clear all

% Dynamic Matrices of the RmMT

syms theta\_1 theta\_2 theta\_3

syms theta\_1\_dot theta\_2\_dot theta\_3\_dot

syms theta\_1\_dot\_dot theta\_2\_dot\_dot theta\_3\_dot\_dot

syms d\_1 d\_2 d\_3

syms d\_1\_dot d\_2\_dot d\_3\_dot

syms d\_1\_dot\_dot d\_2\_dot\_dot d\_3\_dot\_dot

syms fi\_1 fi\_2 fi\_3

syms fi\_1\_dot fi\_2\_dot fi\_3\_dot

syms fi\_1\_dot\_dot fi\_2\_dot\_dot fi\_3\_dot\_dot

syms q11 q12 q13 q14

syms q21 q22 q23 q24

syms q31 q32 q33 q34

syms q11\_dot q12\_dot q13\_dot q14\_dot

syms q21\_dot q22\_dot q23\_dot q24\_dot

syms q31\_dot q32\_dot q33\_dot q34\_dot

syms q11\_dot\_dot q12\_dot\_dot q13\_dot\_dot q14\_dot\_dot

syms q21\_dot\_dot q22\_dot\_dot q23\_dot\_dot q24\_dot\_dot

syms q31\_dot\_dot q32\_dot\_dot q33\_dot\_dot q34\_dot\_dot

syms xe ye ze a b c

syms xe\_dot ye\_dot ze\_dot a\_dot b\_dot c\_dot

syms xe\_dot\_dot ye\_dot\_dot ze\_dot\_dot a\_dot\_dot b\_dot\_dot c\_dot\_dot

syms wx wy wz

syms wx\_dot wy\_dot wz\_dot

syms la1 la2 la3 la4 la5 la6 la7 la8 la9

%% Generalized coordinates

qt1=[theta\_1;d\_1;fi\_1;q11;q12;q13;q14];

qt1\_dot=[theta\_1\_dot;d\_1\_dot;fi\_1\_dot;q11\_dot;q12\_dot;q13\_dot;q14\_dot];

qt1\_dot\_dot=[theta\_1\_dot\_dot;d\_1\_dot\_dot;fi\_1\_dot\_dot;q11\_dot\_dot;q12\_dot\_dot;q13\_dot\_dot;q14\_dot\_dot];

qt2=[theta\_2;d\_2;fi\_2;q21;q22;q23;q24];

qt2\_dot=[theta\_2\_dot;d\_2\_dot;fi\_2\_dot;q21\_dot;q22\_dot;q23\_dot;q24\_dot];

qt2\_dot\_dot=[theta\_2\_dot\_dot;d\_2\_dot\_dot;fi\_2\_dot\_dot;q21\_dot\_dot;q22\_dot\_dot;q23\_dot\_dot;q24\_dot\_dot];

qt3=[theta\_3;d\_3;fi\_3;q31;q32;q33;q34];

qt3\_dot=[theta\_3\_dot;d\_3\_dot;fi\_3\_dot;q31\_dot;q32\_dot;q33\_dot;q34\_dot];

qt3\_dot\_dot=[theta\_3\_dot\_dot;d\_3\_dot\_dot;fi\_3\_dot\_dot;q31\_dot\_dot;q32\_dot\_dot;q33\_dot\_dot;q34\_dot\_dot];

Xe=[xe;ye;ze];

Xe\_dot=[xe\_dot;ye\_dot;ze\_dot];

Xe\_dot\_dot=[xe\_dot\_dot;ye\_dot\_dot;ze\_dot\_dot];

H= [0 -sin(a) cos(a)\*sin(b);

 0 cos(a) sin(a)\*sin(b);

 1 0 cos(b) ];

V\_w = H\*[a\_dot; b\_dot; c\_dot];

wx=V\_w(1,1);

wy=V\_w(2,1);

wz=V\_w(3,1);

w=[wx;wy;wz];

Ze=[Xe;a;b;c];

Ze\_dot=[Xe\_dot;a\_dot;b\_dot;c\_dot];

Ze\_dot\_dot=[Xe\_dot\_dot;a\_dot\_dot;b\_dot\_dot;c\_dot\_dot];

V=[Xe\_dot;wx;wy;wz];

la=[la1;la2;la3;la4;la5;la6;la7;la8;la9];

%% system parameters

g=9.81; %gravity

Rb=.125; % radius of base

m\_act1=.2; % base actuator mass

m\_act2=.2; %vertical actuator mass

m\_vert\_col=.3; % vertical column mass

m\_platform=.5; %platform mass

m\_spindle=.024; %spindle mass

R\_pf =.010; % platform radius

pf\_thick=0.004; % platform thichness

Jo\_pf=(1/4)\*m\_platform\*R\_pf^2+(1/12)\*m\_platform\*pf\_thick^2;

Jz\_pf=(1/2)\*m\_platform\*R\_pf^2;

J\_pf=[Jo\_pf 0 0;

 0 Jo\_pf 0;

 0 0 Jz\_pf];

% spindle constants

r\_sp=0.005; %spindle radius;

L\_tool=0.020; % tool length

Jo\_sp=(1/4)\*m\_spindle\*r\_sp^2+(1/12)\*m\_spindle\*L\_tool^2;

Jz\_sp=(1/2)\*m\_spindle\*r\_sp^2;

J\_sp=[Jo\_sp 0 0;

 0 Jo\_sp 0;

 0 0 Jz\_sp];

%% Actuators/columns

M234\_1 =...

[ Rb^2\*m\_act1 + Rb^2\*m\_act2 + Rb^2\*m\_vert\_col, 0, 0, 0, 0, 0, 0;

 0, m\_act2, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0];

M234\_2 =...

[ Rb^2\*m\_act1 + Rb^2\*m\_act2 + Rb^2\*m\_vert\_col, 0, 0, 0, 0, 0, 0;

 0, m\_act2, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0];

M234\_3 =...

[ Rb^2\*m\_act1 + Rb^2\*m\_act2 + Rb^2\*m\_vert\_col, 0, 0, 0, 0, 0, 0;

 0, m\_act2, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0];

C234\_1 =...

