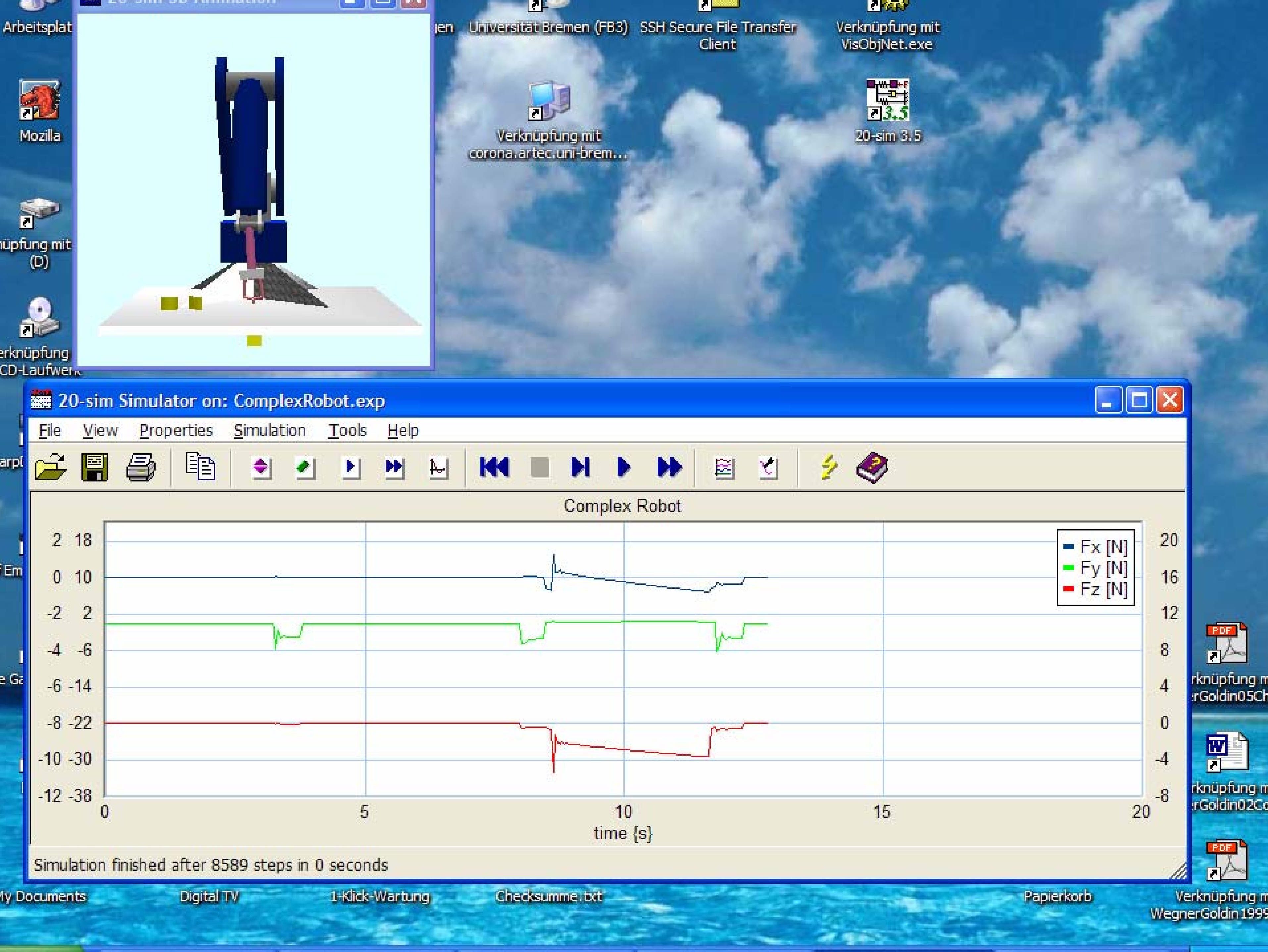
File View Properties Simulation Tools Help



Simulation finished after 3550 steps in 0 seconds

2) The 3D Animation is synchronized with the selected values.

el completely checked.



