TTK4190 Guidance and Control of Vehicles

LaTeX Template Assignment 1

Written Fall 2019 By Name

Info

This is only a short template for the assignments and it is definitely not necessary to use this template if you are familiar with LaTeX beforehand. The best way to learn LaTeX is to write some stuff yourself and Google problems you run into. Therefore, we will not answer LaTeX related questions outside of the assignment guidance, but you are of course welcome to ask questions then.

Problem 1 - Attitude Control of Satellite

You can answer Problem 1 in this file/section. One subsection for each part of the problem might be a good solution.

Problem 1.1

This is where you answer Problem 1.1. Equation (1) from the assignment can be written in LaTeX as:

$$\begin{aligned} \dot{\mathbf{q}} &= \mathbf{T}_q(\mathbf{q})\boldsymbol{\omega} \\ \mathbf{I}_{CG}\dot{\boldsymbol{\omega}} - \mathbf{S}(\mathbf{I}_{CG}\boldsymbol{\omega})\boldsymbol{\omega} &= \boldsymbol{\tau} \end{aligned} \tag{1}$$

You can now refer to this equation as (1) where the label ensures that the correct equation number is used. If you want to write an equation directly in the text (outside of the equation environment), use: $\dot{\mathbf{q}} = \mathbf{T}_q(\mathbf{q})\boldsymbol{\omega}$.

A matrix (and an equation without equation number) can be created as:

$$\mathbf{A} = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} a \\ b \\ c \end{bmatrix}$$

Problem 1.2

Answer Problem 1.2 here. Bold words can be written as **something bold**. It is also possible to create a new section level:

Inner Section 1

text..

Inner Section 2

...

Problem 1.3

Answer Problem 1.3 here. Equation (2) from the assignment can be written as:

$$\tau = -\mathbf{K}_d \boldsymbol{\omega} - k_p \boldsymbol{\epsilon} \tag{2}$$

Problem 1.4

The quaternion error can be written as

$$\tilde{\mathbf{q}} := \begin{bmatrix} \tilde{\eta} \\ \tilde{\epsilon} \end{bmatrix} = \bar{\mathbf{q}}_d \otimes \mathbf{q} \tag{3}$$

Problem 1.5

In problems with simulations, you need to include figures in the report:

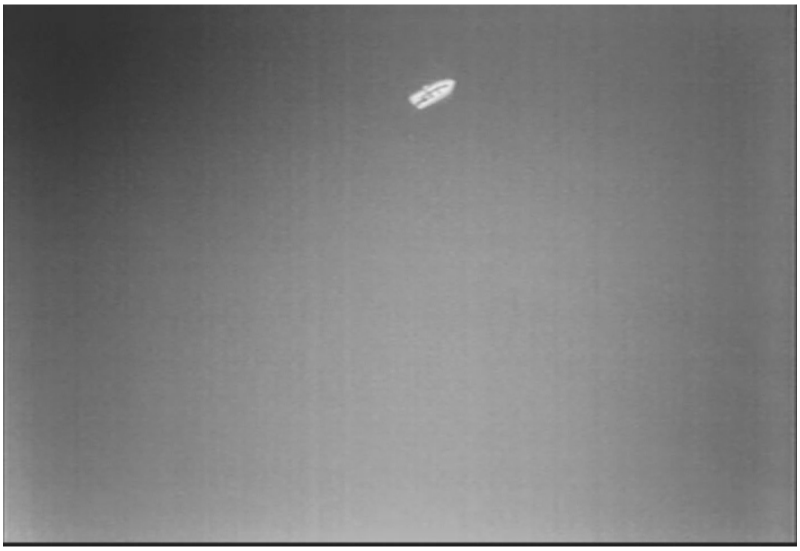


Figure 1: Figure of something useful.

You can now refer to this figure as Figure 1. You can also insert figures side-by-side as in Figure 2.

Problem 1.6

The control law in this problem can be written as

$$\boldsymbol{\tau} = -\mathbf{K}_d \tilde{\boldsymbol{\omega}} - k_p \tilde{\boldsymbol{\epsilon}} \tag{4}$$

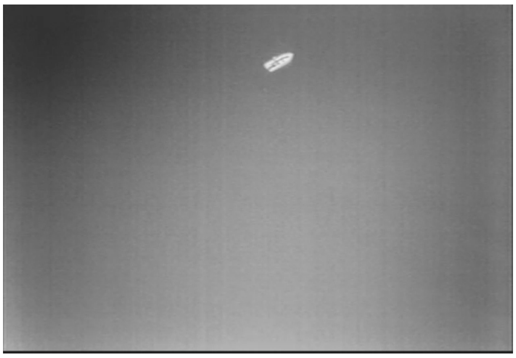
and the desired angular velocity as

$$\boldsymbol{\omega}_d = \mathbf{T}_{\Theta_d}^{-1}(\Theta_d)\dot{\Theta}_d \tag{5}$$

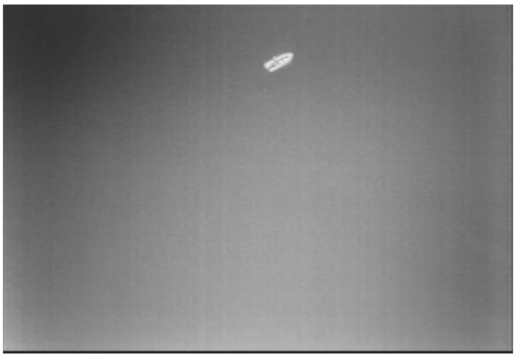
Problem 1.7

The Lyapunov function can be written as

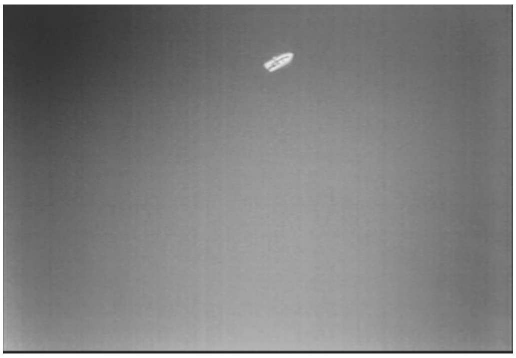
$$V = \frac{1}{2}\tilde{\boldsymbol{\omega}}^\top \mathbf{I}_{CG} \tilde{\boldsymbol{\omega}} + 2k_p(1 - \tilde{\eta}) \tag{6}$$



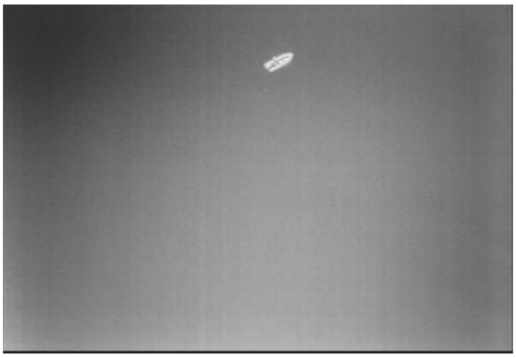
(a) caption..



(b) caption..



(c) caption..



(d) caption..

Figure 2: Caption for all figures

and the derivative as

$$\dot{V} = -k_d \boldsymbol{\omega}^\top \boldsymbol{\omega} \tag{7}$$

Problem 2 - Straight-line path following in the horizontal plane

Answer Problem 2 in this file.

Problem 2.1

Answer problem 2.1 here. The Greek letters for sideslip, heading and course are β, ψ and χ, respectively. Equation (10) in the assignment is:

$$\begin{aligned} \dot{x} &= u\cos(\psi) - v\sin(\psi) \\ \dot{y} &= u\sin(\psi) + v\cos(\psi) \end{aligned} \tag{8}$$

You can refer to equations in the report by using the label and the "eqref" command. Example: equation (8) shows the north and east velocities.

Problem 2.2

Answer Problem 2.2 here...

Problem 2.3

Transfer functions can be written as

$$H(s) = \frac{a_n s^n + ... + a_1 s + a_0}{b_m s^m + ... + b_1 s + b_0} \tag{9}$$

The Nomoto model can be written as

$$\begin{aligned} T\dot{r} + r &= K\delta + b \\ \dot{\psi} &= r \end{aligned} \tag{10}$$

Problem 2.4

Answer Problem 2.4 here. References can be placed in the "bibliography.bib" and referred to as [?] and [?]. The PID-controller is

$$\delta = -k_p y - k_d \dot{y} - k_i \int y \tag{11}$$