AirProperty

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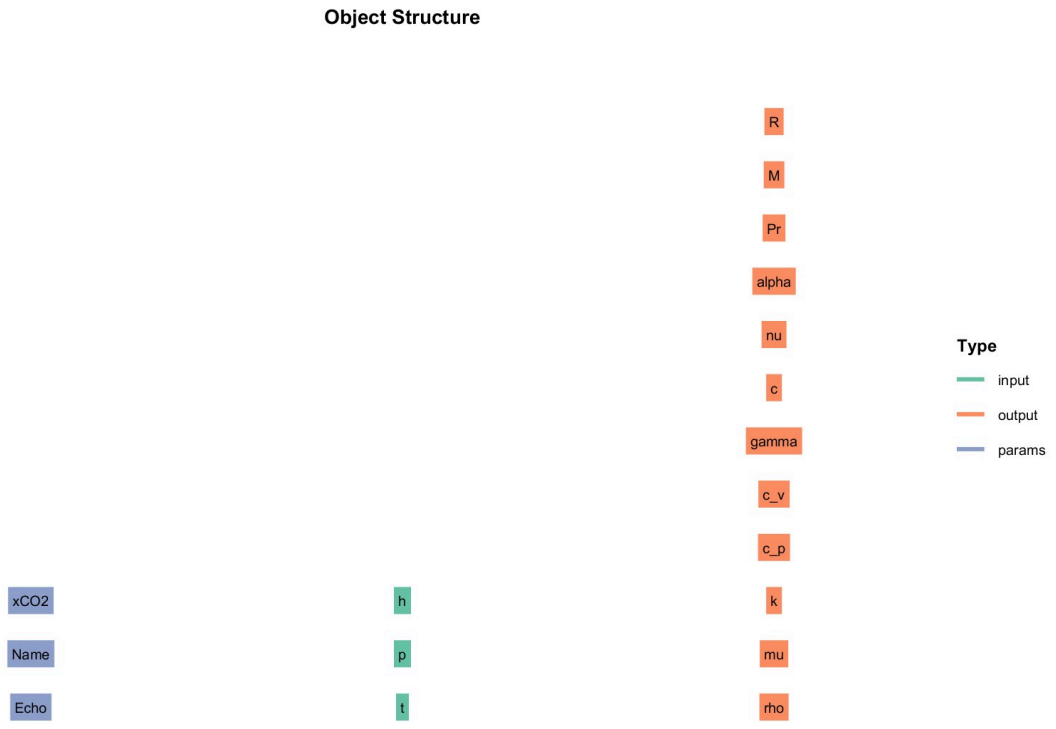
1 介绍

AirProperty用于计算空气性质, 相关的代码参考自参考文献[1] [2] [3]。

2 类结构



输入 input：

- t : 温度 [℃]
- p: 气压 [hPa]
- h : 湿度 0~100

参数 params:

- xCO2 ： Mole fraction of CO2 in the air
- Name : 名称

输出 output :

- rho : [kg m^-3] Density
- mu : [N s m^-2] Dynamic viscosity
- k : [W m^-1 K^-1] Thermal conductivity
- c_p : [J kg^-1 K^-1] Specific heat capacity (constant pressure)
- c_v : [J kg^-1 K^-1] Specific heat capacity (constant volume)

- gamma : [1] Ratio of specific heats
- c : [m s^-1] Speed of sound: c = (gamma*R*T/M)^0.5
- nu : [m^2 s^-1] Kinematic viscosity: nu = mu/rho
- alpha : [m^2 s^-1] Thermal diffusivity: alpha = k/(rho*c_p)*
- Pr : [1] Prandtl number: Pr = mu*c_p/k
- M : [kg mol^-1] Molar mass of humid air
- R : [J kg^-1 K^-1] Specific gas constant

3 案例

3.1 Demo Air Property (Flag=1)

```
inputStruct.t=15;
inputStruct.p=1013.25;
inputStruct.h=[];
paramsStruct.xCO2=0.0004;
Air=method.AirProperty(paramsStruct, inputStruct);
Air=Air.solve();
disp(Air.output)
```

输出结果:

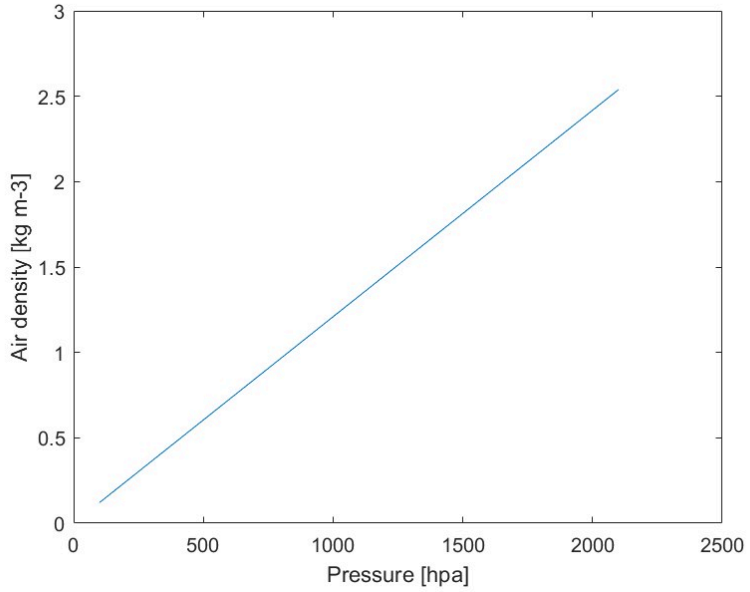
```
Successfully calculate air property ! .
    rho: 1.2250
     mu: 1.7966e-05
      k: 0.0252
    c_p: 1.0058e+03
    c_v: 718.7052
  gamma: 1.3994
      c: 340.2176
     nu: 1.4666e-05
  alpha: 2.0446e-05
     Pr: 0.7173
      M: 0.0290
      R: 287.0478
```

3.2 rho & pressure (Flag=2)

```
inputStruct.t=15;
inputStruct.h=[];
paramsStruct.xCO2=0.0004;
rho=NaN(1,11);
p=100:200:2100;
for i=1:11
  inputStruct.p=p(i);
  Air=method.AirProperty(paramsStruct, inputStruct);
  Air=Air.solve();
  rho(i)=Air.output.rho;
end

figure
plot(p,rho);
xlabel('Pressure [hpa]')
```

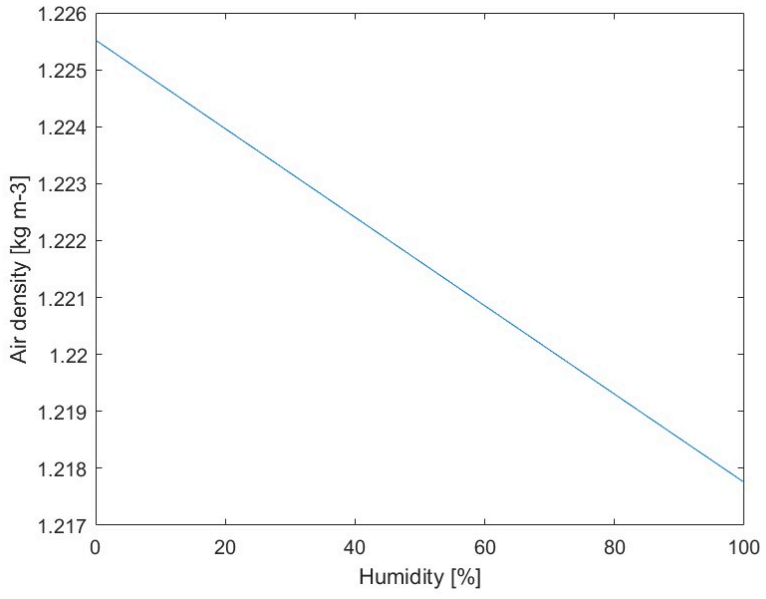
```
ylabel('Air density [kg m-3]')
```



3.3 rho & humidity (Flag=3)

```
inputStruct.t=15;
inputStruct.p=1013.25;
paramsStruct.xCO2=0.0004;
rho=NaN(1,11);
h=0:10:100;
for i=1:11
  inputStruct.h=h(i);
  Air=method.AirProperty(paramsStruct, inputStruct);
  Air=Air.solve();
  rho(i)=Air.output.rho;
end

figure
plot(h,rho);
xlabel('Humidity [%]')
ylabel('Air density [kg m-3]')
```



4 参考文献

[1] https://www.mathworks.com/matlabcentral/fileexchange/64527-calculation-of-air-properties?s_tid=srchtitle

[2] Picard, A, Davis, RS, Glaser, M, Fujii, K, 2008, 'Revised formula for the density of moist air (CIPM-2007)', Metrologia, vol. 45, no. 2, pp. 149-155. DOI: http://dx.doi.org/10.1088/0026-1394/45/2/004

[3] Tsilingiris, P, 2008, 'Thermophysical and transport properties of humid air at temperature range between 0 and 100°C', Energy Conversion and Management, vol. 49, no. 5, pp.1098-1110. DOI: https://doi.org/10.1016/j.enconman.2007.09.015