20-sim Simulator on: ComplexRobot.exp
File View Properties Simulation Tools Help
Complex Robot
Fx [N]
Fy [N]
Fz [N]
time {s}
Simulation finished after 8589 steps in 0 seconds
Universität Bremen (FB3)
SSH Secure File Transfer Client
Verknüpfung mit VisObjNet.exe
Mozilla
Verknüpfung mit corona.artec.uni-brem...
20-sim 3.5
Digital TV
1-Klick-Wartung
Checksumme.txt
Papierkorb

Edit View Insert Model Drawing Tools Help

Hierarchy :

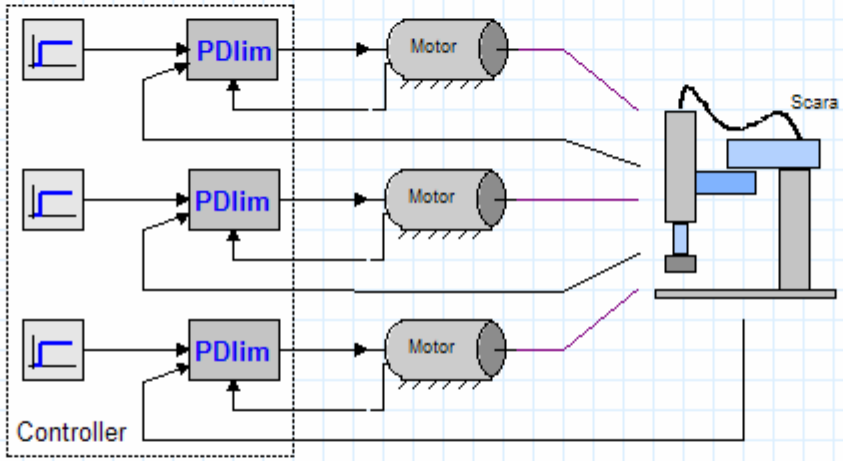
- mode
  - bluelight
  - controller1
  - controller2
  - controller3
  - motor1
  - motor2
  - motor3
  - scara
  - setpoint1
  - setpoint2
  - setpoint3

Type : Mainmodel

Icon :

Implementation :

Scara Robot



reference path for camera

This model demonstrates the various model descriptions that can be combined in 20-sim to generate a model.
Select the various submodels and click the Go Down button to find out that:
- Equations have been used for the robot
- Iconic diagrams have been used for the motors
- Block diagrams have been used for the controllers

3D Animation

1) Do a complete check of the model (Model menu).
2) Open the Simulator (the experiment is automatically loaded).

opened

Edit View Insert Model Drawing Tools Help

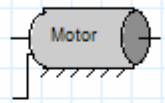
Hierarchy :

- model
  - bluelight
  - controller1
  - controller2
  - controller3
  - motor1
  - motor2
  - motor3
  - scara
  - setpoint1
  - setpoint2
  - setpoint3

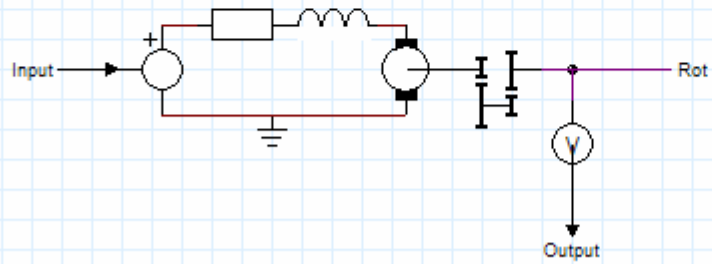
Type :

- Submodel
  - Rot (rotation)
  - signal Input
  - signal Output

Icon :



Implementation :



Scara Motor

Edit View Insert Model Drawing Tools Help

Hierarchy :

