```
clear;
close all;
a1 = 0.4;
a2 = 0.4;
a3 = 0.4;
   theta d a alpha
                      a1 0], 'standard');
L(1) = Link([ 0 0
                    0 a2 0], 'standard');
L(2) = Link([0]
                       a3 0], 'standard');
L(3) = Link([0]
                   0
threelink = SerialLink(L, 'name', 'three link', ...
         'comment', 'from Spong, Hutchinson, Vidyasagar');
threelink.base = [1 0 0 0;
                  0 0 -1 0;
                  0 1 0 0;
                  0 0 0 1];
syms q1 q2 q3
qz = [q1 \ q2 \ q3];
% threelink.plot(qz);
T_1 = threelink.A(1,qz);
T_c1 = T_1;
T_c1(1:3,4) = T_c1(1:3,4)/2;
T_c1;
temp_t2 = threelink.A(2,qz);
T_2 = T_1 * temp_t2;
temp_c2 = temp_t2;
temp_c2(1:3,4) = temp_c2(1:3,4)/2;
T c2 = T 1*temp c2;
temp t3 = threelink.A(3,qz);
T_3 = T_2*temp_t3;
temp_c3 = temp_t3;
temp_c3(1:3,4) = temp_c3(1:3,4)/2;
T c3 = T 2*temp c3;
z = [0; 0; 1];
jacobian_c1 = [cross(z,T_c1(1:3,4)) zeros(3,2); z zeros(3,2)];
jacobian_c2 = [cross(z,T_c2(1:3,4)) cross(z,T_c2(1:3,4)-T_1(1:3,4))]
 zeros(3,1); z z zeros(3,1)];
jacobian_c3 = [cross(z,T_c3(1:3,4)) cross(z,T_c3(1:3,4)-T_1(1:3,4))]
cross(z,T_c3(1:3,4)-T_2(1:3,4)); z z z];
syms Ixx Iyy Izz q_dot1 q_dot2 q_dot3
q_dot = [q_dot1; q_dot2; q_dot3];
mass = 1;
```

```
K_{rot} = 1/2*q_{ot.}'*(jacobian_c1(4:6,:).'*[Ixx 0 0; 0 Iyy 0; 0 0]
 Izz]*jacobian c1(4:6,:)...
                     + jacobian_c2(4:6,:).'*[Ixx 0 0; 0 Iyy 0; 0 0
 Izz]*jacobian c2(4:6,:)...
                     + jacobian_c3(4:6,:).'*[Ixx 0 0; 0 Iyy 0; 0 0
 Izz]*jacobian_c3(4:6,:))*q_dot;
K trans = 1/2*q dot.'*(mass*jacobian c1(1:3,:).'*jacobian c1(1:3,:) +
 mass*jacobian_c2(1:3,:).'*jacobian_c2(1:3,:)...
 mass*jacobian_c3(1:3,:).'*jacobian_c3(1:3,:))*q_dot;
K_total = K_rot+K_trans;
D = jacobian_c1(4:6,:).'*[Ixx 0 0; 0 Iyy 0; 0 0]
 [zz]*jacobian c1(4:6,:)...
                     + jacobian_c2(4:6,:).'*[Ixx 0 0; 0 Iyy 0; 0 0
 Izz]*jacobian_c2(4:6,:)...
                     + jacobian_c3(4:6,:).'*[Ixx 0 0; 0 Iyy 0; 0 0
 Izz]*jacobian_c3(4:6,:)...
                     + mass*jacobian_c1(1:3,:).'*jacobian_c1(1:3,:) +
 mass*jacobian_c2(1:3,:).'*jacobian_c2(1:3,:)...
