$with(LinearAlgebra):$

$$dq := \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \\ q_5 \\ q_6 \\ q_7 \\ q_8 \end{bmatrix}$$

$$dq := \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \\ q_5 \\ q_6 \\ q_7 \\ q_8 \end{bmatrix} \quad (1)$$

$$dq\_dot := \frac{1}{2} \cdot \begin{bmatrix} 0 & w_3 & -w_2 & w_1 & 0 & 0 & 0 & 0 \\ -w_3 & 0 & w_1 & w_2 & 0 & 0 & 0 & 0 \\ w_2 & -w_1 & 0 & w_3 & 0 & 0 & 0 & 0 \\ -w_1 & -w_2 & -w_3 & 0 & 0 & 0 & 0 & 0 \\ 0 & v_3 & -v_2 & v_1 & 0 & w_3 & -w_2 & w_1 \\ -v_3 & 0 & v_1 & v_2 & -w_3 & 0 & w_1 & w_2 \\ v_2 & -v_1 & 0 & v_3 & w_2 & -w_1 & 0 & w_3 \\ -v_1 & -v_2 & -v_3 & 0 & -w_1 & -w_2 & -w_3 & 0 \end{bmatrix} . dq$$

$$dq\_dot := \begin{bmatrix} \frac{w_3 q_2}{2} - \frac{w_2 q_3}{2} + \frac{w_1 q_4}{2} \\ -\frac{w_3 q_1}{2} + \frac{w_1 q_3}{2} + \frac{w_2 q_4}{2} \\ \frac{w_2 q_1}{2} - \frac{w_1 q_2}{2} + \frac{w_3 q_4}{2} \\ -\frac{w_1 q_1}{2} - \frac{w_2 q_2}{2} - \frac{w_3 q_3}{2} \\ \frac{v_3 q_2}{2} - \frac{v_2 q_3}{2} + \frac{v_1 q_4}{2} + \frac{w_3 q_6}{2} - \frac{w_2 q_7}{2} + \frac{w_1 q_8}{2} \\ -\frac{v_3 q_1}{2} + \frac{v_1 q_3}{2} + \frac{v_2 q_4}{2} - \frac{w_3 q_5}{2} + \frac{w_1 q_7}{2} + \frac{w_2 q_8}{2} \\ \frac{v_2 q_1}{2} - \frac{v_1 q_2}{2} + \frac{v_3 q_4}{2} + \frac{w_2 q_5}{2} - \frac{w_1 q_6}{2} + \frac{w_3 q_8}{2} \\ -\frac{v_1 q_1}{2} - \frac{v_2 q_2}{2} - \frac{v_3 q_3}{2} - \frac{w_1 q_5}{2} - \frac{w_2 q_6}{2} - \frac{w_3 q_7}{2} \end{bmatrix} \quad (2)$$

$with(VectorCalculus):$

$$\frac{\partial}{\partial q_1} dq\_dot$$

$$(0)e_{x1} + \left(-\frac{w_3}{2}\right)e_{x2} + \left(\frac{w_2}{2}\right)e_{x3} + \left(-\frac{w_1}{2}\right)e_{x4} + (0)e_{x5} + \left(-\frac{v_3}{2}\right)e_{x6} + \left(\frac{v_2}{2}\right)e_{x7} + \left(-\frac{v_1}{2}\right)e_{x8} \quad (3)$$

$$\frac{\partial}{\partial q_2} dq\_dot$$

$$\left(\frac{w_3}{2}\right)e_{x1} + (0)e_{x2} + \left(-\frac{w_1}{2}\right)e_{x3} + \left(-\frac{w_2}{2}\right)e_{x4} + \left(\frac{v_3}{2}\right)e_{x5} + (0)e_{x6} + \left(-\frac{v_1}{2}\right)e_{x7} + \left(-\frac{v_2}{2}\right)e_{x8} \quad (4)$$

$$\frac{\partial}{\partial q_3} dq\_dot$$

$$\left(-\frac{w_2}{2}\right)e_{x1} + \left(\frac{w_1}{2}\right)e_{x2} + (0)e_{x3} + \left(-\frac{w_3}{2}\right)e_{x4} + \left(-\frac{v_2}{2}\right)e_{x5} + \left(\frac{v_1}{2}\right)e_{x6} + (0)e_{x7} + \left(-\frac{v_3}{2}\right)e_{x8} \quad (5)$$

$$\frac{\partial}{\partial q_4} dq\_dot$$

$$\left(\frac{w_1}{2}\right) e_{x1} + \left(\frac{w_2}{2}\right) e_{x2} + \left(\frac{w_3}{2}\right) e_{x3} + (0) e_{x4} + \left(\frac{v_1}{2}\right) e_{x5} + \left(\frac{v_2}{2}\right) e_{x6} + \left(\frac{v_3}{2}\right) e_{x7} + (0) e_{x8} \tag{6}$$

