Aerial-robot HW5 A071549 莊詠翔

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github

HW5 LINK (https://github.com/studennis911988/Robotics-Aerial-Robots/tree/master/Homework5)

Question1

Question

Given a set of 50 input data and output data, please find the ideal linear regression model! (40%)

Answer

1. Code (**The code is on github**)

- A simple python script for linear regression model.
  I first convert the excel file to **csv file** and separate the input and output variables to 2 categories. Second, we solve the curve fitting problem by **ceres** solver and we get the **coefficients from the optimization results**.
- run the code

```
1. roscore
2. rosrun HW5_1 hw5_1 path_to_HW5-1.csv
```

2. Results

- The coefficients are 0.2 for input variable 1 and 0.3 for input variable 2, therefore the output is equal to 0.2*input1 + 0.3*input2 (i.e. ***output = 0.2input1 + 0.3input2***)

```
dennis@dennis-H97M-D3H:~/ROS/aerial_robots_ws$ rosrun HW5 hw5_1 /home/dennis/ROS/aerial_robots_ws/src/Homework5/HW5-1.csv
iter      cost      cost_change  |gradient|   |step|    tr_ratio  tr_radius  ls_iter  iter_time  total_time
   0  1.856393e+05    0.00e+00    3.88e+05   0.00e+00   0.00e+00  1.00e+04        0    4.68e-04    5.24e-04
   1  2.700616e-02    1.86e+05    2.83e+01   1.07e+00   1.00e+00  3.00e+04        1    4.92e-04    1.12e-03
   2  5.494511e-07    2.70e-02    4.07e-02   9.66e-03   1.00e+00  9.00e+04        1    3.01e-04    1.53e-03
   3  1.272522e-12    5.49e-07    6.14e-05   4.44e-05   1.00e+00  2.70e+05        1    3.38e-04    1.90e-03
   4  8.695351e-16    1.27e-12    3.11e-08   6.76e-08   1.00e+00  8.10e+05        1    3.31e-04    2.26e-03
Ceres Solver Report: Iterations: 5, Initial cost: 1.856393e+05, Final cost: 8.695351e-16, Termination: CONVERGENCE
estimated a,b = 0.2 0.3
```

- **The cost start from 1.8e+5 and converge to 8.6e-16 with 5 iterations.**

Question2

Question

Given the Inertial frame and body-fixed frame on a UAV with their axes initially aligned, where their z axes are pointing upward (opposite to the direction of the gravity), please find the attitude trajectory of the UAV (i.e.,) given the measurement of the accelerometer of SI unit stored in the excel file. The magnitude of the gravity is 9.8 pointing to -z axis of the inertial frame. (60%)

1. Code (**The code is on github**)

- A simple python script for linear regression model.
  I first convert the excel file to **csv file** and by simply using “FromTwoVectors” function from Eigen library. Finally I log the result data and **plot with matlab**.

- run the code

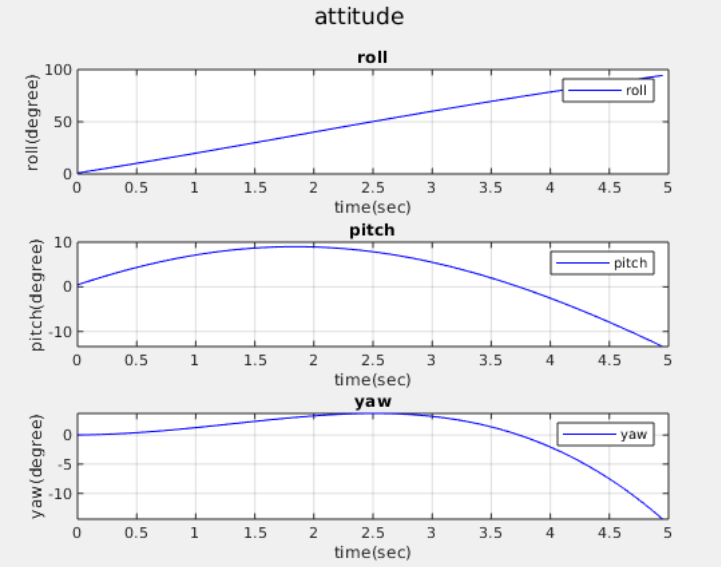
```
1. roscore
2. rosrun HW5_2 hw5_2 path_to_HW5-2.csv
```

2. Results

- I provide two representation of the attitude of the drone, quaternion and euler angle.

```
quaternion (w,x,y,z) = (0.999961,0.00787402,0.00388561,0)
euler, roll: = 0.902326, pitch: 0.445246, yaw: 0.00350608
quaternion (w,x,y,z) = (0.999846,0.0157877,0.00768825,0)
euler, roll: = 1.80937, pitch: 0.880907, yaw: 0.0139107
quaternion (w,x,y,z) = (0.999653,0.0237396,0.0114072,0)
euler, roll: = 2.72114, pitch: 1.30682, yaw: 0.0310396
quaternion (w,x,y,z) = (0.999383,0.0317282,0.0150416,0)
euler, roll: = 3.63762, pitch: 1.72284, yaw: 0.0547128
quaternion (w,x,y,z) = (0.999037,0.039752,0.0185909,0)
euler, roll: = 4.55881, pitch: 2.1288, yaw: 0.0847446
quaternion (w,x,y,z) = (0.998613,0.0478097,0.0220542,0)
euler, roll: = 5.48468, pitch: 2.52453, yaw: 0.120943
quaternion (w,x,y,z) = (0.998112,0.0558997,0.0254308,0)
euler, roll: = 6.41519, pitch: 2.9099, yaw: 0.163111
quaternion (w,x,y,z) = (0.997535,0.0640206,0.0287199,0)
euler, roll: = 7.35032, pitch: 3.28474, yaw: 0.211042
quaternion (w,x,y,z) = (0.996881,0.0721709,0.0319207,0)
euler, roll: = 8.29002, pitch: 3.64891, yaw: 0.264527
quaternion (w,x,y,z) = (0.996151,0.0803491,0.0350326,0)
euler, roll: = 9.23424, pitch: 4.00224, yaw: 0.323347
quaternion (w,x,y,z) = (0.995344,0.0885539,0.0380547,0)
euler, roll: = 10.1829, pitch: 4.3446, yaw: 0.387277
quaternion (w,x,y,z) = (0.994461,0.0967837,0.0409862,0)
euler, roll: = 11.136, pitch: 4.67585, yaw: 0.456084
quaternion (w,x,y,z) = (0.993502,0.105037,0.0438263,0)
euler, roll: = 12.0933, pitch: 4.99582, yaw: 0.529528
quaternion (w,x,y,z) = (0.992467,0.113312,0.0465743,0)
euler, roll: = 13.0549, pitch: 5.3044, yaw: 0.607364
quaternion (w,x,y,z) = (0.991357,0.121608,0.0492294,0)
euler, roll: = 14.0206, pitch: 5.60143, yaw: 0.689335
quaternion (w,x,y,z) = (0.99017,0.129924,0.0517907,0)
euler, roll: = 14.9904, pitch: 5.8868, yaw: 0.77518
```

- In order to visualize the attitude, I assumed that each IMU data comes in 0.05sec, and that results in 5 secs timespan.



tags: `Aerial-robot`