                     + mass*jacobian_c3(1:3,:).'*jacobian_c3(1:3,:);
for k=1:3
    for i=1:3
        for j=1:3
            c(i,j,k) = 1/2 * (diff(D(k,j),qz(i)) + diff(D(k,i),qz(j))
 - diff(D(i,j),qz(k)));
        end
    end
end
gravity = [0; 9.81; 0];
P = gravity'*T_c1(1:3,4) + gravity'*T_c2(1:3,4) +
gravity'*T_c3(1:3,4);
q1 = diff(P,q1);
g2 = diff(P,q2);
g3 = diff(P,q3);
g = [g1; g2; g3];
% Plug into the EOM equation
D
С
g
D =
[
```

```
-(\sin(q1)*\sin(q2))/5)^2 + ((2*\sin(q1))/5 + (\cos(q1)*\sin(q2))/5
    + (\cos(q^2) * \sin(q^1)) / 5)^2 + \cos(q^1)^2 / 25 + \sin(q^1)^2 / 25 +
    ((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5 - (2*\sin(q1)*\sin(q2))/5
    + (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
    (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)^2 +
    ((2*\sin(q1))/5 + (2*\cos(q1)*\sin(q2))/5 + (2*\cos(q2)*\sin(q1))/5
    + (\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
    (\sin(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5)^2, 2*Izz +
    ((\cos(q1)*\cos(q2))/5 - (\sin(q1)*\sin(q2))/5)*((2*\cos(q1))/5 +
    (\cos(q1)*\cos(q2))/5 - (\sin(q1)*\sin(q2))/5) + ((\cos(q1)*\sin(q2))/5)
    + (\cos(q^2)*\sin(q^1))/5)*((2*\sin(q^1))/5 + (\cos(q^1)*\sin(q^2))/5)
    + (\cos(q_2)*\sin(q_1))/5) + ((2*\cos(q_1)*\cos(q_2))/5 -
    (2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
   \cos(q^2) \cdot \sin(q^1) / 5 \cdot ((2 \cdot \cos(q^1)) / 5 + (2 \cdot \cos(q^1) \cdot \cos(q^2)) / 5
    -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
    + \cos(q_2)*\sin(q_1))/5) + ((2*\cos(q_1)*\sin(q_2))/5 +
    (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
    + \cos(q_2) * \sin(q_1)) / 5 + (\sin(q_3) * (\cos(q_1) * \cos(q_2) - q_3) * (\cos(q_3) * \cos(q_3) * \cos(
   \sin(q1)*\sin(q2)))/5)*((2*\sin(q1))/5 + (2*\cos(q1)*\sin(q2))/5)
    + (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
    + \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) \cos(q^1) \cos(q^2) - q^2)
   \sin(q1)*\sin(q2)))/5), Izz + ((\cos(q3)*(\cos(q1)*\cos(q2)))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
   \cos(q^2) \cdot \sin(q^1) / 5 \cdot ((2 \cdot \cos(q^1)) / 5 + (2 \cdot \cos(q^1) \cdot \cos(q^2)) / 5
     -(2*sin(q1)*sin(q2))/5 + (cos(q3)*(cos(q1)*cos(q2))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
    + \cos(q_2) * \sin(q_1)) / 5) + ((\cos(q_3) * (\cos(q_1) * \sin(q_2))) / 5) + (\cos(q_3) * (\cos(q_3) * \cos(q_3) *
    + \cos(q^2) * \sin(q^2) ) / 5 + (\sin(q^3) * (\cos(q^2) * \cos(q^2) - (q^2) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (o^3) * (o
    \sin(q1)*\sin(q2)))/5)*((2*\sin(q1))/5 + (2*\cos(q1)*\sin(q2))/5
    + (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
    + \cos(q_2) * \sin(q_1)) / 5 + (\sin(q_3) * (\cos(q_1) * \cos(q_2) - q_3) * (\cos(q_3) * \cos(q_3) * \cos(
   sin(q1)*sin(q2)))/5)]
[2*Izz + ((cos(q1)*cos(q2))/5 - (sin(q1)*sin(q2))/5)*((2*cos(q1))/5)
   + (\cos(q_1)*\cos(q_2))/5 - (\sin(q_1)*\sin(q_2))/5) + ((\cos(q_1)*\sin(q_2))/5)
   + (\cos(q_2)*\sin(q_1))/5)*((2*\sin(q_1))/5 + (\cos(q_1)*\sin(q_2))/5
    + (\cos(q^2)*\sin(q^1))/5) + ((2*\cos(q^1)*\cos(q^2))/5 -
    (2*sin(q1)*sin(q2))/5 + (cos(q3)*(cos(q1)*cos(q2))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
   \cos(q^2) * \sin(q^1)) / 5) * ((2*\cos(q^1)) / 5 + (2*\cos(q^1)*\cos(q^2)) / 5
     -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
   \cos(q_2) * \sin(q_1)) / 5) + ((2*\cos(q_1)*\sin(q_2)) / 5 + (2*\cos(q_2)*\sin(q_1)) / 5
    + (\cos(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5 +
