SimulasiKontrol

June 10, 2021

1 Simulasi Sistem Kontrol On-Off dan PID

1.1 Simulasi Kontrol On-Off

Program simulasi kontrol on-off untuk kasus tangki pemanas, dapat dilihat berikut ini :

[1]:
```
import numpy as np
import matplotlib.pyplot as plt
#from scipy import integrate

Tsp = 80
C   = 1000  # J/kg C
R   = 1000 # ohm
k   = 0.5   # J/s C
To  = 30    # oC
Vmin= 0
Vmax= 300    # volt

# System Model
def nilaiT(Ti, tn, ti, k, C, V):
        #sistem tangki pemanas
        Tn = Ti + (tn - ti)/C * ((1/R * V*V) - (k*(Ti-To)))
        return Tn

time = np.linspace(1, 1000, 100)
Tact = np.zeros(time.size)
Tsetp= np.zeros(time.size)
i = 0
T0= 60
Ti=T0
Tn=T0
Tsetp[:] = Tsp

print ('time', 'error', 'V', 'Taktual')# time looping
for t in time:
    Ti = Tn
    # calculate error
```

```
    err = Ti - Tsp
    # controller on-off
    if (err <= 0):
        V = Vmax   # Pemanas dinyalakan - On
    else:
        V = Vmin  # Pemanas dimatikan - off
    if (i == 0):
            ti = 0

    #calculate System Response
    Tn = nilaiT(Ti, t, ti, k, C, V)
    ti = t
    print (t, err, V, Tn)
    Tact[i] = Tn
    # selesai time looping, kembali lagi ke atas
    i = i + 1

#print Graph
plt.plot(time, Tact, '-b', label='T Aktual')
plt.plot(time, Tsetp, '--r', label='T Set-Point')
plt.title('Kontrol Temperatur On-Off')
plt.ylabel('Temperatur (C)')
plt.xlabel('Waktu (detik)')
plt.legend(loc='lower right', frameon=False)
plt.show()
```

```
time error V Taktual
1.0 -20 300 60.075
11.090909090909092 -19.924999999999997 300 60.83143977272728
21.181818181818183 -19.16856022727272 300 61.584062962964886
31.272727272727273 -18.415937037035114 300 62.33288882710629
41.36363636363637 -17.667111172893712 300 63.07793652438771
51.45454545454546 -16.92206347561229 300 63.8192251173783
61.54545454545455 -16.180774882621698 300 64.55677357246789
71.63636363636364 -15.44322642753211 300 65.29060076035226
81.72727272727273 -14.709399239647738 300 66.02072545651593
91.81818181818183 -13.979274543484067 300 66.7471663417126
101.90909090909092 -13.2528336582874 300 67.46994200244305
112.00000000000001 -12.530057997556952 300 68.18907093143072
122.0909090909091 -11.81092906856928 300 68.90457152809486
132.1818181818182 -11.095428471905137 300 69.61646209902129
142.27272727272728 -10.383537900978709 300 70.32476085843078
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162.45454545454547 -8.970514071354941 300 71.73065534055053
172.54545454545456 -8.269344659449473 300 72.42828703405957
182.63636363636365 -7.571712965940435 300 73.12239885856954
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```

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586.2727272727274 -0.2032112784172 300 80.45372310576028
596.3636363636364 0.4537231057602753 0 80.19916113918121
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636.7272727272727 0.3467552640870224 0 80.09273299889095
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707.3636363636364 0.38887996606756303 0 80.13464516260241
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778.0000000000001 0.4341214212277862 0 80.17965835405704
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878.909090909091 0.6257691588090921 0 80.37033914168964
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899.0909090909091 0.11619788511112006 0 79.86333888669078
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939.4545454545455 0.011431464919752443 0 79.75910106071039
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969.7272727272727 0.16185282166837567 0 79.90876347334087
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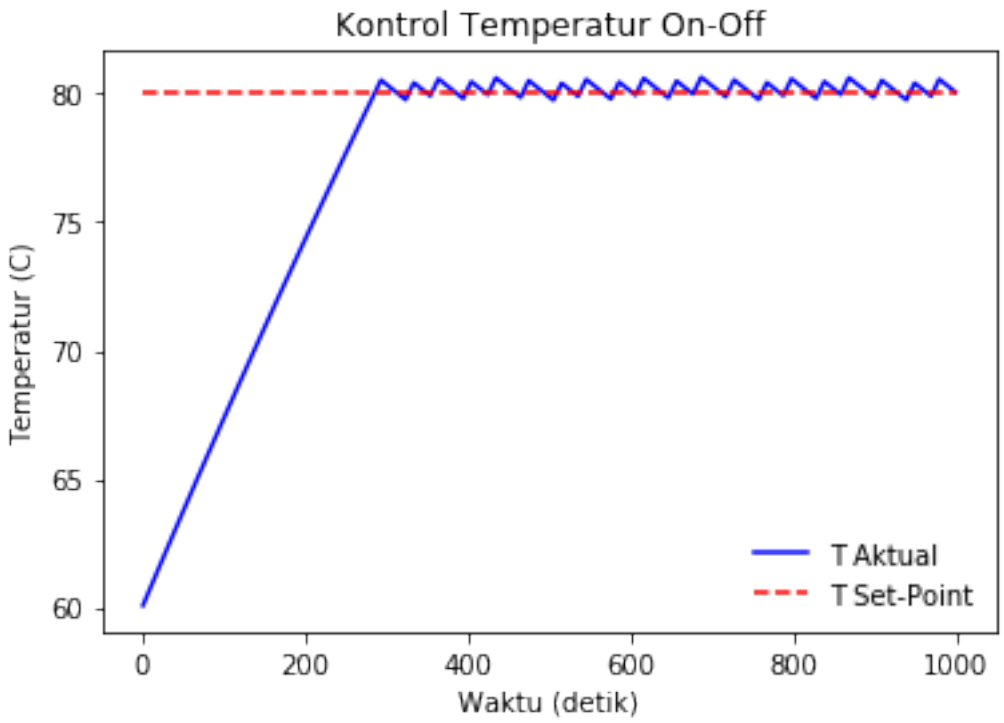
1000.0 0.3100088143965678 0 80.05617195174212



1.2 Simulasi Kontrol PID

Program simulasi kontrol PID untuk kasus tangki pemanas, dapat dilihat berikut ini :

[4]:
```
import numpy as np
import matplotlib.pyplot as plt
#from scipy import integrate

