PistonMass

Piston with an inertia load

In[510]:=
```
<< C:\\Hopsan\Compgen\CompgenNG.mx
```

In[511]:=
```
path = ToFileName[{"C:", "Users", "petkr14", "Dropbox",
    "HopsanComponents", "PneumaticDevelop", "PneumaticComponents"}]
```

Out[511]=
```
C:\Users\petkr14\Dropbox\HopsanComponents\PneumaticDevelop\PneumaticComponents\
```

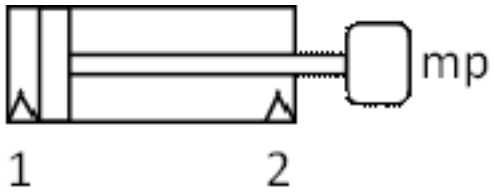
In[512]:=
```
path = ToFileName[{"H:", "PettersDropbox", "Dropbox",
    "HopsanComponents", "PneumaticDevelop", "PneumaticComponents"}]
```

Out[512]=
```
H:\PettersDropbox\Dropbox\HopsanComponents\PneumaticDevelop\PneumaticComponents\
```

In[513]:=
```
domain = "Pneumatic";
displayName = "PistonMass";
brief = "Pneumatic piston with an inertia load";
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

Pneumatic piston with an inertia load. The chamber volumes are not included in the model but can be considered outside the model.



Variables and parameters

In[521]:=
```
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."},
    {mL, 10., double, "kg", "Inertia"},
    {bL, 0., double, "Ns/m", "Viscous friction coefficient of 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"},
    {patm, 100 000., double, "Pa", "Ambient pressure"},
    {R, 287., double, "J/Kg K", "Gas constant"},
    {cv, 718, double, "J/Kg K", "heatcoeff"}
    };
```

In[522]:=
```
nodeConnections = {
    PneumaticQnode[1, 100 000., "pneumatic port 1"],
    PneumaticQnode[2, 100 000., "pneumatic port 2"],
    MechanicQnode[mp, 0., "mechanical node"]};
```

The system of equations

In[523]:=
```
p1e = c1 + Zc1 qm1;
p2e = c2 + Zc2 qm2;
fmpe = cmp + Zcmp vmp;
```

The generated piston force

In[526]:=
```
fg = A1 p1e - A2 p2e - (A1 - A2) patm;
```

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

In[527]:=
```
Bf = bfc mL / mTimestep;
```

In[528]:=
```
fre = limit[Bf vmp, -fc, fc];
```

In[529]:=
```
T0 = 1.;
```

Differential algebraic equations

In[530]:=
```
rho1 := p1 / (R (T1 + T0));
rho2 := p2 / (R (T2 + T0));
```

In[532]:=
```
qm1e = -qm2;
```

In[533]:=
```
q1e = qm1 / rho1;
q2e = qm2 / rho2;
```

In[535]:=
```
cp = cv + R;
```

In[536]:=
```
systemEquationsDA := {
  mL der[vmp] + (bp + bL) vmp + fre == (fg - fmpe),
  der[xmp] == vmp,
  qm1 == - (A1 rho1 vmp + Cip * (p1 - p2)),
  qm2 == (A2 rho2 vmp + Cip * (p1 - p2)),
  dE1 == qm1 cp T1,
  dE2 == qm2 cp T2
 }
```

Boundaries

In[537]:=
```
systemBoundaryEquations = {
   p1 == (c1 + Zc1 dE1),
   p2 == (c2 + Zc2 dE2),
   fmp == cmp + Zcmp vmp
  };
```

The vector of independent variables of the system are

In[538]:=
```
systemVariables = {vmp, xmp, qm1, qm2, dE1, dE2, p1, p2, fmp};
```

Limitations

In[539]:=
```
variable2Limits = {{xmp, vmp, xmin, xmax}};
```

In[540]:=
```
Compgen[file]
```