    (\sin(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5)*((2*\sin(q_1))/5)
    + (2*cos(q1)*sin(q2))/5 + (2*cos(q2)*sin(q1))/5 +
    (\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
    (\sin(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5),
```

```
2*Izz + ((2*cos(q1)*cos(q2))/5 - (2*sin(q1)*sin(q2))/5
+ (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
(\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)^2
 + ((2*cos(q1)*sin(q2))/5 + (2*cos(q2)*sin(q1))/5 +
 (\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
 (\sin(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5)^2
 + ((\cos(q1)*\cos(q2))/5 - (\sin(q1)*\sin(q2))/5)^2 +
 ((\cos(q1)*\sin(q2))/5 + (\cos(q2)*\sin(q1))/5)^2
                                                                                                                      Izz + ((\cos(q3)*(\cos(q1)*\sin(q2)
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
 -\sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\sin(q2))/5 +
(2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
 -\sin(q_1)*\sin(q_2))/5) + ((\cos(q_3)*(\cos(q_1)*\cos(q_2)))
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2) * \sin(q^1)) / 5 * ((2*\cos(q^1)*\cos(q^2)) / 5 - (2*\sin(q^1)*\sin(q^2)) / 5
+ (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
(\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)
                                                                                                                                                                                         Izz + ((\cos(q3)*(\cos(q1)*\cos(q2))
-\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2) \cdot \sin(q^1) / 5 \cdot ((2 \cdot \cos(q^1)) / 5 + (2 \cdot \cos(q^1) \cdot \cos(q^2)) / 5
 -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
 + \cos(q_2)*\sin(q_1)))/5) + ((\cos(q_3)*(\cos(q_1)*\sin(q_2)))
 + \cos(q^2) * \sin(q^2) ) / 5 + (\sin(q^3) * (\cos(q^2) * \cos(q^2) - (q^2) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) 
\sin(q1)*\sin(q2)))/5)*((2*\sin(q1))/5 + (2*\cos(q1)*\sin(q2))/5)
+ (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
 + \cos(q_2) * \sin(q_1)) / 5 + (\sin(q_3) * (\cos(q_1) * \cos(q_2) - q_3) * (\cos(q_3) * \cos(q_3) * \cos(
sin(q1)*sin(q2)))/5),
                                                                                                                                                                              Izz + ((\cos(q3)*(\cos(q1)*\sin(q2))
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
 -\sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\sin(q2))/5 +
(2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
 -\sin(q1)*\sin(q2)))/5) + ((\cos(q3)*(\cos(q1)*\cos(q2)))
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2) * \sin(q^2) = \cos(q^2) * \cos(q^2) = \cos(q^2) = \cos(q^2) * \sin(q^2) = \cos(q^2) * \cos(q^2) * \sin(q^2) = \cos(q^2) * \sin(q^2) = \cos(q^2) * \sin(q^2) * \sin(q^2) = \cos(q^2) * \sin(q^2) * \sin(q^2) = \cos(q^2) * \sin(q^2) * \sin
 + (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
 (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5),
                                    Izz + ((\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5
```

```
+ ((\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
   (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)^2
c(:,:,1) =
                    0, ((\cos(q1)*\cos(q2))/5 - (\sin(q1)*\sin(q2))/5)*((2*\sin(q1))/5)
   + (\cos(q1)*\sin(q2))/5 + (\cos(q2)*\sin(q1))/5) - ((\cos(q1)*\sin(q2))/5
   + (\cos(q^2)*\sin(q^1))/5)*((2*\cos(q^1))/5 + (\cos(q^1)*\cos(q^2))/5)
   -(\sin(q1)*\sin(q2))/5) - ((2*\cos(q1)*\sin(q2))/5 +
   (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
  + \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) \cos(q^1) \cos(q^2) - 6
  \sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5
   -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
   + \cos(q_2)*\sin(q_1)))/5) + ((2*\cos(q_1)*\cos(q_2))/5 -
   (2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
  \cos(q^2) * \sin(q^1)) / 5) * ((2*\sin(q^1)) / 5 + (2*\cos(q^1) * \sin(q^2)) / 5)
  + (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
   + \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) (\cos(q^1) \cos(q^2))
   -\sin(q1)*\sin(q2)))/5), ((\cos(q3)*(\cos(q1)*\cos(q2)))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
  \cos(q^2) \cdot \sin(q^1)) / 5 \cdot ((2 \cdot \sin(q^1)) / 5 + (2 \cdot \cos(q^1) \cdot \sin(q^2)) / 5
   + (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
  + \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) (\cos(q^1) \cos(q^2))
   -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
   + \cos(q_2) * \sin(q_1)) / 5 + (\sin(q_3) * (\cos(q_1) * \cos(q_2) - q_3) * (\cos(q_3) * \cos(q_3) * \cos(
  \sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5)
   -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
  cos(q2)*sin(q1)))/5)]
[((\cos(q_1)*\cos(q_2))/5 - (\sin(q_1)*\sin(q_2))/5)*((2*\sin(q_1))/5 +
   (\cos(q1)*\sin(q2))/5 + (\cos(q2)*\sin(q1))/5) - ((\cos(q1)*\sin(q2))/5
  + (\cos(q_2)*\sin(q_1))/5)*((2*\cos(q_1))/5 + (\cos(q_1)*\cos(q_2))/5
   -(\sin(q1)*\sin(q2))/5) - ((2*\cos(q1)*\sin(q2))/5 +
   (2*cos(q2)*sin(q1))/5 + (cos(q3)*(cos(q1)*sin(q2))
   + \cos(q_2) * \sin(q_1)) / 5 + (\sin(q_3) * (\cos(q_1) * \cos(q_2) - q_2) 
  \sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5)
   -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
```

 $+ (\sin(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5)^2$

```
+ (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
(\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)*((2*\sin(q1))/5)
+ (2*\cos(q1)*\sin(q2))/5 + (2*\cos(q2)*\sin(q1))/5 +
(\cos(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5 +
(\sin(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5),
((\cos(q1)*\cos(q2))/5 - (\sin(q1)*\sin(q2))/5)*((2*\sin(q1))/5 +
(\cos(q1)*\sin(q2))/5 + (\cos(q2)*\sin(q1))/5) - ((\cos(q1)*\sin(q2))/5
+ (\cos(q^2)*\sin(q^1))/5)*((2*\cos(q^1))/5 + (\cos(q^1)*\cos(q^2))/5)
-(\sin(q1)*\sin(q2))/5) - ((2*\cos(q1)*\sin(q2))/5 +
(2*cos(q2)*sin(q1))/5 + (cos(q3)*(cos(q1)*sin(q2))
+ \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) (\cos(q^1) \cos(q^2) -
\sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5
-(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
-\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
+ \cos(q_2)*\sin(q_1)))/5) + ((2*\cos(q_1)*\cos(q_2))/5 -
(2*sin(q1)*sin(q2))/5 + (cos(q3)*(cos(q1)*cos(q2))
-\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2) * \sin(q^1)) / 5) * ((2*\sin(q^1)) / 5 + (2*\cos(q^1) * \sin(q^2)) / 5)
+ (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2)) 
-\sin(q1)*\sin(q2)))/5), ((\cos(q3)*(\cos(q1)*\cos(q2)))
-\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2) \cdot \sin(q^1)) / 5 \cdot ((2 \cdot \sin(q^1)) / 5 + (2 \cdot \cos(q^1) \cdot \sin(q^2)) / 5
+ (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
+ \cos(q^2) * \sin(q^2) ) / 5 + (\sin(q^3) * (\cos(q^2) * \cos(q^2) - (q^2) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (o^3) * (o
\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2)*\sin(q^1))/5 + (\sin(q^3)*(\cos(q^1)*\cos(q^2) -
\sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5)
-(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
-\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
cos(q2)*sin(q1)))/5)]
                                                                                             ((\cos(q3)*(\cos(q1)*\cos(q2))
-\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2) * \sin(q^1)) / 5) * ((2*\sin(q^1)) / 5 + (2*\cos(q^1) * \sin(q^2)) / 5
+ (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2)) 
-\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
+ \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) (\cos(q^1) \cos(q^2) -
\sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5)
-(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
-\sin(q_1)*\sin(q_2)))/5 - (\sin(q_3)*(\cos(q_1)*\sin(q_2)) +
cos(q2)*sin(q1)))/5),
                                                                           ((\cos(q3)*(\cos(q1)*\cos(q2))
-\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
\cos(q^2) * \sin(q^1)) / 5) * ((2*\sin(q^1)) / 5 + (2*\cos(q^1) * \sin(q^2)) / 5)
```

 $\cos(q_2)*\sin(q_1)))/5) + ((2*\cos(q_1)*\cos(q_2))/5 - (2*\sin(q_1)*\sin(q_2))/5)$

```
+ (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
     + \cos(q^2) * \sin(q^2) ) / 5 + (\sin(q^3) * (\cos(q^2) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) 
     -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
    + \cos(q^2) * \sin(q^2) ) / 5 + (\sin(q^3) * (\cos(q^2) * \cos(q^2) - (q^2) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) )
   \sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5
     -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
     -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
     + \cos(q^2) * \sin(q^2) )/5), ((\cos(q^3) * (\cos(q^2) * \cos(q^2)))/5)
     -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
   \cos(q^2) * \sin(q^1)) / 5) * ((2*\sin(q^1)) / 5 + (2*\cos(q^1) * \sin(q^2)) / 5
    + (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
     + \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
     -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
    + \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) \cos(q^1) \cos(q^2) - 6
   \sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5
     -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
     -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
   cos(q2)*sin(q1)))/5)]
c(:,:,2) =
((\cos(q1)*\sin(q2))/5 + (\cos(q2)*\sin(q1))/5)*((2*\cos(q1))/5 +
    (\cos(q_1)*\cos(q_2))/5 - (\sin(q_1)*\sin(q_2))/5) - ((\cos(q_1)*\cos(q_2))/5
     -(\sin(q_1)*\sin(q_2))/5)*((2*\sin(q_1))/5 + (\cos(q_1)*\sin(q_2))/5)
     + (\cos(q_2)*\sin(q_1))/5) + ((2*\cos(q_1)*\sin(q_2))/5 +
     (2*cos(q2)*sin(q1))/5 + (cos(q3)*(cos(q1)*sin(q2))
     + \cos(q^2) * \sin(q^2) ) / 5 + (\sin(q^3) * (\cos(q^2) * \cos(q^2) - (\cos(q^2) * \cos(q^2) ) ) / 6 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 6 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) * \cos(q^3) ) ) / 6 + (\sin(q^3) * \cos(q^3) ) / 6 + (\cos(q^3) * \cos(q^3) ) ) / 6 + (\cos(q^3) * \cos(q^3) ) ) / 6 + (\cos(q^3) * \cos(q^3) ) / 6 + (\cos(q^3) * \cos(q^3) ) ) / 6 + (\cos(q^3) * \cos(q^3) ) / 6 + (\cos(q^3) * \cos(q^3) ) ) / 6 + (\cos(q^3) * \cos(q^3) ) / 6 + (\cos(q^3) * \cos
   \sin(q1)*\sin(q2)))/5)*((2*\cos(q1))/5 + (2*\cos(q1)*\cos(q2))/5)
     -(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