Tsp = 80
C   = 1000  # J/kg C
R   = 1000 # ohm
k   = 0.5   # J/s C
To  = 30    # oC
Vmin= 0
Vmax= 300    # volt

# System Model
def nilaiT(Ti, tn, ti, k, C, V):
        #sistem tangki pemanas
        Tn = Ti + (tn - ti)/C * ((1/R * V*V) - (k*(Ti-To)))
        return Tn

# function to return feasible value of V
```

```
def sat(V):
    return max(Vmin,min(Vmax,V))

time = np.linspace(1, 1000, 100) #detik
Tact = np.zeros(time.size)
Tsetp= np.zeros(time.size)
i = 0
T0= 60
Ti=T0
Tn=T0
Tsetp[:] = Tsp
dt = 1 #detik
ti = 0

#PID constant
kp = 80
ki = 100
kd = 0
beta = 0
gamma = 0
V = 300

errP_ = Ti - beta*Tsp
errD_ = Ti - gamma*Tsp
errD__ = errD_


print ('time', 'error', 'V', 'Taktual')# time looping
for t in time:
    Ti = Tn
    # calculate error
    errP = Ti - beta*Tsp
    errI = Ti - Tsp
    errD = Ti - gamma*Tsp

    # controller PID
    V -= kp*(errP - errP_) + ki*dt*errI + kd*(errD - 2*errD_ + errD__)/dt
    V = sat(V)

    # save data for next PID calculations
    errP_ = errP
    errD__= errD_
    errD_ = errD

    #calculate System Response
    Tn = nilaiT(Ti, t, ti, k, C, V)
    ti = t
```

```
    print (t, errI, V, Tn)
    Tact[i] = Tn
    # selesai time looping, kembali lagi ke atas
    i = i + 1

#print Graph
plt.plot(time, Tact, '-b', label='T Aktual')
plt.plot(time, Tsetp, '--r', label='T Set-Point')
plt.title('Kontrol Temperatur PID')
plt.ylabel('Temperatur (C)')
plt.xlabel('Waktu (detik)')
plt.legend(loc='lower right', frameon=False)
plt.show()
```