[ 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0];

C234\_2=C234\_1;

C234\_3=C234\_1;

G234\_1 = [ 0, g\*m\_act2, 0, 0, 0, 0, 0].';

G234\_2 = [ 0, g\*m\_act2, 0, 0, 0, 0, 0].';

G234\_3 = [ 0, g\*m\_act2, 0, 0, 0, 0, 0].';

K234\_1=zeros(7,7);

K234\_2=zeros(7,7);

K234\_3=zeros(7,7);

%% Platform, spindle, tool

M\_pfsp =...

[ m\_platform + m\_spindle, 0, 0, - L\_tool\*m\_platform\*sin(a)\*sin(b) - (L\_tool\*m\_spindle\*sin(a)\*sin(b))/2, L\_tool\*m\_platform\*cos(a)\*cos(b) + (L\_tool\*m\_spindle\*cos(a)\*cos(b))/2, 0;

 0, m\_platform + m\_spindle, 0, L\_tool\*m\_platform\*cos(a)\*sin(b) + (L\_tool\*m\_spindle\*cos(a)\*sin(b))/2, L\_tool\*m\_platform\*cos(b)\*sin(a) + (L\_tool\*m\_spindle\*cos(b)\*sin(a))/2, 0;

 0, 0, m\_platform + m\_spindle, 0, - L\_tool\*m\_platform\*sin(b) - (L\_tool\*m\_spindle\*sin(b))/2, 0;

 - L\_tool\*m\_platform\*sin(a)\*sin(b) - (L\_tool\*m\_spindle\*sin(a)\*sin(b))/2, L\_tool\*m\_platform\*cos(a)\*sin(b) + (L\_tool\*m\_spindle\*cos(a)\*sin(b))/2, 0, Jo\_pf + Jo\_sp + L\_tool^2\*m\_platform + (L\_tool^2\*m\_spindle)/4 - Jo\_pf\*cos(b)^2 - Jo\_sp\*cos(b)^2 + Jz\_pf\*cos(b)^2 + Jz\_sp\*cos(b)^2 - L\_tool^2\*m\_platform\*cos(b)^2 - (L\_tool^2\*m\_spindle\*cos(b)^2)/4, 0, Jz\_pf\*cos(b) + Jz\_sp\*cos(b);

 L\_tool\*m\_platform\*cos(a)\*cos(b) + (L\_tool\*m\_spindle\*cos(a)\*cos(b))/2, L\_tool\*m\_platform\*cos(b)\*sin(a) + (L\_tool\*m\_spindle\*cos(b)\*sin(a))/2, - L\_tool\*m\_platform\*sin(b) - (L\_tool\*m\_spindle\*sin(b))/2, 0, Jo\_pf + Jo\_sp + L\_tool^2\*m\_platform + (L\_tool^2\*m\_spindle)/4, 0;

 0, 0, 0, Jz\_pf\*cos(b) + Jz\_sp\*cos(b), 0, Jz\_pf + Jz\_sp];

C\_pfsp =...

[ 0, 0, 0, -(L\_tool\*(a\_dot\*cos(a)\*sin(b) + b\_dot\*cos(b)\*sin(a))\*(2\*m\_platform + m\_spindle))/2, -(L\_tool\*(a\_dot\*cos(b)\*sin(a) + b\_dot\*cos(a)\*sin(b))\*(2\*m\_platform + m\_spindle))/2, 0;

 0, 0, 0, (L\_tool\*(b\_dot\*cos(a)\*cos(b) - a\_dot\*sin(a)\*sin(b))\*(2\*m\_platform + m\_spindle))/2, (L\_tool\*(a\_dot\*cos(a)\*cos(b) - b\_dot\*sin(a)\*sin(b))\*(2\*m\_platform + m\_spindle))/2, 0;

 0, 0, 0, 0, -(L\_tool\*b\_dot\*cos(b)\*(2\*m\_platform + m\_spindle))/2, 0;

 0, 0, 0, (b\_dot\*sin(2\*b)\*(4\*Jo\_pf + 4\*Jo\_sp - 4\*Jz\_pf - 4\*Jz\_sp + 4\*L\_tool^2\*m\_platform + L\_tool^2\*m\_spindle))/8, a\_dot\*((Jo\_pf\*sin(2\*b))/2 + (Jo\_sp\*sin(2\*b))/2 - (Jz\_pf\*sin(2\*b))/2 - (Jz\_sp\*sin(2\*b))/2 + (L\_tool^2\*m\_platform\*sin(2\*b))/2 + (L\_tool^2\*m\_spindle\*sin(2\*b))/8) - c\_dot\*((Jz\_pf\*sin(b))/2 + (Jz\_sp\*sin(b))/2), -(b\_dot\*sin(b)\*(Jz\_pf + Jz\_sp))/2;

 0, 0, 0, c\_dot\*((Jz\_pf\*sin(b))/2 + (Jz\_sp\*sin(b))/2) - a\_dot\*((Jo\_pf\*sin(2\*b))/2 + (Jo\_sp\*sin(2\*b))/2 - (Jz\_pf\*sin(2\*b))/2 - (Jz\_sp\*sin(2\*b))/2 + (L\_tool^2\*m\_platform\*sin(2\*b))/2 + (L\_tool^2\*m\_spindle\*sin(2\*b))/8), 0, (a\_dot\*sin(b)\*(Jz\_pf + Jz\_sp))/2;

 0, 0, 0, -(b\_dot\*sin(b)\*(Jz\_pf + Jz\_sp))/2, -(a\_dot\*sin(b)\*(Jz\_pf + Jz\_sp))/2, 0];

G\_pfsp=[ 0, 0, 0, 0, - L\_tool\*g\*m\_platform\*sin(b) - (L\_tool\*g\*m\_spindle\*sin(b))/2, 0].';

K\_pfsp=zeros(6,6);

%% Platform links

M\_rr\_link1 =...

