

Get the Transformation Matrices from DH

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A = {{Cos[θ], -Sin[θ] * Cos[α], Sin[θ] * Sin[α], a * Cos[θ]}, {Sin[θ], Cos[θ] * Cos[α],  
      -Cos[θ] * Sin[α], a * Sin[θ]}, {0, Sin[α], Cos[α], d}, {0, 0, 0, 1}};  
A1 = A /. {a → 0, α → Pi/2, d → 0.2, θ → q1[t]};  
A2 = A /. {a → 0.36, α → 0, d → 0, θ → (Pi/2 + q2[t])};  
A3 = A /. {a → 0, α → Pi/2, d → 0, θ → q3[t]};  
A4 = A /. {a → 0, α → -Pi/2, d → 0.38, θ → q4[t]};  
A5 = A /. {a → 0, α → Pi/2, d → 0, θ → q5[t]};  
A6 = A /. {a → 0, α → 0, d → 0.065, θ → q6[t]};  
R12 = A2[[1 ;; 3, 1 ;; 3]];  
R23 = A3[[1 ;; 3, 1 ;; 3]];  
R34 = A4[[1 ;; 3, 1 ;; 3]];  
R45 = A5[[1 ;; 3, 1 ;; 3]];  
R56 = A6[[1 ;; 3, 1 ;; 3]];
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```
T01 = A1;  
T02 = Simplify[A1.A2];  
T03 = Simplify[T02.A3];  
T04 = Simplify[T03.A4];  
T05 = Simplify[T04.A5];  
T06 = Simplify[T05.A6];  
R01 = T01[[1 ;; 3, 1 ;; 3]];  
R02 = T02[[1 ;; 3, 1 ;; 3]];  
R03 = T03[[1 ;; 3, 1 ;; 3]];  
R04 = T04[[1 ;; 3, 1 ;; 3]];  
R05 = T05[[1 ;; 3, 1 ;; 3]];  
R06 = T06[[1 ;; 3, 1 ;; 3]];
```

```
zvec = {0, 0, 1};  
b1 = Transpose[R01].zvec;  
b2 = Simplify[Transpose[R02].R01.zvec];  
b3 = Simplify[Transpose[R03].R02.zvec];  
b4 = Simplify[Transpose[R04].R03.zvec];  
b5 = Simplify[Transpose[R05].R04.zvec];  
b6 = Simplify[Transpose[R06].R05.zvec];
```

General Parameters

```
rho = 3200;
g0 = {0, 0, -g};
(*qdes = {q1[t], q2[t], q3[t], q4[t], q5[t], q6[t]};
qdotdes = {q1'[t], q2'[t], q3'[t], q4'[t], q5'[t], q6'[t]};
qdotdotdes = {q1''[t], q2''[t], q3''[t], q4''[t], q5''[t], q6''[t]};*)
qdes = {0, -Pi/2, Pi/2, 0, 0, 0};
qdotdes = {0, 0, 0, 0, 0, 0};
qdotdotdes = {0, 0, 0, 0, 0, 0};
payload = 6;
```

Link Parameters

Link 1

```
r1 = 0.098;
h1 = 0.2;
r01 = {0, 0.2, 0};
r1c1 = {0, -0.1, 0};
r0c1 = r01 + r1c1;
m1 = rho * Pi * r1^2 * h1;
I1 = 
$$\begin{pmatrix} \frac{m_1}{12} * (3 * r1^2 + h1^2) & 0 & 0 \\ 0 & \frac{m_1}{2} * r1^2 & 0 \\ 0 & 0 & \frac{m_1}{12} * (3 * r1^2 + h1^2) \end{pmatrix};$$

```

Link 2

```
l2 = 0.36;
b2 = 0.15;
h2 = 0.15;
r12 = {0.36, 0, 0};
r2c2 = {-0.18, 0, 0};
r1c2 = r12 + r2c2;
m2 = rho * l2 * b2 * h2;
I2 = 
$$\begin{pmatrix} \frac{m_2}{12} * (b2^2 + h2^2) & 0 & 0 \\ 0 & \frac{m_2}{12} * (l2^2 + h2^2) & 0 \\ 0 & 0 & \frac{m_2}{12} * (b2^2 + l2^2) \end{pmatrix};$$

```

Link 3

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r23 = {0, 0, 0};
r3c3 = {0, 0, 0};
r2c3 = r23 + r3c3;
m3 = 0;
I3 =  $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ ;

```

Link 4

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l4 = 0.38;
b4 = 0.146;
h4 = 0.146;
r34 = {0, -0.38, 0};
r4c4 = {0, 0.19, 0};
r3c4 = r34 + r4c4;
m4 = rho * l4 * b4 * h4;
I4 =  $\begin{pmatrix} \frac{m_4}{12} * (b4^2 + l4^2) & 0 & 0 \\ 0 & \frac{m_4}{12} * (b4^2 + h4^2) & 0 \\ 0 & 0 & \frac{m_4}{12} * (h4^2 + l4^2) \end{pmatrix}$ ;

```

Link 5

```

r45 = {0, 0, 0};
r5c5 = {0, 0, 0};
r4c5 = r45 + r5c5;
m5 = 0;
I5 =  $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ ;

```

Link 6

```

r6 = 0.108;
h6 = 0.065;
r56 = {0, 0, 0.065};
r6c6 = {0, 0, -0.0325};
r5c6 = r56 + r6c6;
m6 = rho * Pi * r6^2 * h6;
I6 = 
$$\begin{pmatrix} \frac{m_6}{12} * (3 * r6^2 + h6^2) & 0 & 0 \\ 0 & \frac{m_6}{12} * (3 * r6^2 + h6^2) & 0 \\ 0 & 0 & \frac{m_6}{2} * r6^2 \end{pmatrix};$$


```

Forward Recursion

Link 1

```

w0 = {0, 0, 0};
a0 = {0, 0, 0};
a0 = {0, 0, 0};
w1 = Transpose[R01].w0 + q1'[t] * b1;
a1 = Simplify[Transpose[R01].a0 + q1''[t] * b1 + (Transpose[R01].w0) * (q1'[t] * b1)];
a1 = Transpose[R01].a0 + a1 * r01 + w1 * (w1 * r01);
ac1 = a1 + a1 * r1c1 + w1 * (w1 * r1c1);

```

Link 2

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w2 = Transpose[R12].w1 + q2'[t] * b2;
a2 = Simplify[Transpose[R12].a1 + q2''[t] * b2 + (Transpose[R12].w1) * (q2'[t] * b2)];
a2 = Transpose[R12].a1 + a2 * r12 + w2 * (w2 * r12);
ac2 = a2 + a2 * r2c2 + w2 * (w2 * r2c2);

```

Link 3

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w3 = Transpose[R23].w2 + q3'[t] * b3;
a3 = Simplify[Transpose[R23].a2 + q3''[t] * b3 + (Transpose[R23].w2) * (q3'[t] * b3)];
a3 = Simplify[Transpose[R23].a2 + a3 * r23 + w3 * (w3 * r23)];
ac3 = Simplify[a3 + a3 * r3c3 + w3 * (w3 * r3c3)];

```

Link 4

```

 $\omega_4 = \text{Transpose}[R_{34}] \cdot \omega_3 + q_4' [t] * b_4;$ 
 $\alpha_4 = \text{Simplify}[\text{Transpose}[R_{34}] \cdot \alpha_3 + q_4'' [t] * b_4 + (\text{Transpose}[R_{34}] \cdot \omega_3) \times (q_4' [t] * b_4)];$ 
 $a_4 = \text{Transpose}[R_{34}] \cdot a_3 + \alpha_4 \times r_{34} + \omega_4 \times (\omega_4 \times r_{34});$ 
 $a_{c4} = a_4 + \alpha_4 \times r_{4c4} + \omega_4 \times (\omega_4 \times r_{4c4});$ 

```

Link 5

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 $\omega_5 = \text{Transpose}[R_{45}] \cdot \omega_4 + q_5' [t] * b_5;$ 
 $\alpha_5 = \text{Simplify}[\text{Transpose}[R_{45}] \cdot \alpha_4 + q_5'' [t] * b_5 + (\text{Transpose}[R_{45}] \cdot \omega_4) \times (q_5' [t] * b_5)];$ 
 $a_5 = \text{Transpose}[R_{45}] \cdot a_4 + \alpha_5 \times r_{45} + \omega_5 \times (\omega_5 \times r_{45});$ 
 $a_{c5} = a_5 + \alpha_5 \times r_{5c5} + \omega_5 \times (\omega_5 \times r_{5c5});$ 

```

Link 6

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 $\omega_6 = \text{Transpose}[R_{56}] \cdot \omega_5 + q_6' [t] * b_6;$ 
 $\alpha_6 = \text{Transpose}[R_{56}] \cdot \alpha_5 + q_6'' [t] * b_6 + (\text{Transpose}[R_{56}] \cdot \omega_5) \times (q_6' [t] * b_6);$ 
 $a_6 = \text{Transpose}[R_{56}] \cdot a_5 + \alpha_6 \times r_{56} + \omega_6 \times (\omega_6 \times r_{56});$ 
 $a_{c6} = a_6 + \alpha_6 \times r_{6c6} + \omega_6 \times (\omega_6 \times r_{6c6});$ 

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Backward Recursion

Link 6

```

 $g_6 = \text{Transpose}[R_{06}] \cdot g_0;$ 
 $f_{67} = -\text{payload} * g_6;$ 
 $f_{56} = f_{67} - m_6 * g_6 + m_6 * a_{c6};$ 
 $\tau_{56} = -r_{6c6} \times f_{67} + r_{5c6} \times f_{56} + I_6 \cdot \alpha_6 + \omega_6 \times (I_6 \cdot \omega_6);$ 

```

Link 5

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 $g_5 = \text{Transpose}[R_{05}] \cdot g_0;$ 
 $f_{45} = R_{56} \cdot f_{56} - m_5 * g_5 + m_5 * a_{c5};$ 
 $\tau_{45} = (R_{56} \cdot \tau_{56}) - r_{5c5} \times (R_{56} \cdot f_{56}) + r_{4c5} \times f_{45} + I_5 \cdot \alpha_5 + \omega_5 \times (I_5 \cdot \omega_5);$ 

```

Link 4

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 $g_4 = \text{Transpose}[R_{04}] \cdot g_0;$ 
 $f_{34} = R_{45} \cdot f_{45} - m_4 * g_4 + m_4 * a_{c4};$ 
 $\tau_{34} = R_{45} \cdot \tau_{45} - r_{4c4} \times (R_{45} \cdot f_{45}) + r_{3c4} \times f_{34} + I_4 \cdot \alpha_4 + \omega_4 \times (I_4 \cdot \omega_4);$ 

```

Link 3

$$\begin{aligned} g_3 &= \text{Transpose}[R_{03}] \cdot g_0; \\ f_{23} &= R_{34} \cdot f_{34} - m_3 * g_3 + m_3 * a_{c3}; \\ \tau_{23} &= R_{34} \cdot \tau_{34} - r_{3c3} \times (R_{34} \cdot f_{34}) + r_{2c3} \times f_{23} + I_3 \cdot \alpha_3 + \omega_3 \times (I_3 \cdot \omega_3); \end{aligned}$$

Link 2

$$\begin{aligned} g_2 &= \text{Transpose}[R_{02}] \cdot g_0; \\ f_{12} &= R_{23} \cdot f_{23} - m_2 * g_2 + m_2 * a_{c2}; \\ \tau_{12} &= R_{23} \cdot \tau_{23} - r_{2c2} \times (R_{23} \cdot f_{23}) + r_{1c2} \times f_{12} + I_2 \cdot \alpha_2 + \omega_2 \times (I_2 \cdot \omega_2); \end{aligned}$$

Link 1

$$\begin{aligned} g_1 &= \text{Transpose}[R_{01}] \cdot g_0; \\ f_{01} &= R_{12} \cdot f_{12} - m_1 * g_1 + m_1 * a_{c1}; \\ \tau_{01} &= R_{12} \cdot \tau_{12} - r_{1c1} \times (R_{12} \cdot f_{12}) + r_{0c1} \times f_{01} + I_1 \cdot \alpha_1 + \omega_1 \times (I_1 \cdot \omega_1); \end{aligned}$$

Computation

[illegible]

Actual Torques Required

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 $\tau_{z1} = \text{TrigReduce}[b_1.t1];$ 
 $\tau_{z2} = \text{TrigReduce}[b_2.t2];$ 
 $\tau_{z3} = \text{TrigReduce}[b_3.t3];$ 
 $\tau_{z4} = \text{TrigReduce}[b_4.t4];$ 
 $\tau_{z5} = \text{TrigReduce}[b_5.t5];$ 
 $\tau_{z6} = \text{TrigReduce}[b_6.t6];$ 
Torq = { $\tau_{z1}$ ,  $\tau_{z2}$ ,  $\tau_{z3}$ ,  $\tau_{z4}$ ,  $\tau_{z5}$ ,  $\tau_{z6}$ }
{0., 290.765, 105.348, 0., 6.25594, 0.}

```

Following sections should only be used to extract the Manipulator equations

Configuration Dependent Mass Matrix