```
time error V Taktual
1.0 -20 300 60.075
11.090909090909092 -19.924999999999997 300 60.83143977272728
21.181818181818183 -19.16856022727272 300 61.584062962964886
31.272727272727273 -18.415937037035114 300 62.33288882710629
41.36363636363637 -17.667111172893712 300 63.07793652438771
51.45454545454546 -16.92206347561229 300 63.8192251173783
61.54545454545455 -16.180774882621698 300 64.55677357246789
71.63636363636364 -15.44322642753211 300 65.29060076035226
81.72727272727273 -14.709399239647738 300 66.02072545651593
91.81818181818183 -13.979274543484067 300 66.7471663417126
101.90909090909092 -13.2528336582874 300 67.46994200244305
112.00000000000001 -12.530057997556952 300 68.18907093143072
122.0909090909091 -11.81092906856928 300 68.90457152809486
132.1818181818182 -11.095428471905137 300 69.61646209902129
142.27272727272728 -10.383537900978709 300 70.32476085843078
152.36363636363637 -9.675239141569222 300 71.02948592864506
162.45454545454547 -8.970514071354941 300 71.73065534055053
172.54545454545456 -8.269344659449473 300 72.42828703405957
182.63636363636365 -7.571712965940435 300 73.12239885856954
192.72727272727275 -6.8776011414304605 300 73.81300857341948
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212.90909090909093 -5.499866151655496 300 75.18379226392786
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233.09090909090912 -4.13599868794924 300 76.54077839633996
243.1818181818182 -3.4592216036600405 300 77.21414083261297
253.27272727272728 -2.7858591673870308 300 77.88410584932114
263.3636363636364 -2.115894150678855 300 78.55069058799047
273.4545454545455 -1.4493094120095265 300 79.21391210366016
283.54545454545456 -0.7860878963398363 300 79.87378736531896
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```

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394.54545454545456 -0.08208248298603849 185.64880434520575 80.01384694404933
404.6363636363637 0.013846944049333842 176.58975577744258 80.07617867490931
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475.2727272727273 -0.04311373539593433 158.91602289573996 79.9596699347202
485.3636363636364 -0.04033006527980376 162.7263358144299 79.97480655466798
495.4545454545455 -0.025193445332021724 164.0347507518095 79.99418106154371
505.54545454545456 -0.00581893845628656 163.06668404737934 80.01026246823584
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525.7272727272727 0.018705461928220757 158.207939000213 80.01891130872114
535.8181818181819 0.018911308721143882 156.30034038466476 80.0130620199257
545.909090909091 0.01306201992569811 155.46208149573062 80.00460510927165
556.0 0.004605109271651031 155.67812342088928 79.99686917171263
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596.3636363636364 -0.006825358495134992 159.26881340400058 79.99690795094692
606.4545454545455 -0.003092049053080359 159.27935355394425 80.00065630483172
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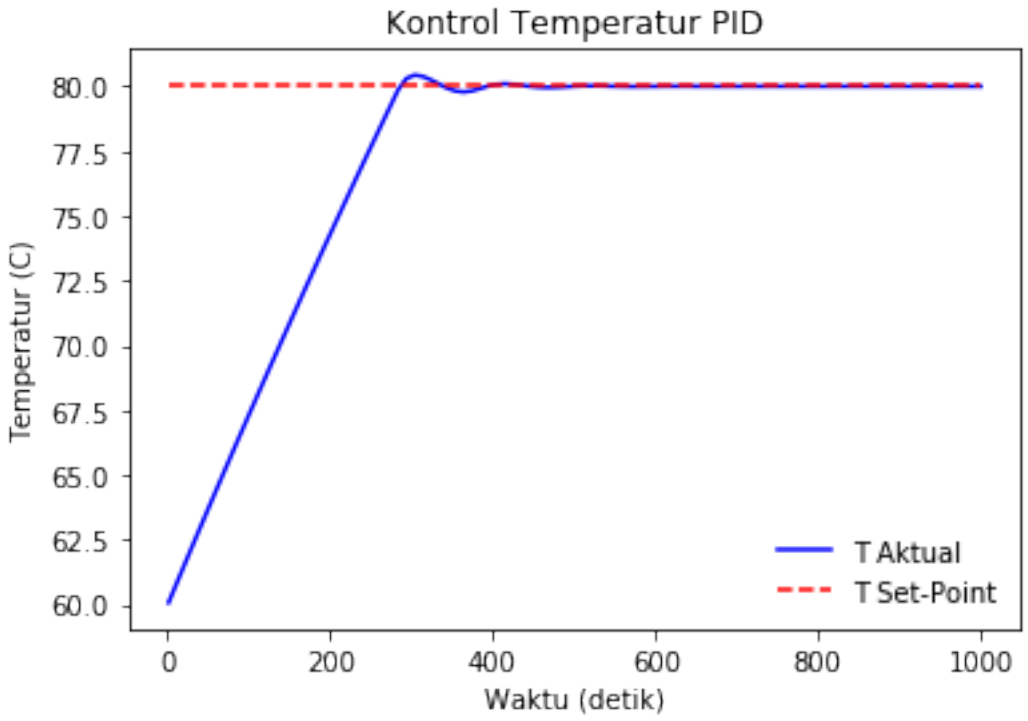

[ ]: