Project 1: Hunter Drone Net Stabilization

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Contents

$$\begin{bmatrix} M_{00} & M_{011} & M_{021} & M_{031} & -R\widehat{A_1} & c_1 R q_t \\ M_{011}\widehat{q}_{11}^2 & -M_{111} & 0_3 & 0_3 & -K_{11} & M_{011} l \widehat{q}_{11}^2 R q_t \\ M_{021}\widehat{q}_{21}^2 & 0_3 & -M_{211} & 0_3 & -K_{21} & M_{021} l \widehat{q}_{21}^2 R q_t \\ M_{031}\widehat{q}_{31}^2 & 0_3 & 0_3 & -M_{311} & -K_{m1} & M_{031} l \widehat{q}_{31}^2 R q_t \\ A_2 & K_{R_{11}} R^T & K_{R_{21}} R^T & K_{R_{31}} R^T & \bar{J} & A_3 q_t \\ c_1 q_t^T R^T & M_{011} l q_t^T R^T & M_{021} l q_t^T R^T & M_{031} l q_t^T R^T & -l q_t^T \widehat{A_4} & c_1 l \end{bmatrix} \begin{bmatrix} \ddot{x}_q \\ \ddot{q}_{11} \\ \ddot{q}_{21} \\ \ddot{q}_{31} \\ \dot{\Omega} \\ \ddot{\alpha} \end{bmatrix} \tag{1}$$

$$+ \begin{bmatrix} +R\widehat{\Omega}^2 A_1 + 2c_1\dot{\alpha} R\widehat{\Omega} q_t - c_1\dot{\alpha}^2 R q_b + M_{00} g e_3 \\ -M_{111} q_{11} \|\dot{q}_{11}\|^2 + m_{11} l_{11} \widehat{q}_{11}^2 R\widehat{\Omega}^2(\rho + \rho_1 + l q_b) + 2M_{011} l \widehat{q}_{11}^2 R\widehat{\Omega} q_t \dot{\alpha} - M_{011} l \dot{\alpha}^2 \widehat{q}_{11}^2 R q_b + \widehat{q}_{11}^2 M_{011} g e_3 \\ -M_{211} q_{21} \|\dot{q}_{21}\|^2 + m_{21} l_{21} \widehat{q}_{21}^2 R\widehat{\Omega}^2(\rho + \rho_2 + l q_b) + 2M_{021} l \widehat{q}_{21}^2 R\widehat{\Omega} q_t \dot{\alpha} - M_{021} l \dot{\alpha}^2 \widehat{q}_{21}^2 R q_b + \widehat{q}_{21}^2 M_{021} g e_3 \\ -M_{311} q_{31} \|\dot{q}_{31}\|^2 + m_{31} l_{31} \widehat{q}_{31}^2 R\widehat{\Omega}^2(\rho + \rho_3 + l q_b) + 2M_{031} l \widehat{q}_{31}^2 R\widehat{\Omega} q_t \dot{\alpha} - M_{031} l \dot{\alpha}^2 \widehat{q}_{31}^2 R q_b + \widehat{q}_{31}^2 M_{031} g e_3 \\ +\widehat{\Omega}\bar{J}\Omega + \dot{\bar{J}}\Omega - A_3 \dot{\alpha}^2 q_b + \widehat{\Omega} A_3 \dot{\alpha} q_t + A_2 e_3 \\ +\frac{1}{2}\Omega^T A_3 \widehat{q_t}\Omega + c_1 g q_t^T R^T e_3 \end{bmatrix} = \begin{bmatrix} u \\ 0 \\ 0 \\ 0 \\ \tau \\ 0 \end{bmatrix} \tag{2}$$

where,

$$M_{00} = \left(m_q + m_r + \sum_{i=1}^{m} m_{i1} + \sum_{i=1}^{m} m_i \right), \qquad M_{ijk} = m_{i1} l_{ij} l_{ik}, \qquad M_{0ij} = m_{i1} l_{ij} \tag{3}$$

$$\bar{J} = \left(J - \frac{1}{2} m_r \widehat{\rho}^2 - \frac{1}{6} m_r l_r^2 \widehat{e_2}^2 - \frac{1}{2} \sum_{i=1}^{m} m_{i1} ([\rho + \widehat{\rho_i} + l q_b])^2 - \frac{1}{2} \sum_{i=1}^{m} m_i ([\rho + \widehat{\rho_i} + l q_b])^2 \right) \tag{4}$$

$$A_1 = \left(m_r \rho + \sum_{i=1}^{m} m_{i1} (\rho + \rho_i + l q_b) + \sum_{i=1}^{m} m_i (\rho + \rho_i + l q_b) \right) \tag{5}$$

$$c_1 = \left(\sum_{i=1}^{m} m_{i1} l + \sum_{i=1}^{m} m_i l \right) \tag{6}$$

$$\boldsymbol{A_2} = \left(m_r g\widehat{\boldsymbol{\rho}}\boldsymbol{R}^T + \sum_{i=1}^{m} m_{i1} g[(\boldsymbol{\rho} + \widehat{\boldsymbol{\rho_i}} + l\boldsymbol{q_b})]\boldsymbol{R}^T + \sum_{i=1}^{m} m_i g[(\boldsymbol{\rho} + \widehat{\boldsymbol{\rho_i}} + l\boldsymbol{q_b})]\boldsymbol{R}^T\right) \tag{7}$$

$$\boldsymbol{A_3} = \left(\sum_{i=1}^{m} m_{i1}(\boldsymbol{\rho} + \widehat{\boldsymbol{\rho_i}} + l\boldsymbol{q_b})l + \sum_{i=1}^{m} m_i(\boldsymbol{\rho} + \widehat{\boldsymbol{\rho_i}} + l\boldsymbol{q_b})l\right) \tag{8}$$

$$\boldsymbol{K_{i1}} = m_{i1} l_{i1} \widehat{\boldsymbol{q}}_{\boldsymbol{i1}}^2 \boldsymbol{R}(\boldsymbol{\rho} + \widehat{\boldsymbol{\rho_i}} + l\boldsymbol{q_b}) \tag{9}$$

$$\boldsymbol{K_{R_{i1}}} = m_{i1} l_{i1} (\boldsymbol{\rho} + \widehat{\boldsymbol{\rho_i}} + l\boldsymbol{q_b}) \tag{10}$$

References