$$\frac{\partial}{\partial q_5} dq\_dot$$

$$(0) e_{x1} + (0) e_{x2} + (0) e_{x3} + (0) e_{x4} + (0) e_{x5} + \left(-\frac{w_3}{2}\right) e_{x6} + \left(\frac{w_2}{2}\right) e_{x7} + \left(-\frac{w_1}{2}\right) e_{x8} \tag{7}$$

$$\frac{\partial}{\partial q_6} dq\_dot$$

$$(0) e_{x1} + (0) e_{x2} + (0) e_{x3} + (0) e_{x4} + \left(\frac{w_3}{2}\right) e_{x5} + (0) e_{x6} + \left(-\frac{w_1}{2}\right) e_{x7} + \left(-\frac{w_2}{2}\right) e_{x8} \tag{8}$$

$$\frac{\partial}{\partial q_7} dq\_dot$$

$$(0) e_{x1} + (0) e_{x2} + (0) e_{x3} + (0) e_{x4} + \left(-\frac{w_2}{2}\right) e_{x5} + \left(\frac{w_1}{2}\right) e_{x6} + (0) e_{x7} + \left(-\frac{w_3}{2}\right) e_{x8} \tag{9}$$

$$\frac{\partial}{\partial q_8} dq\_dot$$

$$(0) e_{x1} + (0) e_{x2} + (0) e_{x3} + (0) e_{x4} + \left(\frac{w_1}{2}\right) e_{x5} + \left(\frac{w_2}{2}\right) e_{x6} + \left(\frac{w_3}{2}\right) e_{x7} + (0) e_{x8} \tag{10}$$

$$\frac{\partial}{\partial w_1} dq\_dot$$

$$\left(\frac{q_4}{2}\right) e_{x1} + \left(\frac{q_3}{2}\right) e_{x2} + \left(-\frac{q_2}{2}\right) e_{x3} + \left(-\frac{q_1}{2}\right) e_{x4} + \left(\frac{q_8}{2}\right) e_{x5} + \left(\frac{q_7}{2}\right) e_{x6} + \left(-\frac{q_6}{2}\right) e_{x7} + \left(-\frac{q_5}{2}\right) e_{x8} \tag{11}$$

$$\frac{\partial}{\partial w_2} dq\_dot$$

$$\left(-\frac{q_3}{2}\right) e_{x1} + \left(\frac{q_4}{2}\right) e_{x2} + \left(\frac{q_1}{2}\right) e_{x3} + \left(-\frac{q_2}{2}\right) e_{x4} + \left(-\frac{q_7}{2}\right) e_{x5} + \left(\frac{q_8}{2}\right) e_{x6} + \left(\frac{q_5}{2}\right) e_{x7} + \left(-\frac{q_6}{2}\right) e_{x8} \tag{12}$$

$$\frac{\partial}{\partial w_3} dq\_dot$$

$$\left(\frac{q_2}{2}\right) e_{x1} + \left(-\frac{q_1}{2}\right) e_{x2} + \left(\frac{q_4}{2}\right) e_{x3} + \left(-\frac{q_3}{2}\right) e_{x4} + \left(\frac{q_6}{2}\right) e_{x5} + \left(-\frac{q_5}{2}\right) e_{x6} + \left(\frac{q_8}{2}\right) e_{x7} \tag{13}$$

$$+\left(-\frac{q_7}{2}\right)e_{x8}$$

$$\frac{\partial}{\partial v_1}dq\_dot$$

$$(0)e_{x1}+(0)e_{x2}+(0)e_{x3}+(0)e_{x4}+\left(\frac{q_4}{2}\right)e_{x5}+\left(\frac{q_3}{2}\right)e_{x6}+\left(-\frac{q_2}{2}\right)e_{x7}+\left(-\frac{q_1}{2}\right)e_{x8} \quad \textbf{(14)}$$

$$\frac{\partial}{\partial v_2}dq\_dot$$

$$(0)e_{x1}+(0)e_{x2}+(0)e_{x3}+(0)e_{x4}+\left(-\frac{q_3}{2}\right)e_{x5}+\left(\frac{q_4}{2}\right)e_{x6}+\left(\frac{q_1}{2}\right)e_{x7}+\left(-\frac{q_2}{2}\right)e_{x8} \quad \textbf{(15)}$$

