temperature_tests

December 3, 2017

0.1 Tests description:

In all files input data from Arduino/temperature_test measurements. Thus, we have temperature measurements with 1 minute step in reversed in time array. If array ends with sequence of zeros, that means, we didn't obtain hour of measurements, and last non-zero measurement is the beginning.

Conventions: TMT | Temperature Measurement Tool - consists of arduino nano (PB-04) connected to temp sensor (PB-01) and 9v battery.

test1.txt : We put TMT into thermos, thermos into usual freezer at Skoltech 1st floor kitchen (close to Robotics lab).

test2.txt : We put TMT into thermos, thermos into usual fridge (same location).

test3.txt : We put TMT into thermos, thermos into room conditions (see first measurements on plot)

test4.txt : We put TMT into transparent polyethilene bag, without thermos, in fridge.

test5.txt : We put TMT with additional 50 Ohm resistor connected to battery, simulating extra heating in thermos, freezer (same as for test1.txt).

test6.txt : We put TMT with additional 200 Ohm resistor connected to battery, simulating RPi Zero heating in thermos, freezer (same as for test1.txt)

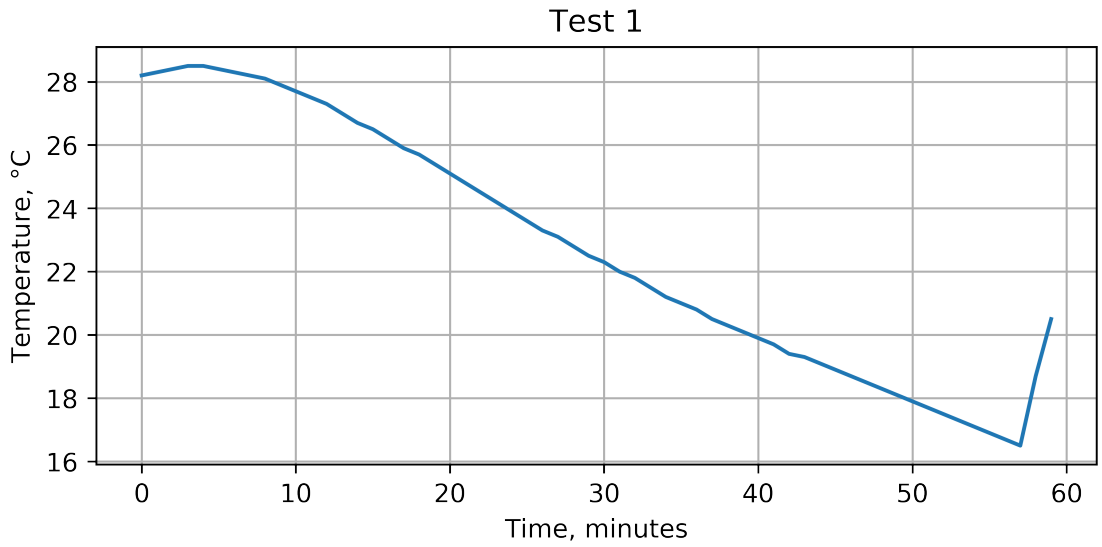
test7.txt : Measuring real temperature inside freezer, which used for tests (1,5,6). We put TMT in transparent polyethilene bag and than to freezer for almost an hour.

```
In [4]: from matplotlib import pyplot as plt
        %matplotlib inline
        import numpy as np
```

```
In [15]: def plot_test(test_number):
             fig,ax = plt.subplots(figsize=(7,3),dpi=600)
             test_data = np.loadtxt("test"+str(test_number)+".txt")
             test_data = np.flip(test_data,0)
             first_non_zero = (test_data != 0).argmax()
             test_data = test_data[first_non_zero:]
             time_list = list(range(test_data.shape[0]))
             ax.plot(time_list, test_data)
             ax.grid()
             ax.set_xlabel('Time, minutes')
             ax.set_ylabel('Temperature, řC')
             ax.set_title('Test %d'%(test_number))
             plt.savefig("test"+str(test_number)+".pdf", bbox_inches='tight')
```