- model
  - bluelight
  - controller1
  - controller2
  - controller3
  - motor1
  - motor2
  - motor3
  - scara
  - setpoint1
  - setpoint2
  - setpoint3

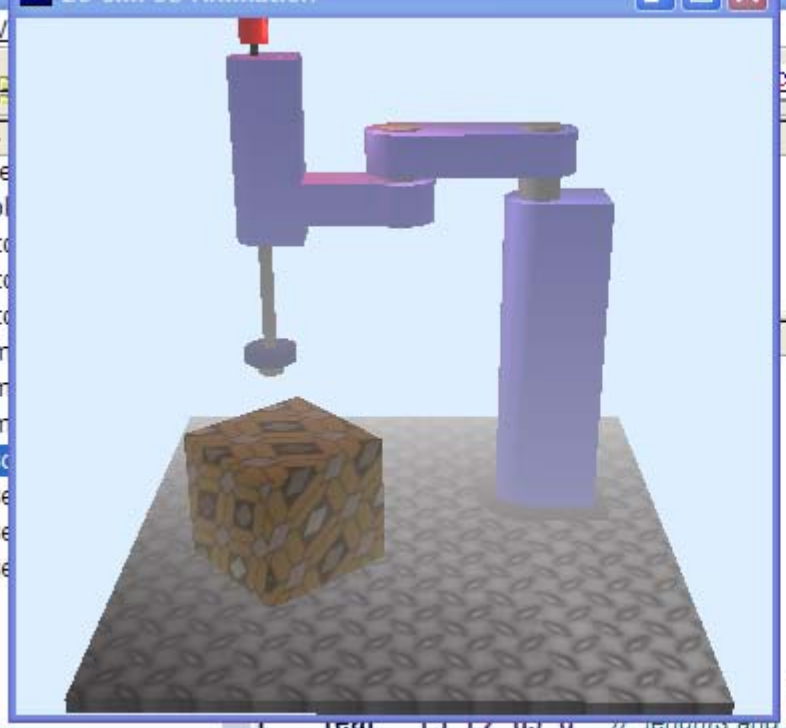
Type :

- Scara
  - a1 (rotation)
  - a2 (rotation)
  - a3 (rotation)

Icon :

Implementation :

```
// Owner: Jan F. Broenink
// Change_Notes:
//  01-04-1998  Broenink        Created
// General_Description:
// SNE comparison 11 SCARA robot
// Validity_Domain:
// Modeling_Assumptions:
parameters
    real    m1, m2, m3A, m3L, I3m;   // masses
    real    L1, L2, u3, g;   // lenghts and gravity accel
variables
    real    dq1, dq2, dq3; // first derivatives of robot coordinates, i.e. velocities
    real    ddq1, ddq2, ddq3; // second derivatives of robot coordinates
    real    T1, T2, T3; // torques, applied by the motors on the robot
    real    m11, m12, m21, m22, m33;// Mass matrix terms
    real    det12;  // Determinant for mass matrix inverse
    real    b1, b2, b3; // b-vars
    real    I1, I2, I3, m3;   // moments of inertia
    real    cosq2, sinq2;   // cos(q2) and sin(q2)
equations
// port equations
    T1 = a1.e;
    T2 = a2.e;
    T3 = a3.e;
    a1.f = dq1;
    a2.f = dq2;
    a3.f = dq3;
```



Edit V

Hierarchy

mode

Icon :

masses

gravity accel

20-sim Simulator on: ScaraRobot.exp

File View Properties Simulation Tools Help

Scara Robot

scara\q1
scara\q2
scara\q3

3 0.8
2 0.4
1 0
0 -0.4
-1 -0.8
-2 -1.2

-0.00010791
-0.100108
-0.200108
-0.300107
-0.400107
-0.500107

0 1 2 3 4 5 6 7 8

time {s}

Edit V

Hierarchy

mode

Icon :