$$\frac{\partial}{\partial v_3}dq\_dot$$

$$(0)e_{x1}+(0)e_{x2}+(0)e_{x3}+(0)e_{x4}+\left(\frac{q_2}{2}\right)e_{x5}+\left(-\frac{q_1}{2}\right)e_{x6}+\left(\frac{q_4}{2}\right)e_{x7}+\left(-\frac{q_3}{2}\right)e_{x8} \quad \textbf{(16)}$$

$$q\_dot := simplify\left(\left\langle \frac{\partial}{\partial q_1}dq\_dot \middle| \frac{\partial}{\partial q_2}dq\_dot \middle| \frac{\partial}{\partial q_3}dq\_dot \middle| \frac{\partial}{\partial q_4}dq\_dot \middle| \frac{\partial}{\partial q_5}dq\_dot \middle| \frac{\partial}{\partial q_6}dq\_dot \middle| \frac{\partial}{\partial q_7}dq\_dot \middle| \frac{\partial}{\partial q_8}dq\_dot \right\rangle\right)$$

$$q\_dot := \begin{bmatrix} 0 & \frac{w_3}{2} & -\frac{w_2}{2} & \frac{w_1}{2} & 0 & 0 & 0 & 0 \\ -\frac{w_3}{2} & 0 & \frac{w_1}{2} & \frac{w_2}{2} & 0 & 0 & 0 & 0 \\ \frac{w_2}{2} & -\frac{w_1}{2} & 0 & \frac{w_3}{2} & 0 & 0 & 0 & 0 \\ -\frac{w_1}{2} & -\frac{w_2}{2} & -\frac{w_3}{2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \frac{v_3}{2} & -\frac{v_2}{2} & \frac{v_1}{2} & 0 & \frac{w_3}{2} & -\frac{w_2}{2} & \frac{w_1}{2} \\ -\frac{v_3}{2} & 0 & \frac{v_1}{2} & \frac{v_2}{2} & -\frac{w_3}{2} & 0 & \frac{w_1}{2} & \frac{w_2}{2} \\ \frac{v_2}{2} & -\frac{v_1}{2} & 0 & \frac{v_3}{2} & \frac{w_2}{2} & -\frac{w_1}{2} & 0 & \frac{w_3}{2} \\ -\frac{v_1}{2} & -\frac{v_2}{2} & -\frac{v_3}{2} & 0 & -\frac{w_1}{2} & -\frac{w_2}{2} & -\frac{w_3}{2} & 0 \end{bmatrix} \quad \textbf{(17)}$$

$$w\_dot := simplify\left(\left\langle \frac{\partial}{\partial w_1}dq\_dot \middle| \frac{\partial}{\partial w_2}dq\_dot \middle| \frac{\partial}{\partial w_3}dq\_dot \middle| \langle 0,0,0,0,0,0,0,0\rangle \middle| \frac{\partial}{\partial v_1}dq\_dot \right.\right.$$

$$\left| \frac{\partial}{\partial v_2} dq\_dot \right| \left| \frac{\partial}{\partial v_3} dq\_dot \right| \langle 0, 0, 0, 0, 0, 0, 0, 0 \rangle \Big\rangle \Big)$$

$$w\_dot := \begin{bmatrix} \frac{q_4}{2} & -\frac{q_3}{2} & \frac{q_2}{2} & 0 & 0 & 0 & 0 & 0 \\ \frac{q_3}{2} & \frac{q_4}{2} & -\frac{q_1}{2} & 0 & 0 & 0 & 0 & 0 \\ -\frac{q_2}{2} & \frac{q_1}{2} & \frac{q_4}{2} & 0 & 0 & 0 & 0 & 0 \\ -\frac{q_1}{2} & -\frac{q_2}{2} & -\frac{q_3}{2} & 0 & 0 & 0 & 0 & 0 \\ \frac{q_8}{2} & -\frac{q_7}{2} & \frac{q_6}{2} & 0 & \frac{q_4}{2} & -\frac{q_3}{2} & \frac{q_2}{2} & 0 \\ \frac{q_7}{2} & \frac{q_8}{2} & -\frac{q_5}{2} & 0 & \frac{q_3}{2} & \frac{q_4}{2} & -\frac{q_1}{2} & 0 \\ -\frac{q_6}{2} & \frac{q_5}{2} & \frac{q_8}{2} & 0 & -\frac{q_2}{2} & \frac{q_1}{2} & \frac{q_4}{2} & 0 \\ -\frac{q_5}{2} & -\frac{q_6}{2} & -\frac{q_7}{2} & 0 & -\frac{q_1}{2} & -\frac{q_2}{2} & -\frac{q_3}{2} & 0 \end{bmatrix} \quad \textbf{(18)}$$