Test 1. Temperature falls - OK, good.

```
In [16]: plot_test(1)
```



Test 2. Temperature is stable or decreasing very slowly.

```
In [17]: plot_test(2)
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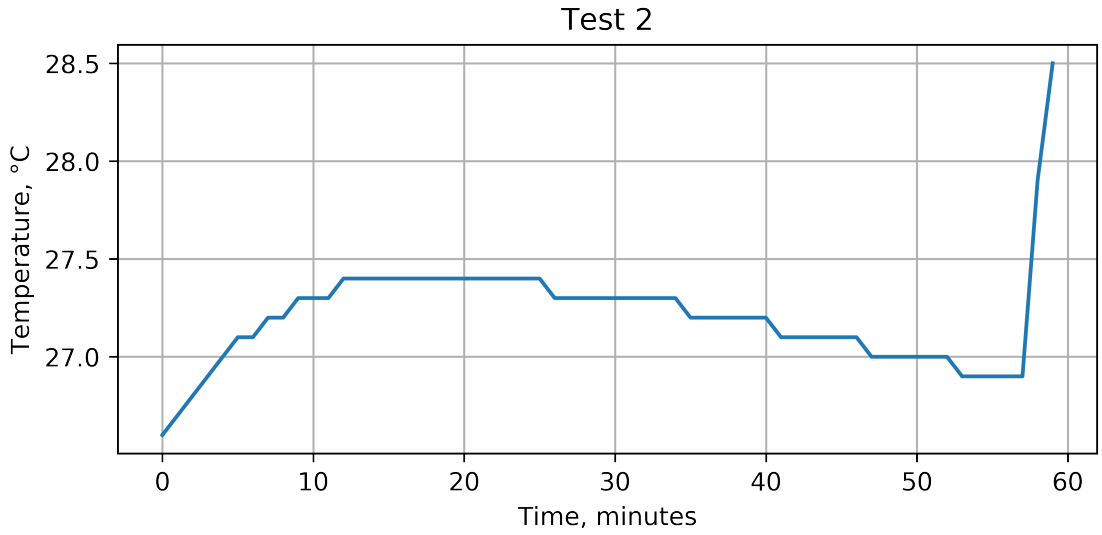
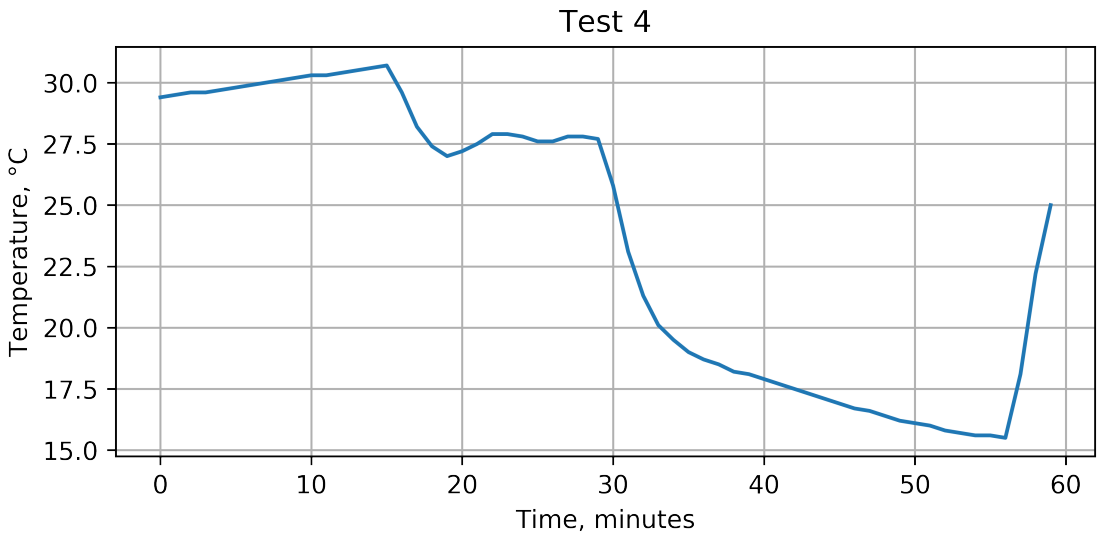


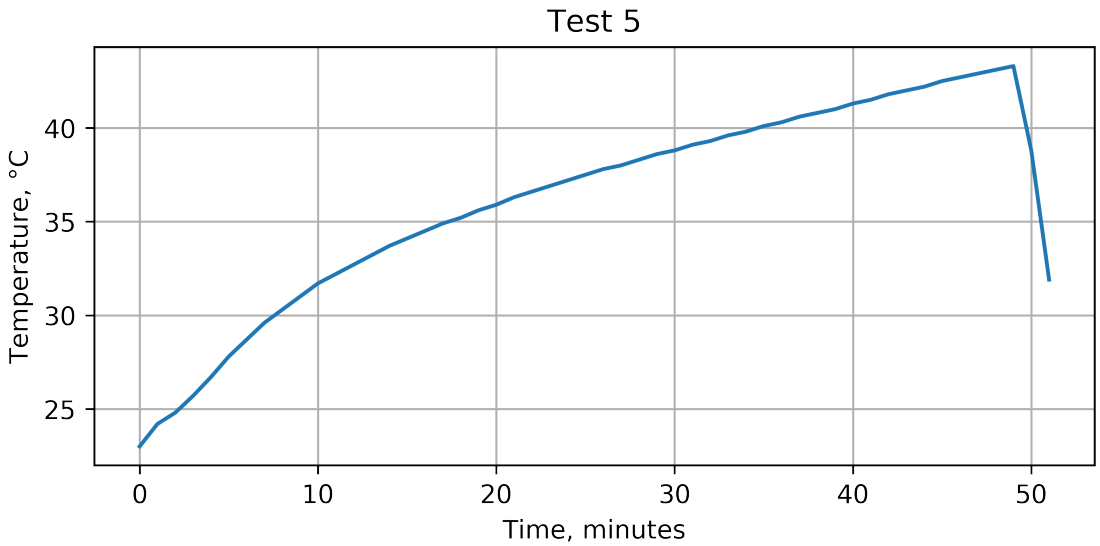
Test 4. We put in fridge from 30 to 55 minutes on plot, and it's temperature slowly decreased.

