Formulae Given with Test #2

$$S\theta_1 C\theta_2 + C\theta_1 S\theta_2 = S(\theta_1 + \theta_2) = S\theta_{12}$$

$$C\theta_1 C\theta_2 - S\theta_1 S\theta_2 = C(\theta_1 + \theta_2) = C\theta_{12}$$

$$J(q) = \begin{bmatrix} \frac{\partial p_x(q)}{\partial q_1} & \frac{\partial p_x(q)}{\partial q_2} \\ \frac{\partial p_y(q)}{\partial q_1} & \frac{\partial p_y(q)}{\partial q_2} \end{bmatrix}$$

$$J(q) = \begin{bmatrix} \frac{\partial p_x(q)}{\partial q_1} & \frac{\partial p_x(q)}{\partial q_2} & \frac{\partial p_x(q)}{\partial q_3} \\ \frac{\partial p_y(q)}{\partial q_1} & \frac{\partial p_y(q)}{\partial q_2} & \frac{\partial p_y(q)}{\partial q_3} \\ \zeta_1 t_1 & \zeta_2 t_2 & \zeta_3 t_3 \end{bmatrix}$$

$$\begin{bmatrix} v_x \\ v_y \\ v_z \\ \omega_x \\ \omega_y \\ \omega_z \end{bmatrix} = J(q) \begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \vdots \\ \dot{q}_n \end{bmatrix}$$

$$J(q) = \begin{bmatrix} \frac{\partial p_x(q)}{\partial q_1} & \frac{\partial p_x(q)}{\partial q_2} & \frac{\partial p_x(q)}{\partial q_3} \\ \frac{\partial p_y(q)}{\partial q_1} & \frac{\partial p_y(q)}{\partial q_2} & \frac{\partial p_y(q)}{\partial q_3} \\ \frac{\partial p_z(q)}{\partial q_1} & \frac{\partial p_z(q)}{\partial q_2} & \frac{\partial p_z(q)}{\partial q_3} \end{bmatrix}$$

$$A_{n+1} = {}^{n}T_{n+1} = \begin{bmatrix} \mathrm{C}\theta_{n+1} & -\mathrm{S}\theta_{n+1}\mathrm{C}\alpha_{n+1} & \mathrm{S}\theta_{n+1}\mathrm{S}\alpha_{n+1} & a_{n+1}\mathrm{C}\theta_{n+1} \\ \mathrm{S}\theta_{n+1} & \mathrm{C}\theta_{n+1}\mathrm{C}\alpha_{n+1} & -\mathrm{C}\theta_{n+1}\mathrm{S}\alpha_{n+1} & a_{n+1}\mathrm{S}\theta_{n+1} \\ 0 & \mathrm{S}\alpha_{n+1} & \mathrm{C}\alpha_{n+1} & d_{n+1} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$J(q) = \left[\begin{array}{cccc} \frac{\partial p_x(q)}{\partial q_1} & \frac{\partial p_x(q)}{\partial q_2} & \cdots & \frac{\partial p_x(q)}{\partial q_n} \\ \frac{\partial p_y(q)}{\partial q_1} & \frac{\partial p_y(q)}{\partial q_2} & \cdots & \frac{\partial p_y(q)}{\partial q_n} \\ \frac{\partial p_z(q)}{\partial q_1} & \frac{\partial p_z(q)}{\partial q_2} & \cdots & \frac{\partial p_z(q)}{\partial q_n} \\ \hdashline \zeta_1 z_0(q) & \zeta_2 z_1(q) & \cdots & \zeta_n z_{n-1}(q) \end{array}\right]$$

$$z_i = {}^{0}R_i \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad \text{for } i = 1 \text{ to } n-1$$

where $^{0}R_i = \prod_{k=1}^{i} {}^{k-1}R_k$