masses

gravity accel

20-sim Simulator on: ScaraRobot.exp

File View Properties Simulation Tools Help

Scara Robot

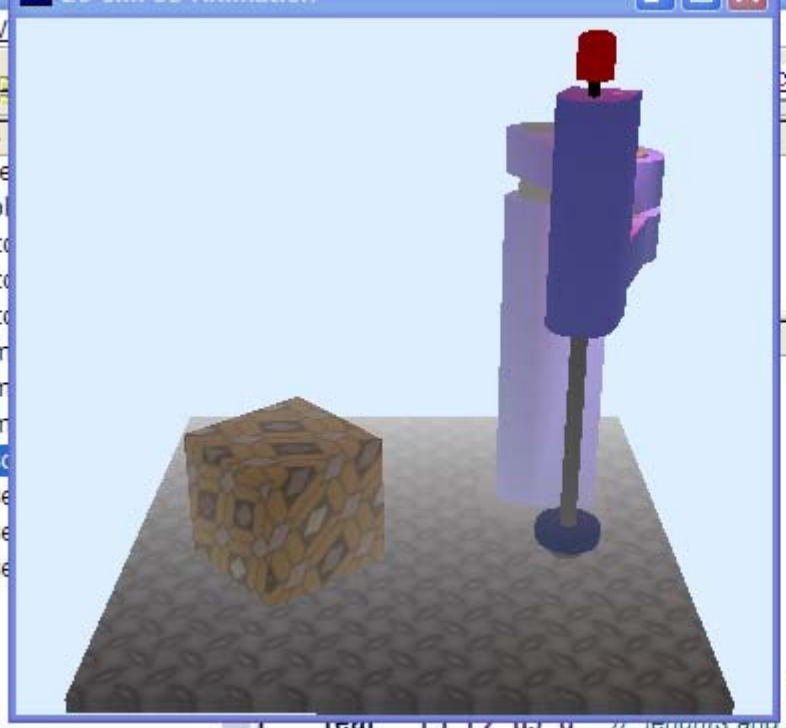
scara\q1
scara\q2
scara\q3

0.2 0.6
0 0.2
-0.2 -0.2
-0.4 -0.6
-0.6 -1
-0.8 -1.4

-0.00010791
-0.0993597
-0.198611
-0.297863
-0.397115
-0.496367

0 0.2 0.4 0.6 0.8 1 1.2 1.4

time {s}



Edit V

Hierarchy

mode

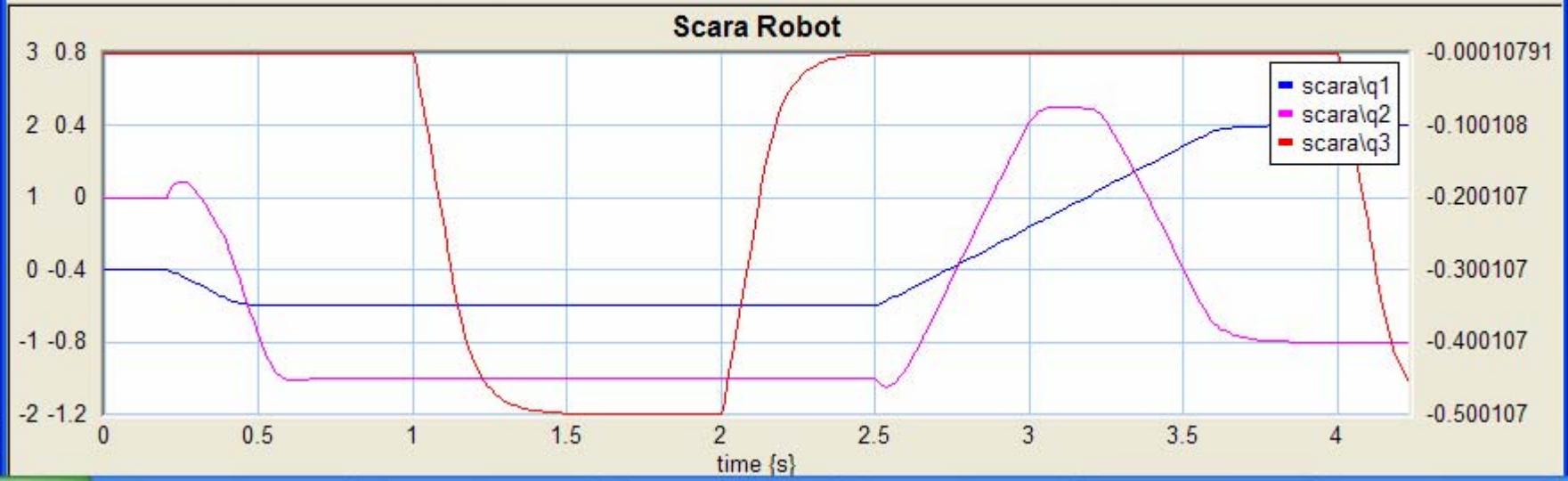
Icon :