```
In [23]: plot_test(4)
```



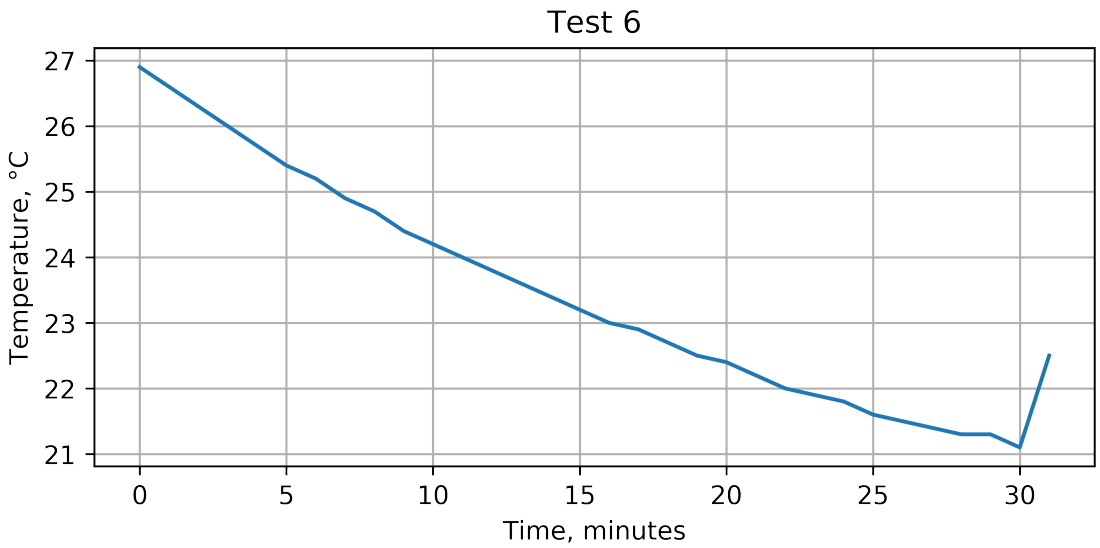
Test 5. 50 Ohm resistor to 9V leads to overheating -> can be used as heating resistor.

```
In [24]: plot_test(5)
```



Test 6. With additional heating comparable to RPi Zero it's still cooling down. Worth notice, that's speed in terms of řC/minute is just twice as small as without RPi Zero.

```
In [25]: plot_test(6)
```



Test 7. We see here that cooling cycle of freezer is about from -20 to -15.

```
In [27]: plot_test(7)
```