Attitude Dynamics and Control of a Nano-Satellite Orbiting Mars

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This project for ASEN5010 Spacecraft Dynamics and Control considers a small satellite orbiting Mars at a low altitude. This spacecraft gathers science data and transfers this data to another satellite orbiting at a higher altitude. Periodically, this spacecraft must transition from nadir-pointing, science gathering mode to sun-pointing mode to recharge the battery system. The three missions goals are nadir-pointing, communicating with the mother spacecraft, and to sun-point. We must develop a simulation architecture to demonstrate closed loop attitude control and verify performance characteristics.

Introduction and Problem Definition

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Problem Statement

$$\left|\begin{array}{c|c|c|c} f_1 & f_2 & t_1 & t_2 - t_1 \\ \vdots & \vdots & \vdots & \vdots \\ f_j & f_k & t_j & t_k - t_j \\ \vdots & \vdots & \vdots & \vdots \\ f_m & f_n & t_m & t_n - t_m \end{array}\right| \tag{1}$$

$$\boldsymbol{x} = T(:,2) + 2^8 T(:,1) + 2^{16} T(:,4) \tag{2}$$

$$h(x) = \min\left(\boldsymbol{a}x + \boldsymbol{b} \mod w\right) \in \mathbb{R}^k \tag{3}$$

$$\boldsymbol{a},\ \boldsymbol{b}\ \text{Uni}[] \tag{4}$$

References

[1]Schaub, P. D. H., "Attitude Dynamics and Control of a Nano-Satellite Orbiting Mars," 2019.

[2]Schaub, H. and Junkins, J. L., *Analytical mechanics of space systems*, American Institute of Aeronautics and Astronautics, Inc, Reston, Virginia, 4th ed., 2018.

Project Code

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Algorithm 1 Simple Matching Function

$Cliphashtable = minhash(make\_table(clip))$;
$k = \text{const},\ \dim(h(x))$
$clip\_score = 0$
for i = 1:N **do**
    $hashTable\_sentence = minhashTable((i-1) * k + 1 : i * k, 1)$
    $local\_sens\_bool = abs(Cliphashtable - hashTable\_sentence) \leq 100$
    $local\_score = \sum(local\_sens\_bool)$
    if $song\_score < local\_score$ **then**
        $song\_score = local\_score$
        $songName = i$
    end if
end for