PistonSASpringMass

Single acting piston with an inertia load and spring

In[570]:=
```
<< C:\\Hopsan\Compgen\CompgenNG.mx
```

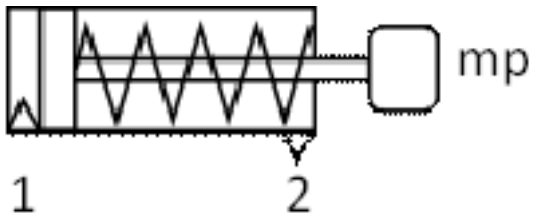
In[571]:=
```
path = ToFileName[{"C:", "Users", "petkr14", "Dropbox",
     "HopsanComponents", "PneumaticDev", "PneumaticComponents"}];
```

In[572]:=
```
path = ToFileName[{"H:", "PettersDropbox", "Dropbox",
     "HopsanComponents", "PneumaticDevelop", "PneumaticComponents"}];
```

In[573]:=
```
domain = "Pneumatic";
displayName = "PistonSASpringMass";
brief = "Single acting pneumatic piston with spring return";
componentType = "ComponentQ";
author = "Petter Krus <petter.krus@liu.se>";
affiliation = "Division of Fluid and Mechatronic Systems, Linköping University";
SetFilenames[path, domain, displayName];
ResetComponentVariables[];
```

Component description

Single acting pneumatic piston with spring return connected to an inertia load.
The chamber volume is not included in the model but can be considered outside the model.



Component equations

The name of the component is stored in ComponentName.

Variables and parameters

In[581]:=
```
inputParameters = {
    {A1, 0.001, double, "m2", "Piston area 1"},
    {A2, 0.001, double, "m2", "Piston area 2"},
    {SL, 0.5, double, "m", "Stroke"},
    {Cip, 0., double, "m3/(s Pa)", "Leak coeff."},
    {bp, 30., double, "N/m/s", "Visc. friction coeff."},
    {ks, 100., double, "N/m", "Spring constant"},
    {f0, 100., double, "N", "Spring pre-load"},
    {fc, 30., double, "N", "Dry friction (+/-)"},
    {bfc, 1., double, "", "Numerical friction factor."},
    {xmin, 0., double, "m", "Limitation on stroke"},
    {xmax, 0.5, double, "m", "Limitation on stroke"},
    {mL, 100., double, "kg", "Inertia"},
    {bL, 0., double, "Ns/m", "Viscous friction coefficient of load"},
    {patm, 100000., double, "Pa", "Ambient pressure"},
    {Tatm, 297., double, "K", "Ambient temperature"},
    {R, 287., double, "J/Kg K", "Gas constant"},
    {cv, 718, double, "J/Kg K", "heatcoeff"}
    };
```

In[582]:=
```
nodeConnections = {
      PneumaticQnode[1, 1. * 10^5, "hydraulic node 1"],
      MechanicQnode[mp, 0., "mechanical node"]};
```

The system of equations

In[583]:=
```
p1e = c1 + Zc1 qm1;
fmpe = cmp + Zcmp vmp;
```

The generated piston force

In[585]:=
```
fg = A1 (p1e - patm);
```

Dry friction is modelled with a small linear region for low speeds for numerical reasons

In[586]:=
```
Bf = bfc mL / mTimestep;
```

In[587]:=
```
fre = limit[Bf vmp, -fc, fc];
```

In[588]:=
```
T0 = 1.;
```

Differrential algebraic equations

In[589]:=
```
rho1 := p1 / (R (T1 + T0));
rho2 := pp2 / (R (Tp2 + T0));
```

In[591]:=
```
qm1e = -qmp2;
```

In[592]:=
```
q1e = qm1 / rho1;
```

In[593]:=
```
cp = cv + R;
```

In[594]:=
```
systemEquationsDA := {
  mL der[vmp] + (bp + bL) vmp + ks xmp + fre + f0 == (fg - fmpe),
  der[xmp] == vmp,
  qm1 == - (A1 rho1 vmp + Cip * (p1 - patm)),
  dE1 == qm1 cp T1
 }
```

Boundaries

In[595]:=
```
systemBoundaryEquations = {
   p1 == (c1 + Zc1 dE1),
   fmp == cmp + Zcmp vmp
  };
```

The vector of independent variables of the system are

In[596]:=
```
systemVariables = {vmp, xmp, qm1, dE1, p1, fmp};
```

Limitations

In[597]:=
```
variable2Limits = {{xmp, vmp, xmin, xmax}};
```

In[598]:=
```
Compgen[file]
```