[ - (4503599627381703\*q11^2\*cos(fi\_1)^2)/9007199254740992 + (4503599627381703\*q11^2\*sin(fi\_1)^2)/9007199254740992 + (4503599627381703\*q11^2)/9007199254740992 + (7600980450084613\*q11\*q12\*cos(fi\_1)^2)/147573952589676412928 - (7600980450084613\*q11\*q12\*sin(fi\_1)^2)/147573952589676412928 - (7600980450084613\*q11\*q12)/147573952589676412928 + (2600709427658073\*q11\*q13\*cos(fi\_1)^2)/36893488147419103232 - (2600709427658073\*q11\*q13\*sin(fi\_1)^2)/36893488147419103232 - (2600709427658073\*q11\*q13)/36893488147419103232 + (8561737489858895\*q11\*q14\*cos(fi\_1)^2)/36893488147419103232 - (8561737489858895\*q11\*q14\*sin(fi\_1)^2)/36893488147419103232 - (8561737489858895\*q11\*q14)/36893488147419103232 + (5067133536030169\*q11\*cos(fi\_1)\*sin(fi\_1))/4722366482869645213696 - (1266427652570665\*q11\*sin(fi\_1))/4503599627370496 - (4503599627362597\*q12^2\*cos(fi\_1)^2)/9007199254740992 + (4503599627362597\*q12^2\*sin(fi\_1)^2)/9007199254740992 + (4503599627362597\*q12^2)/9007199254740992 + (5579170998860119\*q12\*q13\*cos(fi\_1)^2)/73786976294838206464 - (5579170998860119\*q12\*q13\*sin(fi\_1)^2)/73786976294838206464 - (5579170998860119\*q12\*q13)/73786976294838206464 + (4537588927149065\*q12\*q14\*cos(fi\_1)^2)/18446744073709551616 - (4537588927149065\*q12\*q14\*sin(fi\_1)^2)/18446744073709551616 - (4537588927149065\*q12\*q14)/18446744073709551616 + (3148167743914421\*q12\*cos(fi\_1)\*sin(fi\_1))/147573952589676412928 + (5466165233750959\*q12\*sin(fi\_1))/36028797018963968 - (q13^2\*cos(fi\_1)^2)/2 + (q13^2\*sin(fi\_1)^2)/2 + q13^2/2 + (5795726909949103\*q13\*q14\*cos(fi\_1)^2)/18446744073709551616 - (5795726909949103\*q13\*q14\*sin(fi\_1)^2)/18446744073709551616 - (5795726909949103\*q13\*q14)/18446744073709551616 + (4639097744824433\*q13\*cos(fi\_1)\*sin(fi\_1))/147573952589676412928 - (7580929533345111\*q13\*sin(fi\_1))/72057594037927936 - (9007199254722041\*q14^2\*cos(fi\_1)^2)/18014398509481984 + (9007199254722041\*q14^2\*sin(fi\_1)^2)/18014398509481984 + (9007199254722041\*q14^2)/18014398509481984 + (3871657051539189\*q14\*cos(fi\_1)\*sin(fi\_1))/36893488147419103232 + (5789705833529205\*q14\*sin(fi\_1))/72057594037927936 + (2492607671927221\*cos(fi\_1)^2)/72057594037927936 - (1557879794954513\*cos(fi\_1))/9007199254740992 - (2492607671927221\*sin(fi\_1)^2)/72057594037927936 + 6439236485811987/36028797018963968, 0, 0;

 0, (2349\*pi)/800, (5466165233750959\*q12\*sin(fi\_1))/9007199254740992 - (1266427652570665\*q11\*sin(fi\_1))/1125899906842624 - (7047\*pi\*cos(fi\_1))/32000 - (7580929533345111\*q13\*sin(fi\_1))/18014398509481984 + (5789705833529205\*q14\*sin(fi\_1))/18014398509481984;

 0, (5466165233750959\*q12\*sin(fi\_1))/9007199254740992 - (1266427652570665\*q11\*sin(fi\_1))/1125899906842624 - (7047\*pi\*cos(fi\_1))/32000 - (7580929533345111\*q13\*sin(fi\_1))/18014398509481984 + (5789705833529205\*q14\*sin(fi\_1))/18014398509481984, (4503599627381703\*q11^2)/4503599627370496 - (7600980450084613\*q11\*q12)/73786976294838206464 - (2600709427658073\*q11\*q13)/18446744073709551616 - (8561737489858895\*q11\*q14)/18446744073709551616 + (4503599627362597\*q12^2)/4503599627370496 - (5579170998860119\*q12\*q13)/36893488147419103232 - (4537588927149065\*q12\*q14)/9223372036854775808 + q13^2 - (5795726909949103\*q13\*q14)/9223372036854775808 + (9007199254722041\*q14^2)/9007199254740992 + 2492607671927221/36028797018963968];

M\_rr\_link2 =...

[ - (4503599627381703\*q21^2\*cos(fi\_2)^2)/9007199254740992 + (4503599627381703\*q21^2\*sin(fi\_2)^2)/9007199254740992 + (4503599627381703\*q21^2)/9007199254740992 + (7600980450084613\*q21\*q22\*cos(fi\_2)^2)/147573952589676412928 - (7600980450084613\*q21\*q22\*sin(fi\_2)^2)/147573952589676412928 - (7600980450084613\*q21\*q22)/147573952589676412928 + (2600709427658073\*q21\*q23\*cos(fi\_2)^2)/36893488147419103232 - (2600709427658073\*q21\*q23\*sin(fi\_2)^2)/36893488147419103232 - (2600709427658073\*q21\*q23)/36893488147419103232 + (8561737489858895\*q21\*q24\*cos(fi\_2)^2)/36893488147419103232 - (8561737489858895\*q21\*q24\*sin(fi\_2)^2)/36893488147419103232 - (8561737489858895\*q21\*q24)/36893488147419103232 + (5067133536030169\*q21\*cos(fi\_2)\*sin(fi\_2))/4722366482869645213696 - (1266427652570665\*q21\*sin(fi\_2))/4503599627370496 - (4503599627362597\*q22^2\*cos(fi\_2)^2)/9007199254740992 + (4503599627362597\*q22^2\*sin(fi\_2)^2)/9007199254740992 + (4503599627362597\*q22^2)/9007199254740992 + (5579170998860119\*q22\*q23\*cos(fi\_2)^2)/73786976294838206464 - (5579170998860119\*q22\*q23\*sin(fi\_2)^2)/73786976294838206464 - (5579170998860119\*q22\*q23)/73786976294838206464 + (4537588927149065\*q22\*q24\*cos(fi\_2)^2)/18446744073709551616 - (4537588927149065\*q22\*q24\*sin(fi\_2)^2)/18446744073709551616 - (4537588927149065\*q22\*q24)/18446744073709551616 + (3148167743914421\*q22\*cos(fi\_2)\*sin(fi\_2))/147573952589676412928 + (5466165233750959\*q22\*sin(fi\_2))/36028797018963968 - (q23^2\*cos(fi\_2)^2)/2 + (q23^2\*sin(fi\_2)^2)/2 + q23^2/2 + (5795726909949103\*q23\*q24\*cos(fi\_2)^2)/18446744073709551616 - (5795726909949103\*q23\*q24\*sin(fi\_2)^2)/18446744073709551616 - (5795726909949103\*q23\*q24)/18446744073709551616 + (4639097744824433\*q23\*cos(fi\_2)\*sin(fi\_2))/147573952589676412928 - (7580929533345111\*q23\*sin(fi\_2))/72057594037927936 - (9007199254722041\*q24^2\*cos(fi\_2)^2)/18014398509481984 + (9007199254722041\*q24^2\*sin(fi\_2)^2)/18014398509481984 + (9007199254722041\*q24^2)/18014398509481984 + (3871657051539189\*q24\*cos(fi\_2)\*sin(fi\_2))/36893488147419103232 + (5789705833529205\*q24\*sin(fi\_2))/72057594037927936 + (2492607671927221\*cos(fi\_2)^2)/72057594037927936 - (1557879794954513\*cos(fi\_2))/9007199254740992 - (2492607671927221\*sin(fi\_2)^2)/72057594037927936 + 6439236485811987/36028797018963968, 0, 0;

 0, (2349\*pi)/800, (5466165233750959\*q22\*sin(fi\_2))/9007199254740992 - (1266427652570665\*q21\*sin(fi\_2))/1125899906842624 - (7047\*pi\*cos(fi\_2))/32000 - (7580929533345111\*q23\*sin(fi\_2))/18014398509481984 + (5789705833529205\*q24\*sin(fi\_2))/18014398509481984;

 0, (5466165233750959\*q22\*sin(fi\_2))/9007199254740992 - (1266427652570665\*q21\*sin(fi\_2))/1125899906842624 - (7047\*pi\*cos(fi\_2))/32000 - (7580929533345111\*q23\*sin(fi\_2))/18014398509481984 + (5789705833529205\*q24\*sin(fi\_2))/18014398509481984, (4503599627381703\*q21^2)/4503599627370496 - (7600980450084613\*q21\*q22)/73786976294838206464 - (2600709427658073\*q21\*q23)/18446744073709551616 - (8561737489858895\*q21\*q24)/18446744073709551616 + (4503599627362597\*q22^2)/4503599627370496 - (5579170998860119\*q22\*q23)/36893488147419103232 - (4537588927149065\*q22\*q24)/9223372036854775808 + q23^2 - (5795726909949103\*q23\*q24)/9223372036854775808 + (9007199254722041\*q24^2)/9007199254740992 + 2492607671927221/36028797018963968];

M\_rr\_link3=...

[ - (4503599627381703\*q31^2\*cos(fi\_3)^2)/9007199254740992 + (4503599627381703\*q31^2\*sin(fi\_3)^2)/9007199254740992 + (4503599627381703\*q31^2)/9007199254740992 + (7600980450084613\*q31\*q32\*cos(fi\_3)^2)/147573952589676412928 - (7600980450084613\*q31\*q32\*sin(fi\_3)^2)/147573952589676412928 - (7600980450084613\*q31\*q32)/147573952589676412928 + (2600709427658073\*q31\*q33\*cos(fi\_3)^2)/36893488147419103232 - (2600709427658073\*q31\*q33\*sin(fi\_3)^2)/36893488147419103232 - (2600709427658073\*q31\*q33)/36893488147419103232 + (8561737489858895\*q31\*q34\*cos(fi\_3)^2)/36893488147419103232 - (8561737489858895\*q31\*q34\*sin(fi\_3)^2)/36893488147419103232 - (8561737489858895\*q31\*q34)/36893488147419103232 + (5067133536030169\*q31\*cos(fi\_3)\*sin(fi\_3))/4722366482869645213696 - (1266427652570665\*q31\*sin(fi\_3))/4503599627370496 - (4503599627362597\*q32^2\*cos(fi\_3)^2)/9007199254740992 + (4503599627362597\*q32^2\*sin(fi\_3)^2)/9007199254740992 + (4503599627362597\*q32^2)/9007199254740992 + (5579170998860119\*q32\*q33\*cos(fi\_3)^2)/73786976294838206464 - (5579170998860119\*q32\*q33\*sin(fi\_3)^2)/73786976294838206464 - (5579170998860119\*q32\*q33)/73786976294838206464 + (4537588927149065\*q32\*q34\*cos(fi\_3)^2)/18446744073709551616 - (4537588927149065\*q32\*q34\*sin(fi\_3)^2)/18446744073709551616 - (4537588927149065\*q32\*q34)/18446744073709551616 + (3148167743914421\*q32\*cos(fi\_3)\*sin(fi\_3))/147573952589676412928 + (5466165233750959\*q32\*sin(fi\_3))/36028797018963968 - (q33^2\*cos(fi\_3)^2)/2 + (q33^2\*sin(fi\_3)^2)/2 + q33^2/2 + (5795726909949103\*q33\*q34\*cos(fi\_3)^2)/18446744073709551616 - (5795726909949103\*q33\*q34\*sin(fi\_3)^2)/18446744073709551616 - (5795726909949103\*q33\*q34)/18446744073709551616 + (4639097744824433\*q33\*cos(fi\_3)\*sin(fi\_3))/147573952589676412928 - (7580929533345111\*q33\*sin(fi\_3))/72057594037927936 - (9007199254722041\*q34^2\*cos(fi\_3)^2)/18014398509481984 + (9007199254722041\*q34^2\*sin(fi\_3)^2)/18014398509481984 + (9007199254722041\*q34^2)/18014398509481984 + (3871657051539189\*q34\*cos(fi\_3)\*sin(fi\_3))/36893488147419103232 + (5789705833529205\*q34\*sin(fi\_3))/72057594037927936 + (2492607671927221\*cos(fi\_3)^2)/72057594037927936 - (1557879794954513\*cos(fi\_3))/9007199254740992 - (2492607671927221\*sin(fi\_3)^2)/72057594037927936 + 6439236485811987/36028797018963968, 0, 0;

 0, (2349\*pi)/800, (5466165233750959\*q32\*sin(fi\_3))/9007199254740992 - (1266427652570665\*q31\*sin(fi\_3))/1125899906842624 - (7047\*pi\*cos(fi\_3))/32000 - (7580929533345111\*q33\*sin(fi\_3))/18014398509481984 + (5789705833529205\*q34\*sin(fi\_3))/18014398509481984;

 0, (5466165233750959\*q32\*sin(fi\_3))/9007199254740992 - (1266427652570665\*q31\*sin(fi\_3))/1125899906842624 - (7047\*pi\*cos(fi\_3))/32000 - (7580929533345111\*q33\*sin(fi\_3))/18014398509481984 + (5789705833529205\*q34\*sin(fi\_3))/18014398509481984, (4503599627381703\*q31^2)/4503599627370496 - (7600980450084613\*q31\*q32)/73786976294838206464 - (2600709427658073\*q31\*q33)/18446744073709551616 - (8561737489858895\*q31\*q34)/18446744073709551616 + (4503599627362597\*q32^2)/4503599627370496 - (5579170998860119\*q32\*q33)/36893488147419103232 - (4537588927149065\*q32\*q34)/9223372036854775808 + q33^2 - (5795726909949103\*q33\*q34)/9223372036854775808 + (9007199254722041\*q34^2)/9007199254740992 + 2492607671927221/36028797018963968];

M\_rf\_link1 =...

[ 0, 0, 0, 0;

 1.1248137111247524823306139275607\*cos(fi\_1), -0.60686624989158658836081990243376\*cos(fi\_1), 0.42082612579902926606277135283501\*cos(fi\_1), -0.3213932361095353286763496475881\*cos(fi\_1);

 -0.00000053650363164434230933172382892285, -0.000010666407210315014054101209830673, -0.000015717874541597668928892912650003, -0.000052470737329970143828376018243396];

M\_rf\_link2 =...

[ 0, 0, 0, 0;

 1.1248137111247524823306139275607\*cos(fi\_2), -0.60686624989158658836081990243376\*cos(fi\_2), 0.42082612579902926606277135283501\*cos(fi\_2), -0.3213932361095353286763496475881\*cos(fi\_2);

 -0.00000053650363164434230933172382892285, -0.000010666407210315014054101209830673, -0.000015717874541597668928892912650003, -0.000052470737329970143828376018243396];

M\_rf\_link3 =...

[ 0, 0, 0, 0;

 1.1248137111247524823306139275607\*cos(fi\_3), -0.60686624989158658836081990243376\*cos(fi\_3), 0.42082612579902926606277135283501\*cos(fi\_3), -0.3213932361095353286763496475881\*cos(fi\_3);

 -0.00000053650363164434230933172382892285, -0.000010666407210315014054101209830673, -0.000015717874541597668928892912650003, -0.000052470737329970143828376018243396];

M\_fr\_link1 =...

[ 0, 1.1248137111247524823306139275607\*cos(fi\_1), -0.00000053650363164434230933172382892285;

 0, -0.60686624989158658836081990243376\*cos(fi\_1), -0.000010666407210315014054101209830673;

 0, 0.42082612579902926606277135283501\*cos(fi\_1), -0.000015717874541597668928892912650003;

 0, -0.3213932361095353286763496475881\*cos(fi\_1), -0.000052470737329970143828376018243396];

M\_fr\_link2 =...

[ 0, 1.1248137111247524823306139275607\*cos(fi\_2), -0.00000053650363164434230933172382892285;

 0, -0.60686624989158658836081990243376\*cos(fi\_2), -0.000010666407210315014054101209830673;

 0, 0.42082612579902926606277135283501\*cos(fi\_2), -0.000015717874541597668928892912650003;

 0, -0.3213932361095353286763496475881\*cos(fi\_2), -0.000052470737329970143828376018243396];

M\_fr\_link3 =...

[ 0, 1.1248137111247524823306139275607\*cos(fi\_3), -0.00000053650363164434230933172382892285;

 0, -0.60686624989158658836081990243376\*cos(fi\_3), -0.000010666407210315014054101209830673;

 0, 0.42082612579902926606277135283501\*cos(fi\_3), -0.000015717874541597668928892912650003;

 0, -0.3213932361095353286763496475881\*cos(fi\_3), -0.000052470737329970143828376018243396];

M\_ff\_link1 =...

[ 1.0000000000024884623582436885433, -0.000051506246981259903152135202525795, -0.000070492370286760392798390735858025, -0.00023206635966889007440410789984914;

 -0.000051506246981259903152135202525795, 0.99999999999824609970186027435951, -0.000075611866470403283816624243355146, -0.00024598318863305927145324192806045;

 -0.000070492370286760392798390735858025, -0.000075611866470403283816624243355146, 1.0000000000000208495246898068747, -0.00031418698534497585802321100442191;

 -0.00023206635966889007440410789984914, -0.00024598318863305927145324192806045, -0.00031418698534497585802321100442191, 0.99999999999789602462879809814619];

M\_ff\_link2 =...

[ 1.0000000000024884623582436885433, -0.000051506246981259903152135202525795, -0.000070492370286760392798390735858025, -0.00023206635966889007440410789984914;

 -0.000051506246981259903152135202525795, 0.99999999999824609970186027435951, -0.000075611866470403283816624243355146, -0.00024598318863305927145324192806045;

 -0.000070492370286760392798390735858025, -0.000075611866470403283816624243355146, 1.0000000000000208495246898068747, -0.00031418698534497585802321100442191;

 -0.00023206635966889007440410789984914, -0.00024598318863305927145324192806045, -0.00031418698534497585802321100442191, 0.99999999999789602462879809814619];

M\_ff\_link3 =...

[ 1.0000000000024884623582436885433, -0.000051506246981259903152135202525795, -0.000070492370286760392798390735858025, -0.00023206635966889007440410789984914;

 -0.000051506246981259903152135202525795, 0.99999999999824609970186027435951, -0.000075611866470403283816624243355146, -0.00024598318863305927145324192806045;

 -0.000070492370286760392798390735858025, -0.000075611866470403283816624243355146, 1.0000000000000208495246898068747, -0.00031418698534497585802321100442191;

 -0.00023206635966889007440410789984914, -0.00024598318863305927145324192806045, -0.00031418698534497585802321100442191, 0.99999999999789602462879809814619];

C\_rr\_link1 =...

[ (4503599627381703\*q11\*q11\_dot)/9007199254740992 - (7600980450084613\*q11\*q12\_dot)/295147905179352825856 - (7600980450084613\*q12\*q11\_dot)/295147905179352825856 - (2600709427658073\*q11\*q13\_dot)/73786976294838206464 + (4503599627362597\*q12\*q12\_dot)/9007199254740992 - (2600709427658073\*q11\_dot\*q13)/73786976294838206464 - (8561737489858895\*q11\*q14\_dot)/73786976294838206464 - (5579170998860119\*q12\*q13\_dot)/147573952589676412928 - (8561737489858895\*q11\_dot\*q14)/73786976294838206464 - (5579170998860119\*q13\*q12\_dot)/147573952589676412928 - (4537588927149065\*q12\*q14\_dot)/36893488147419103232 + (q13\*q13\_dot)/2 - (4537588927149065\*q12\_dot\*q14)/36893488147419103232 - (5795726909949103\*q13\*q14\_dot)/36893488147419103232 - (5795726909949103\*q14\*q13\_dot)/36893488147419103232 + (9007199254722041\*q14\*q14\_dot)/18014398509481984 + (1557879794954513\*fi\_1\_dot\*sin(fi\_1))/18014398509481984 - (1266427652570665\*q11\_dot\*sin(fi\_1))/9007199254740992 + (5466165233750959\*q12\_dot\*sin(fi\_1))/72057594037927936 - (7580929533345111\*q13\_dot\*sin(fi\_1))/144115188075855872 + (5789705833529205\*q14\_dot\*sin(fi\_1))/144115188075855872 - (1266427652570665\*fi\_1\_dot\*q11\*cos(fi\_1))/9007199254740992 + (5466165233750959\*fi\_1\_dot\*q12\*cos(fi\_1))/72057594037927936 - (7580929533345111\*fi\_1\_dot\*q13\*cos(fi\_1))/144115188075855872 + (5789705833529205\*fi\_1\_dot\*q14\*cos(fi\_1))/144115188075855872 + (5067133536030169\*fi\_1\_dot\*q11\*cos(fi\_1)^2)/9444732965739290427392 + (3148167743914421\*fi\_1\_dot\*q12\*cos(fi\_1)^2)/295147905179352825856 + (4639097744824433\*fi\_1\_dot\*q13\*cos(fi\_1)^2)/295147905179352825856 + (3871657051539189\*fi\_1\_dot\*q14\*cos(fi\_1)^2)/73786976294838206464 - (2492607671927221\*fi\_1\_dot\*cos(fi\_1)\*sin(fi\_1))/36028797018963968 - (4503599627381703\*q11\*q11\_dot\*cos(fi\_1)^2)/9007199254740992 + (7600980450084613\*q11\*q12\_dot\*cos(fi\_1)^2)/295147905179352825856 + (7600980450084613\*q12\*q11\_dot\*cos(fi\_1)^2)/295147905179352825856 + (2600709427658073\*q11\*q13\_dot\*cos(fi\_1)^2)/73786976294838206464 - (4503599627362597\*q12\*q12\_dot\*cos(fi\_1)^2)/9007199254740992 + (2600709427658073\*q11\_dot\*q13\*cos(fi\_1)^2)/73786976294838206464 + (8561737489858895\*q11\*q14\_dot\*cos(fi\_1)^2)/73786976294838206464 + (5579170998860119\*q12\*q13\_dot\*cos(fi\_1)^2)/147573952589676412928 + (8561737489858895\*q11\_dot\*q14\*cos(fi\_1)^2)/73786976294838206464 + (5579170998860119\*q13\*q12\_dot\*cos(fi\_1)^2)/147573952589676412928 + (4537588927149065\*q12\*q14\_dot\*cos(fi\_1)^2)/36893488147419103232 - (q13\*q13\_dot\*cos(fi\_1)^2)/2 + (4537588927149065\*q12\_dot\*q14\*cos(fi\_1)^2)/36893488147419103232 + (5795726909949103\*q13\*q14\_dot\*cos(fi\_1)^2)/36893488147419103232 + (5795726909949103\*q14\*q13\_dot\*cos(fi\_1)^2)/36893488147419103232 - (9007199254722041\*q14\*q14\_dot\*cos(fi\_1)^2)/18014398509481984 - (5067133536030169\*fi\_1\_dot\*q11\*sin(fi\_1)^2)/9444732965739290427392 - (3148167743914421\*fi\_1\_dot\*q12\*sin(fi\_1)^2)/295147905179352825856 - (4639097744824433\*fi\_1\_dot\*q13\*sin(fi\_1)^2)/295147905179352825856 - (3871657051539189\*fi\_1\_dot\*q14\*sin(fi\_1)^2)/73786976294838206464 + (5067133536030169\*q11\_dot\*cos(fi\_1)\*sin(fi\_1))/9444732965739290427392 + (3148167743914421\*q12\_dot\*cos(fi\_1)\*sin(fi\_1))/295147905179352825856 + (4639097744824433\*q13\_dot\*cos(fi\_1)\*sin(fi\_1))/295147905179352825856 + (3871657051539189\*q14\_dot\*cos(fi\_1)\*sin(fi\_1))/73786976294838206464 + (4503599627381703\*q11\*q11\_dot\*sin(fi\_1)^2)/9007199254740992 - (7600980450084613\*q11\*q12\_dot\*sin(fi\_1)^2)/295147905179352825856 - (7600980450084613\*q12\*q11\_dot\*sin(fi\_1)^2)/295147905179352825856 - (2600709427658073\*q11\*q13\_dot\*sin(fi\_1)^2)/73786976294838206464 + (4503599627362597\*q12\*q12\_dot\*sin(fi\_1)^2)/9007199254740992 - (2600709427658073\*q11\_dot\*q13\*sin(fi\_1)^2)/73786976294838206464 - (8561737489858895\*q11\*q14\_dot\*sin(fi\_1)^2)/73786976294838206464 - (5579170998860119\*q12\*q13\_dot\*sin(fi\_1)^2)/147573952589676412928 - (8561737489858895\*q11\_dot\*q14\*sin(fi\_1)^2)/73786976294838206464 - (5579170998860119\*q13\*q12\_dot\*sin(fi\_1)^2)/147573952589676412928 - (4537588927149065\*q12\*q14\_dot\*sin(fi\_1)^2)/36893488147419103232 + (q13\*q13\_dot\*sin(fi\_1)^2)/2 - (4537588927149065\*q12\_dot\*q14\*sin(fi\_1)^2)/36893488147419103232 - (5795726909949103\*q13\*q14\_dot\*sin(fi\_1)^2)/36893488147419103232 - (5795726909949103\*q14\*q13\_dot\*sin(fi\_1)^2)/36893488147419103232 + (9007199254722041\*q14\*q14\_dot\*sin(fi\_1)^2)/18014398509481984 + (4503599627381703\*fi\_1\_dot\*q11^2\*cos(fi\_1)\*sin(fi\_1))/4503599627370496 + (4503599627362597\*fi\_1\_dot\*q12^2\*cos(fi\_1)\*sin(fi\_1))/4503599627370496 + fi\_1\_dot\*q13^2\*cos(fi\_1)\*sin(fi\_1) + (9007199254722041\*fi\_1\_dot\*q14^2\*cos(fi\_1)\*sin(fi\_1))/9007199254740992 - (7600980450084613\*fi\_1\_dot\*q11\*q12\*cos(fi\_1)\*sin(fi\_1))/73786976294838206464 - (2600709427658073\*fi\_1\_dot\*q11\*q13\*cos(fi\_1)\*sin(fi\_1))/18446744073709551616 - (8561737489858895\*fi\_1\_dot\*q11\*q14\*cos(fi\_1)\*sin(fi\_1))/18446744073709551616 - (5579170998860119\*fi\_1\_dot\*q12\*q13\*cos(fi\_1)\*sin(fi\_1))/36893488147419103232 - (4537588927149065\*fi\_1\_dot\*q12\*q14\*cos(fi\_1)\*sin(fi\_1))/9223372036854775808 - (5795726909949103\*fi\_1\_dot\*q13\*q14\*cos(fi\_1)\*sin(fi\_1))/9223372036854775808, 0, (4503599627381703\*theta\_1\_dot\*q11^2\*cos(fi\_1)\*sin(fi\_1))/4503599627370496 - (7600980450084613\*theta\_1\_dot\*q11\*q12\*cos(fi\_1)\*sin(fi\_1))/73786976294838206464 - (2600709427658073\*theta\_1\_dot\*q11\*q13\*cos(fi\_1)\*sin(fi\_1))/18446744073709551616 - (8561737489858895\*theta\_1\_dot\*q11\*q14\*cos(fi\_1)\*sin(fi\_1))/18446744073709551616 + (5067133536030169\*theta\_1\_dot\*q11\*cos(fi\_1)^2)/9444732965739290427392 - (1266427652570665\*theta\_1\_dot\*q11\*cos(fi\_1))/9007199254740992 - (5067133536030169\*theta\_1\_dot\*q11\*sin(fi\_1)^2)/9444732965739290427392 + (4503599627362597\*theta\_1\_dot\*q12^2\*cos(fi\_1)\*sin(fi\_1))/4503599627370496 - (5579170998860119\*theta\_1\_dot\*q12\*q13\*cos(fi\_1)\*sin(fi\_1))/36893488147419103232 - (4537588927149065\*theta\_1\_dot\*q12\*q14\*cos(fi\_1)\*sin(fi\_1))/9223372036854775808 + (3148167743914421\*theta\_1\_dot\*q12\*cos(fi\_1)^2)/295147905179352825856 + (5466165233750959\*theta\_1\_dot\*q12\*cos(fi\_1))/72057594037927936 - (3148167743914421\*theta\_1\_dot\*q12\*sin(fi\_1)^2)/295147905179352825856 + theta\_1\_dot\*q13^2\*cos(fi\_1)\*sin(fi\_1) - (5795726909949103\*theta\_1\_dot\*q13\*q14\*cos(fi\_1)\*sin(fi\_1))/9223372036854775808 + (4639097744824433\*theta\_1\_dot\*q13\*cos(fi\_1)^2)/295147905179352825856 - (7580929533345111\*theta\_1\_dot\*q13\*cos(fi\_1))/144115188075855872 - (4639097744824433\*theta\_1\_dot\*q13\*sin(fi\_1)^2)/295147905179352825856 + (9007199254722041\*theta\_1\_dot\*q14^2\*cos(fi\_1)\*sin(fi\_1))/9007199254740992 + (3871657051539189\*theta\_1\_dot\*q14\*cos(fi\_1)^2)/73786976294838206464 + (5789705833529205\*theta\_1\_dot\*q14\*cos(fi\_1))/144115188075855872 - (3871657051539189\*theta\_1\_dot\*q14\*sin(fi\_1)^2)/73786976294838206464 - (2492607671927221\*theta\_1\_dot\*cos(fi\_1)\*sin(fi\_1))/36028797018963968 + (1557879794954513\*theta\_1\_dot\*sin(fi\_1))/18014398509481984;