masses

gravity accel

20-sim Simulator on: ScaraRobot.exp

File View Properties Simulation Tools Help



Edit View Insert Model Drawing Tools Help

Hierarchy :

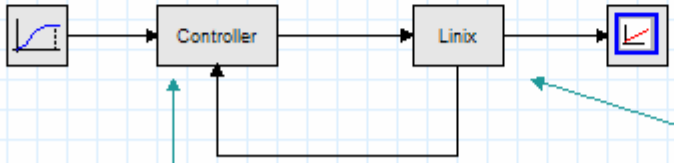
- MainMode
  - Controller
  - Linix
  - omega_load
  - reference

Type : Mainmodel

Icon :

Implementation :

Mechatronic System



Select this submodel and click the "Go Down" button
to inspect the custom made Icons of the various models.
In 20-sim every model icon can be edited in the Icon Editor.

Select this submodel and click the "Go Down" button
to inspect the use of background and text.

This model demonstrates the various options that 20-sim offers
to better understand the working of a model.

opened

Edit View Insert Model Drawing Tools Help

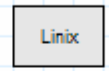
Hierarchy :

- MainModel
  - Controller
  - Linix
  - omega_load
  - reference

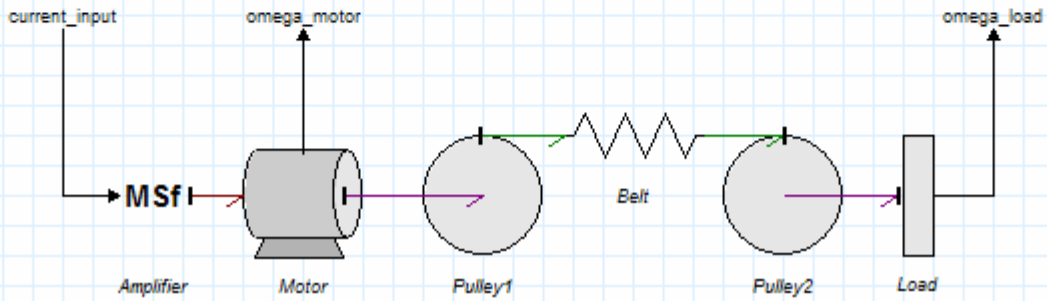
Type :

- linix
  - signal current_input
  - signal omega_load
  - signal omega_motor

Icon :



Implementation :



Help users to understand your model by creating custom made icons.

Edit View Insert Model Drawing Tools Help

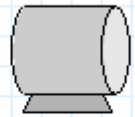
Hierarchy :

- MainModel
  - Controller
  - Linix
    - Belt
    - current
    - Load
    - Motor
    - Pulley1
    - Pulley2
  - omega_load
  - reference

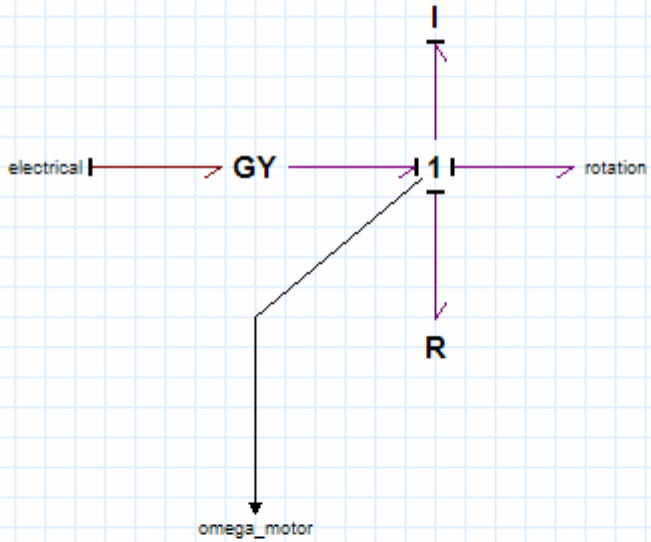
Type :

- Motor
  - electrical (electric)
  - rotation (rotation)
  - signal omega_motor

Icon :



Implementation :



Edit View Insert Model Drawing Tools Help

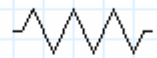
Hierarchy :

- MainModel
  - Controller
  - Linix
    - Belt
    - current
    - Load
    - Motor
    - Pulley1
    - Pulley2
  - omega_load
  - reference

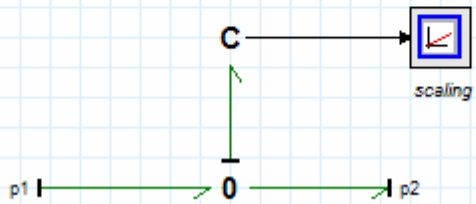
Type :

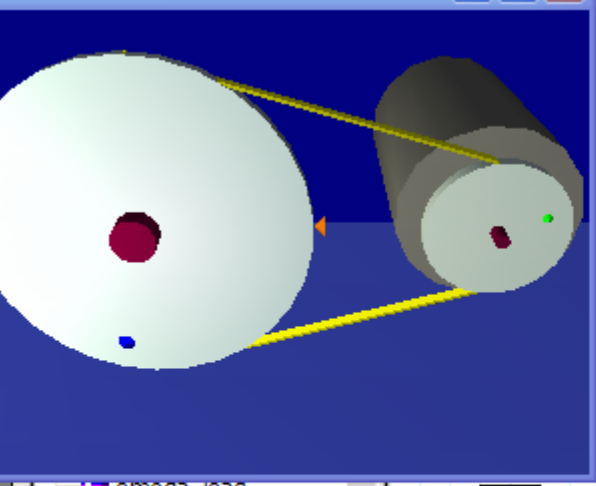
- Belt
  - p1 (translation)
  - p2 (translation)

Icon :



Implementation :





Help

Icon :

Linix

t_input
a_load
a_motor

Mechatronic System

omega_load
reference

Controller

Linix

20-sim Simulator on: mechatronicsystemohneregelung.exp

File View Properties Simulation Tools Help

Controlled Linix

control signal {A}
flow {rad/s}

1.5
1
0.5
0

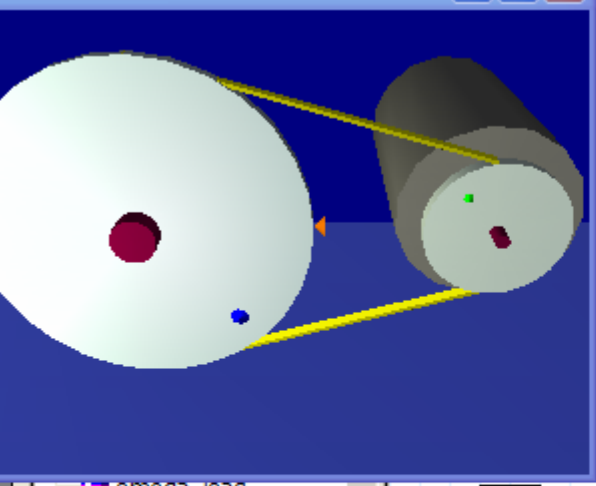
32.5
20
7.5
-5

0 1 2 3 4 5

time {s}

File opened.

del completely checked.



Help

Icon :

Linix

t_input
a_load
a_motor

Mechatronic System

omega_load
reference

Controller

Linix

20-sim Simulator on: mechatronicsystemohneregelung.exp

File View Properties Simulation Tools Help

Controlled Linix

control signal {A}
flow {rad/s}

1.5
1
0.5
0

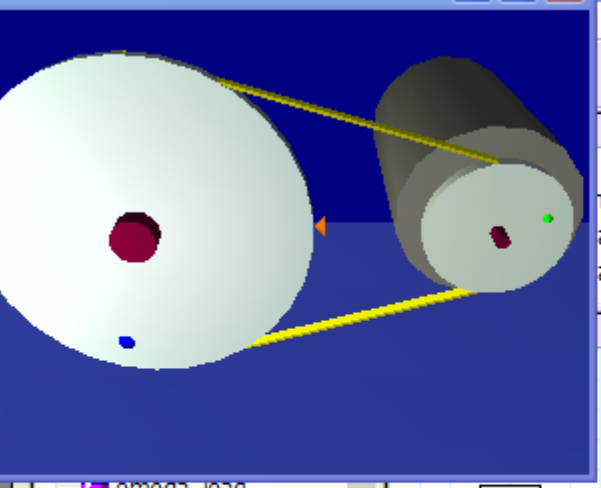
17
12
7
2

0 0.2 0.4 0.6 0.8 1 1.2 1.4

time {s}

Simulation finished after 2561 steps in 1.632 seconds

del completely checked.



Help

Icon :

Linix

t_input
a_load
a_motor

Mechatronic System

omega_load
reference

Controller

Linix

20-sim Simulator on: mechatronicsystemohneregelung.exp

File View Properties Simulation Tools Help

Controlled Linix

control signal {A}
flow {rad/s}

1.5
1
0.5
0

32.5
20
7.5
-5

0 1 2 3 4 5

time {s}

Ohne Regelung

Simulation finished after 7703 steps in 4.103 seconds

del completely checked.

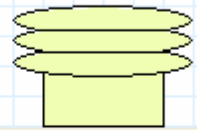
Edit View Insert Model Drawing Tools Help

Hierarchy :

- model
  - Bellows
  - Ground1
  - Lever
  - Magnet
  - MSe1
  - Pipe
  - WaveGenerator1

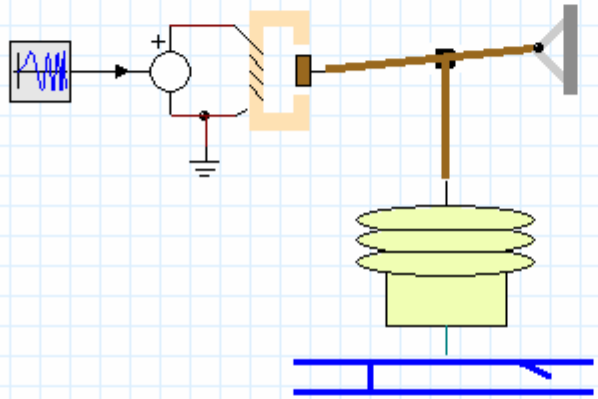
Type : Mainmodel

Icon :



Implementation :

Aquarium Pump

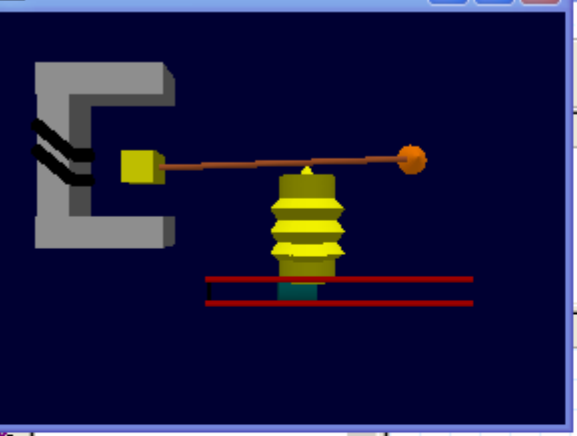


This demo shows the performance of simple aquarium pump. In order to maximize the air flow, the compliance of the bellows (k) is varied by means of the optimization routine (details and instruction how to run the various experiments can be found in the help files).

Running the demo

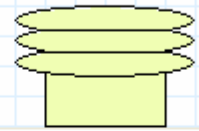
1) Start the Simulator
2) Perform a simulation run.

del completely checked.

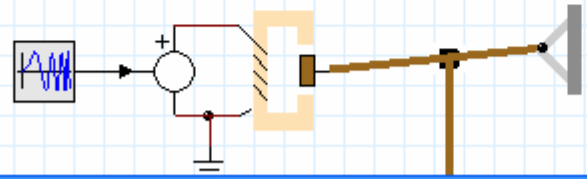


Help

Icon :

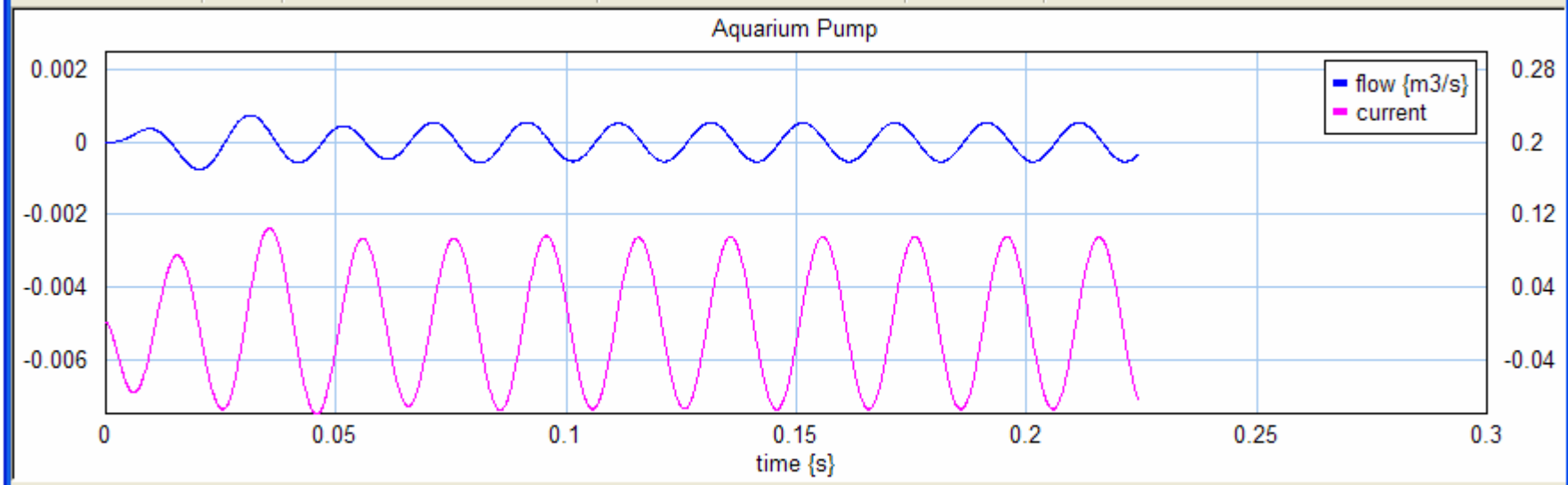


Aquarium Pump



20-sim Simulator on: AquariumPump.exp

File View Properties Simulation Tools Help



Simulation finished after 8973 steps in 0.843 seconds

del completely checked.

Beispiel