     -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
   \cos(q_2)*\sin(q_1)))/5) - ((2*\cos(q_1)*\cos(q_2))/5 - (2*\sin(q_1)*\sin(q_2))/5)
     + (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
     (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)*((2*\sin(q1))/5)
     + (2*cos(q1)*sin(q2))/5 + (2*cos(q2)*sin(q1))/5 +
     (\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
     (\sin(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5),
                                                                                                                                                             0, ((\cos(q3)*(\cos(q1)*\cos(q2))
     -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
     + \cos(q_2)*\sin(q_1)))/5)*((2*\cos(q_1)*\sin(q_2))/5 +
    (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
     + \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
     -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
     + \cos(q_2) * \sin(q_1)) / 5 + (\sin(q_3) * (\cos(q_1) * \cos(q_2) - q_2) 
    \sin(q1)*\sin(q2))/5* ((2*\cos(q1)*\cos(q2))/5 - (2*\sin(q1)*\sin(q2))/5
     + (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
     (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)]
```

[

0,

```
0, ((\cos(q3)*(\cos(q1)*\cos(q2))
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
 + \cos(q^2) * \sin(q^1)) / 5) * ((2*\cos(q^1)*\sin(q^2)) / 5 +
 (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
 -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
+ \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2) - q^2) 
\sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\cos(q2))/5 - (2*\sin(q1)*\sin(q2))/5)
+ (\cos(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5 -
 (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)]
[
                                          ((\cos(q3)*(\cos(q1)*\cos(q2)
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
 + \cos(q^2) \sin(q^1) )/5 ((2 \cos(q^1) \sin(q^2))/5 +
 (2*cos(q2)*sin(q1))/5 + (cos(q3)*(cos(q1)*sin(q2))
+ \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) \cos(q^1) \cos(q^2))
 -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
 + \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
 -\sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\cos(q2))/5 -
(2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
 + \cos(q^2)*\sin(q^1))/5), ((\cos(q^3)*(\cos(q^1)*\cos(q^2)))
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
 + cos(q2)*sin(q1)))/5)*((2*cos(q1)*sin(q2))/5 +
(2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
 + \cos(q^2) \sin(q^1)) / 5 + (\sin(q^3) \cos(q^1) \cos(q^2))
 -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
 + \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2))
 -\sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\cos(q2))/5 -
 (2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
 -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
```

```
+ \cos(q^2) * \sin(q^1)) / 5), ((\cos(q^3) * (\cos(q^1) * \cos(q^2))) / 5)
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
   + cos(q2)*sin(q1)))/5)*((2*cos(q1)*sin(q2))/5 +
   (2*\cos(q2)*\sin(q1))/5 + (\cos(q3)*(\cos(q1)*\sin(q2))
   + \cos(q_2)*\sin(q_1))/5 + (\sin(q_3)*(\cos(q_1)*\cos(q_2))
   -\sin(q1)*\sin(q2)))/5) - ((\cos(q3)*(\cos(q1)*\sin(q2)))
   + \cos(q_2) * \sin(q_1)) / 5 + (\sin(q_3) * (\cos(q_1) * \cos(q_2) - q_2) 
   \sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\cos(q2))/5 - (2*\sin(q1)*\sin(q2))/5
   + (\cos(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5 -
