Robot vision - assignment 4

kjetiskr

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task 1

task 1a

After writing the function we get residuals in the order of 0.4 to 1 which seems reasonable enough as the unit it is expressed in is pixels squared

task 1c

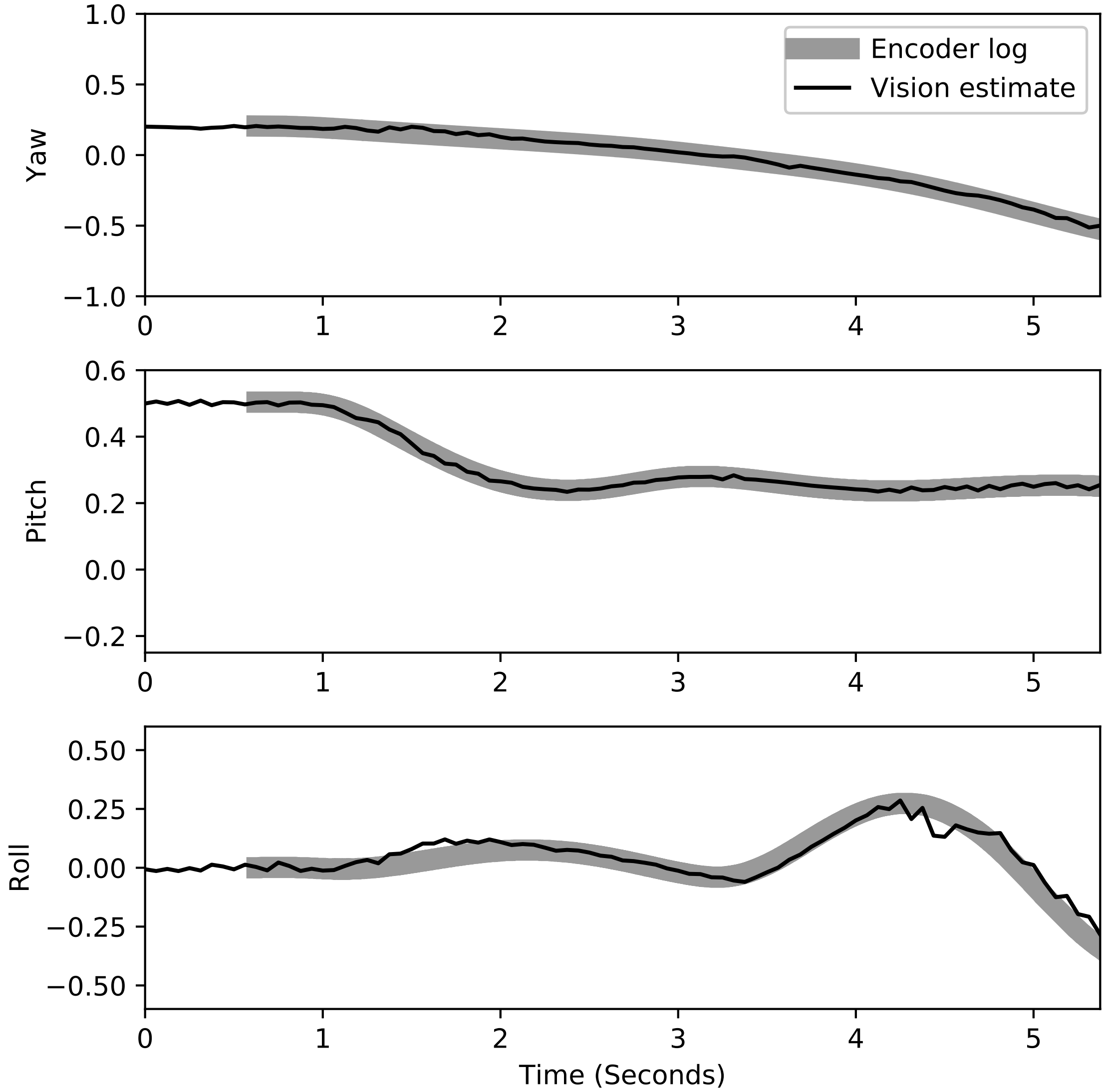

Figure 1: estimates with $\alpha = 0.25$ and 8 iterations for each image

task 1d

Running Gauss-Newton on image 87 gives us a singular jacobian matrix. Checking the markers for image 87 tells us that none of the markers on the rotors of the helicopter were detected. We then have literally no info about the pitch angle and it cannot be estimated. This leads to the jacobian being singular as an entire column in it becomes zero or can be cancelled out by a linear combination of the two others (**Is this right?**).