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 (4503599627381703\*fi\_2\_dot\*q21)/4503599627370496 - (7600980450084613\*fi\_2\_dot\*q22)/147573952589676412928 - (2600709427658073\*fi\_2\_dot\*q23)/36893488147419103232 - (8561737489858895\*fi\_2\_dot\*q24)/36893488147419103232, (4503599627362597\*fi\_2\_dot\*q22)/4503599627370496 - (7600980450084613\*fi\_2\_dot\*q21)/147573952589676412928 - (5579170998860119\*fi\_2\_dot\*q23)/73786976294838206464 - (4537588927149065\*fi\_2\_dot\*q24)/18446744073709551616, fi\_2\_dot\*q23 - (5579170998860119\*fi\_2\_dot\*q22)/73786976294838206464 - (2600709427658073\*fi\_2\_dot\*q21)/36893488147419103232 - (5795726909949103\*fi\_2\_dot\*q24)/18446744073709551616, (9007199254722041\*fi\_2\_dot\*q24)/9007199254740992 - (4537588927149065\*fi\_2\_dot\*q22)/18446744073709551616 - (5795726909949103\*fi\_2\_dot\*q23)/18446744073709551616 - (8561737489858895\*fi\_2\_dot\*q21)/36893488147419103232];

C\_rf\_link3 =...

