Project Proposal

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1 Projective Title

Optimal cable length for a UAV to carry a load with maximum weight and minimum oscillation angle.

2 Project Description

This project will implement and analyze a research paper using the knowledge taught in class. The name of the paper is: Trajectory Planning on Quadrotor UAV with Maximum Payload and Minimum Oscillation os Suspended Load Using Optimal Control. The paper discusses how to transport a cable-suspended load by UVA for a safer and more efficient flight. Optimal control was used to find out the optimal cable length that maximizes the payload while minimizing the oscillation angle of singing. Dynamics of the quadrotor was derived by using the Euler-Lagrange method, and assumptions were made in order to obtain this modeling. The general dynamic model of the whole system could be written as follow:

$$M(q)\ddot{q} + C(q,\dot{q})\dot{q} + G(q) = U \tag{1}$$

where:

- $M(q) \in R^{8\times 8}$ is the mass matrix
- $C(q,\dot{q}) \in R^{8\times 8}$ is the Coriolis and centrifugal matrix
- $G(q) \in R^{8\times 1}$ is the gravity matrix
- $U \in R^{8\times 1}$ is the generalized force in which $U = b \times u$

And our state vector was defined as

$$X = \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} q \\ \dot{q} \end{bmatrix} \tag{2}$$

The cost functional was then defined and objective function was optimized based on the constraints.

3 Project Deliverables

The project deliverables will be calculating the optimal path for the maximum payload, and optimal path for minimum oscillation of the swinging load. Matlab will be used as the computational tool.

References

[1] Hashemi, D., Heidari, H. (2020). Trajectory Planning of Quadrotor UAV with Maximum Payload and Minimum Oscillation of Suspended Load Using Optimal Control. Journal of Intelligent Robotic Systems., 100(3–4), 1369–1381. https://doi.org/10.1007/s10846-020-01166-4