2a

For only one image the estimate doesnt manage to converge absolutely to the correct pose. It does however almost halve the residual error in the 100 time steps.

2b

We now get no error on image 87. This is because we are adding a multiple of a positive definite matrix to JTJ before inverting it which means we are inverting a non singular matrix which is done without problems.

2c

It was added an if to go ahead with a step if lambda went over a certain limit. This was to prevent it from never iterating further as no matter how big lambda got the residue error would not be reduced at some images. This is reasonable as the pitch is very slowly changing and if we have a near perfect estimate it will be really hard or maybe impossible to reduce the residual error.

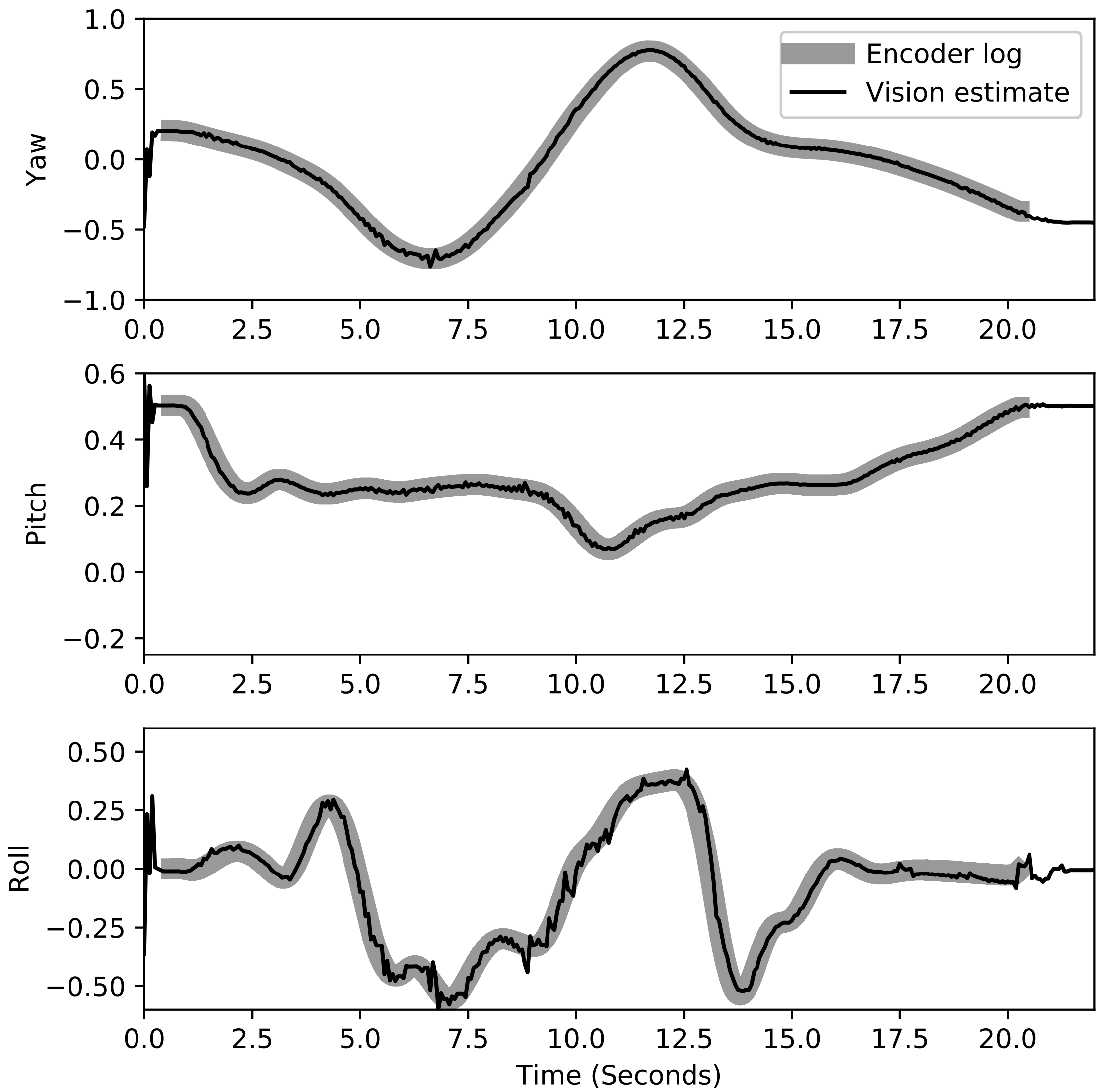

Figure 2: Levenberg-Marquart

Below it is shown simulation results using a modified Gauss which replaces JTJ when singular with the identity matrix multiplied with the trace of JTJ. This ran way faster than the Levenberg-Marquart algorithm, but suffered some losses in performance in roll at some places. It uses 8 iterations per image and has step size equal to 0.25

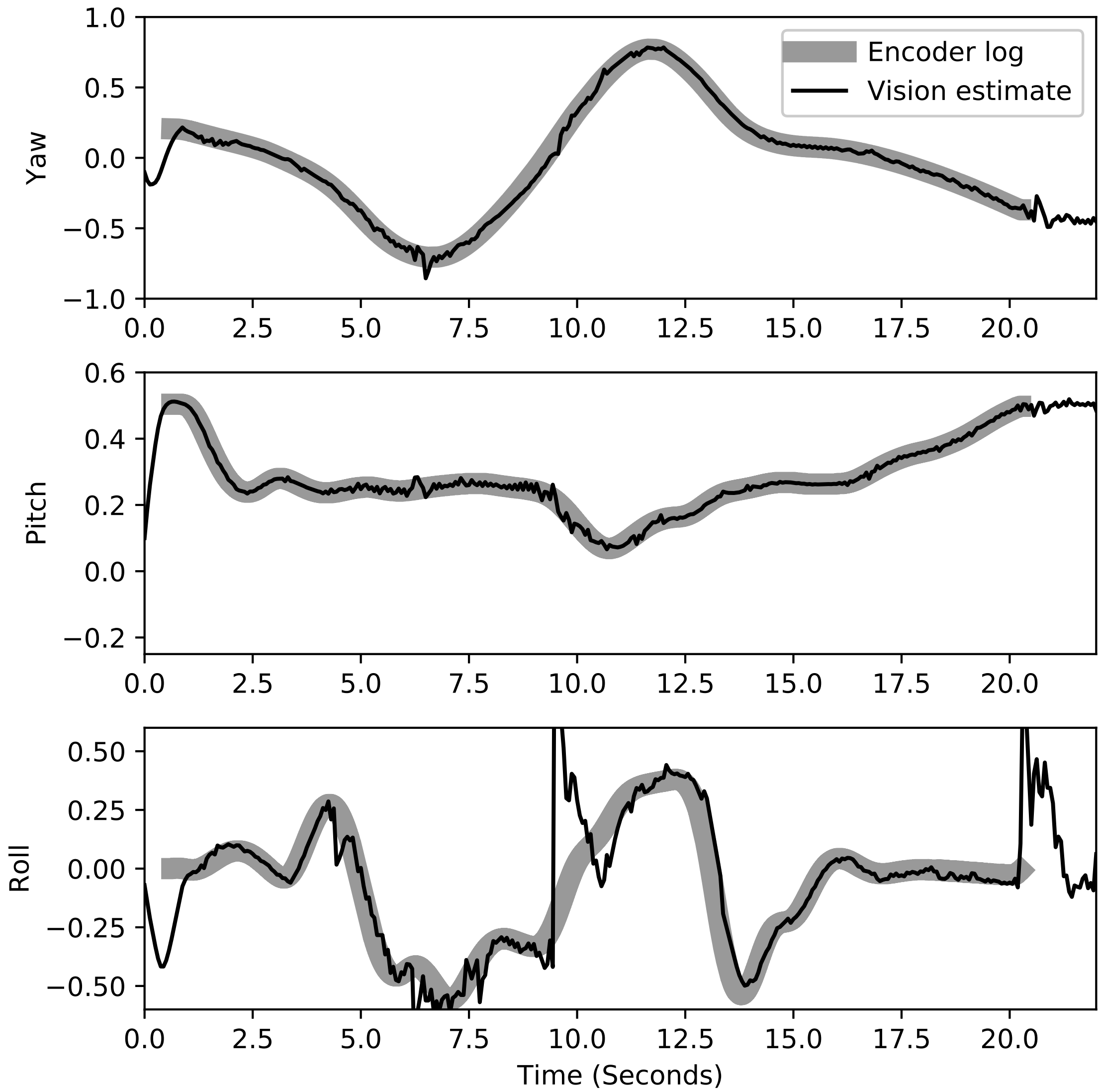

Figure 3: Modified Gauss-Newton