```

 $m_{11} = \tau_{z1} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 1, q_2''[t] \rightarrow 0, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{21} = \tau_{z2} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 1, q_2''[t] \rightarrow 0, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{31} = \tau_{z3} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 1, q_2''[t] \rightarrow 0, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{41} = \tau_{z4} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 1, q_2''[t] \rightarrow 0, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{51} = \tau_{z5} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 1, q_2''[t] \rightarrow 0, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{61} = \tau_{z6} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 1, q_2''[t] \rightarrow 0, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{12} = \tau_{z1} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 0, q_2''[t] \rightarrow 1, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{22} = \tau_{z2} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 0, q_2''[t] \rightarrow 1, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{32} = \tau_{z3} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 0, q_2''[t] \rightarrow 1, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{42} = \tau_{z4} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 0, q_2''[t] \rightarrow 1, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 
 $m_{52} = \tau_{z5} /. \{q_1'[t] \rightarrow 0, q_2'[t] \rightarrow 0, q_3'[t] \rightarrow 0, q_4'[t] \rightarrow 0, q_5'[t] \rightarrow 0, q_6'[t] \rightarrow 0, q_1''[t] \rightarrow 0, q_2''[t] \rightarrow 1, q_3''[t] \rightarrow 0, q_4''[t] \rightarrow 0, q_5''[t] \rightarrow 0, q_6''[t] \rightarrow 0, g \rightarrow 0\};$ 

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[illegible]

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m55 =  $\tau_{25}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 1, q6''[t] → 0, g → 0};
m65 =  $\tau_{26}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 1, q6''[t] → 0, g → 0};
m16 =  $\tau_{21}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 1, g → 0};
m26 =  $\tau_{22}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 1, g → 0};
m36 =  $\tau_{23}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 1, g → 0};
m46 =  $\tau_{24}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 1, g → 0};
m56 =  $\tau_{25}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 1, g → 0};
m66 =  $\tau_{26}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0,
  q5'[t] → 0, q6'[t] → 0, q1''[t] → 0, q2''[t] → 0,
  q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 1, g → 0};

```

$$M = \begin{pmatrix} m_{11} & m_{12} & m_{13} & m_{14} & m_{15} & m_{16} \\ m_{21} & m_{22} & m_{23} & m_{24} & m_{25} & m_{26} \\ m_{31} & m_{32} & m_{33} & m_{34} & m_{35} & m_{36} \\ m_{41} & m_{42} & m_{43} & m_{44} & m_{45} & m_{46} \\ m_{51} & m_{52} & m_{53} & m_{54} & m_{55} & m_{56} \\ m_{61} & m_{62} & m_{63} & m_{64} & m_{65} & m_{66} \end{pmatrix}$$

```

{{0., 0., 0., 0., 0., 0.}, {290.765, 290.765, 290.765, 290.765, 290.765, 290.765}},
{105.348, 105.348, 105.348, 105.348, 105.348, 105.348}, {0., 0., 0., 0., 0., 0.},
{6.25594, 6.25594, 6.25594, 6.25594, 6.25594, 6.25594}, {0., 0., 0., 0., 0., 0.}}

```

Gravitational Terms

```

g6 =  $\tau_{z6}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0, q5'[t] → 0, q6'[t] → 0,
  q1''[t] → 0, q2''[t] → 0, q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 0};
g5 =  $\tau_{z5}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0, q5'[t] → 0, q6'[t] → 0,
  q1''[t] → 0, q2''[t] → 0, q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 0};
g4 =  $\tau_{z4}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0, q5'[t] → 0, q6'[t] → 0,
  q1''[t] → 0, q2''[t] → 0, q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 0};
g3 =  $\tau_{z3}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0, q5'[t] → 0, q6'[t] → 0,
  q1''[t] → 0, q2''[t] → 0, q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 0};
g2 =  $\tau_{z2}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0, q5'[t] → 0, q6'[t] → 0,
  q1''[t] → 0, q2''[t] → 0, q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 0};
g1 =  $\tau_{z1}$  /. {q1'[t] → 0, q2'[t] → 0, q3'[t] → 0, q4'[t] → 0, q5'[t] → 0, q6'[t] → 0,
  q1''[t] → 0, q2''[t] → 0, q3''[t] → 0, q4''[t] → 0, q5''[t] → 0, q6''[t] → 0};
G = {g1, g2, g3, g4, g5, g6}
{0., 290.765, 105.348, 0., 6.25594, 0.}

```

Coriolis Terms

```

CDq = Torq - M.qdotdotdes - G
{0., 0., 0., 0., 0., 0.}

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