   (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)]
c(:,:,3) =
[((\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
   (\sin(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5)*((2*\cos(q_1))/5)
   + (2*cos(q1)*cos(q2))/5 - (2*sin(q1)*sin(q2))/5 +
   (\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
   (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5) -
   ((\cos(q_3)*(\cos(q_1)*\cos(q_2) - \sin(q_1)*\sin(q_2)))/5 -
   (\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5)*((2*\sin(q1))/5)
   + (2*cos(q1)*sin(q2))/5 + (2*cos(q2)*sin(q1))/5 +
   (\cos(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/5 +
   (\sin(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5),
   ((\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
   (\sin(q3)*(\cos(q1)*\cos(q2) -
  \sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\cos(q2))/5 -
   (2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
   + \cos(q^2) * \sin(q^2) ) / 5 ) - ((\cos(q^3) * (\cos(q^2) * \cos(q^2)) ) / 5 )
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
  \cos(q^2) * \sin(q^1)) / 5 * ((2*\cos(q^1)*\sin(q^2)) / 5 + (2*\cos(q^2)*\sin(q^1)) / 5
   + (\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
   (\sin(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5), 0]
                                                                                                             ((\cos(q3)*(\cos(q1)*\sin(q2))
Γ
   + \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2)) 
   -\sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\cos(q2))/5
   (2*sin(q1)*sin(q2))/5 + (cos(q3)*(cos(q1)*cos(q2))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
   + \cos(q_2)*\sin(q_1)))/5) - ((\cos(q_3)*(\cos(q_1)*\cos(q_2)))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
   + \cos(q^2) * \sin(q^1)) / 5) * ((2*\cos(q^1)*\sin(q^2)) / 5 +
   (2*cos(q2)*sin(q1))/5 + (cos(q3)*(cos(q1)*sin(q2))
   + \cos(q^2) * \sin(q^1)) / 5 + (\sin(q^3) * (\cos(q^1) * \cos(q^2)) 
   - \sin(q1)*\sin(q2)))/5), ((\cos(q3)*(\cos(q1)*\sin(q2))
   + \cos(q^2) * \sin(q^2) ) / 5 + (\sin(q^3) * (\cos(q^2) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^2) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\sin(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) * (\cos(q^3) * \cos(q^3) ) ) / 5 + (\cos(q^3) * (\cos(q^3) 
   -\sin(q1)*\sin(q2)))/5)*((2*\cos(q1)*\cos(q2))/5
   (2*\sin(q1)*\sin(q2))/5 + (\cos(q3)*(\cos(q1)*\cos(q2))
    -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2))
   + \cos(q_2)*\sin(q_1)))/5) - ((\cos(q_3)*(\cos(q_1)*\cos(q_2)))
   -\sin(q1)*\sin(q2)))/5 - (\sin(q3)*(\cos(q1)*\sin(q2) +
  \cos(q^2) * \sin(q^2) = \cos(q^2) * \cos(q^2) * \sin(q^2) = \cos(q^2) * \sin(q^2) = \cos(q^2) * \cos
   + (\cos(q_3)*(\cos(q_1)*\sin(q_2) + \cos(q_2)*\sin(q_1)))/5 +
   (\sin(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/5), 0]
```

[

0,

0,0]

g =

```
 (981*\cos(q1))/100 + (2943*\cos(q1)*\cos(q2))/500 - \\ (2943*\sin(q1)*\sin(q2))/500 + (981*\cos(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/500 - (981*\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/500 \\ \qquad \qquad (2943*\cos(q1)*\cos(q2))/500 - \\ (2943*\sin(q1)*\sin(q2))/500 + (981*\cos(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/500 - (981*\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/500 \\ \qquad \qquad (981*\cos(q3)*(\cos(q1)*\cos(q2) - \sin(q1)*\sin(q2)))/500 - \\ (981*\sin(q3)*(\cos(q1)*\sin(q2) + \cos(q2)*\sin(q1)))/500 \\ \end{pmatrix}
```

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