[ (5067133536030169\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/9444732965739290427392 - (1266427652570665\*theta\_3\_dot\*sin(fi\_3))/9007199254740992 + (4503599627381703\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/4503599627370496 - (7600980450084613\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/147573952589676412928 - (2600709427658073\*q33\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232 - (8561737489858895\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232, (5466165233750959\*theta\_3\_dot\*sin(fi\_3))/72057594037927936 + (3148167743914421\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/295147905179352825856 - (7600980450084613\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/147573952589676412928 + (4503599627362597\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/4503599627370496 - (5579170998860119\*q33\*theta\_3\_dot\*sin(fi\_3)^2)/73786976294838206464 - (4537588927149065\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616, (4639097744824433\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/295147905179352825856 - (7580929533345111\*theta\_3\_dot\*sin(fi\_3))/144115188075855872 - (2600709427658073\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232 - (5579170998860119\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/73786976294838206464 + q33\*theta\_3\_dot\*sin(fi\_3)^2 - (5795726909949103\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616, (5789705833529205\*theta\_3\_dot\*sin(fi\_3))/144115188075855872 + (3871657051539189\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/73786976294838206464 - (8561737489858895\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232 - (4537588927149065\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616 - (5795726909949103\*q33\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616 + (9007199254722041\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/9007199254740992;

 -(1266427652570665\*fi\_3\_dot\*sin(fi\_3))/1125899906842624, (5466165233750959\*fi\_3\_dot\*sin(fi\_3))/9007199254740992, -(7580929533345111\*fi\_3\_dot\*sin(fi\_3))/18014398509481984, (5789705833529205\*fi\_3\_dot\*sin(fi\_3))/18014398509481984;

 (4503599627381703\*fi\_3\_dot\*q31)/4503599627370496 - (7600980450084613\*fi\_3\_dot\*q32)/147573952589676412928 - (2600709427658073\*fi\_3\_dot\*q33)/36893488147419103232 - (8561737489858895\*fi\_3\_dot\*q34)/36893488147419103232, (4503599627362597\*fi\_3\_dot\*q32)/4503599627370496 - (7600980450084613\*fi\_3\_dot\*q31)/147573952589676412928 - (5579170998860119\*fi\_3\_dot\*q33)/73786976294838206464 - (4537588927149065\*fi\_3\_dot\*q34)/18446744073709551616, fi\_3\_dot\*q33 - (5579170998860119\*fi\_3\_dot\*q32)/73786976294838206464 - (2600709427658073\*fi\_3\_dot\*q31)/36893488147419103232 - (5795726909949103\*fi\_3\_dot\*q34)/18446744073709551616, (9007199254722041\*fi\_3\_dot\*q34)/9007199254740992 - (4537588927149065\*fi\_3\_dot\*q32)/18446744073709551616 - (5795726909949103\*fi\_3\_dot\*q33)/18446744073709551616 - (8561737489858895\*fi\_3\_dot\*q31)/36893488147419103232];

C\_fr\_link1 =...

[ (1266427652570665\*theta\_1\_dot\*sin(fi\_1))/9007199254740992 - (5067133536030169\*theta\_1\_dot\*cos(fi\_1)\*sin(fi\_1))/9444732965739290427392 - (4503599627381703\*q11\*theta\_1\_dot\*sin(fi\_1)^2)/4503599627370496 + (7600980450084613\*q12\*theta\_1\_dot\*sin(fi\_1)^2)/147573952589676412928 + (2600709427658073\*q13\*theta\_1\_dot\*sin(fi\_1)^2)/36893488147419103232 + (8561737489858895\*q14\*theta\_1\_dot\*sin(fi\_1)^2)/36893488147419103232, 0, (7600980450084613\*fi\_1\_dot\*q12)/147573952589676412928 - (4503599627381703\*fi\_1\_dot\*q11)/4503599627370496 + (2600709427658073\*fi\_1\_dot\*q13)/36893488147419103232 + (8561737489858895\*fi\_1\_dot\*q14)/36893488147419103232;

 (7600980450084613\*q11\*theta\_1\_dot\*sin(fi\_1)^2)/147573952589676412928 - (3148167743914421\*theta\_1\_dot\*cos(fi\_1)\*sin(fi\_1))/295147905179352825856 - (5466165233750959\*theta\_1\_dot\*sin(fi\_1))/72057594037927936 - (4503599627362597\*q12\*theta\_1\_dot\*sin(fi\_1)^2)/4503599627370496 + (5579170998860119\*q13\*theta\_1\_dot\*sin(fi\_1)^2)/73786976294838206464 + (4537588927149065\*q14\*theta\_1\_dot\*sin(fi\_1)^2)/18446744073709551616, 0, (7600980450084613\*fi\_1\_dot\*q11)/147573952589676412928 - (4503599627362597\*fi\_1\_dot\*q12)/4503599627370496 + (5579170998860119\*fi\_1\_dot\*q13)/73786976294838206464 + (4537588927149065\*fi\_1\_dot\*q14)/18446744073709551616;

 (7580929533345111\*theta\_1\_dot\*sin(fi\_1))/144115188075855872 - (4639097744824433\*theta\_1\_dot\*cos(fi\_1)\*sin(fi\_1))/295147905179352825856 + (2600709427658073\*q11\*theta\_1\_dot\*sin(fi\_1)^2)/36893488147419103232 + (5579170998860119\*q12\*theta\_1\_dot\*sin(fi\_1)^2)/73786976294838206464 - q13\*theta\_1\_dot\*sin(fi\_1)^2 + (5795726909949103\*q14\*theta\_1\_dot\*sin(fi\_1)^2)/18446744073709551616, 0, (2600709427658073\*fi\_1\_dot\*q11)/36893488147419103232 + (5579170998860119\*fi\_1\_dot\*q12)/73786976294838206464 - fi\_1\_dot\*q13 + (5795726909949103\*fi\_1\_dot\*q14)/18446744073709551616;

 (8561737489858895\*q11\*theta\_1\_dot\*sin(fi\_1)^2)/36893488147419103232 - (3871657051539189\*theta\_1\_dot\*cos(fi\_1)\*sin(fi\_1))/73786976294838206464 - (5789705833529205\*theta\_1\_dot\*sin(fi\_1))/144115188075855872 + (4537588927149065\*q12\*theta\_1\_dot\*sin(fi\_1)^2)/18446744073709551616 + (5795726909949103\*q13\*theta\_1\_dot\*sin(fi\_1)^2)/18446744073709551616 - (9007199254722041\*q14\*theta\_1\_dot\*sin(fi\_1)^2)/9007199254740992, 0, (8561737489858895\*fi\_1\_dot\*q11)/36893488147419103232 + (4537588927149065\*fi\_1\_dot\*q12)/18446744073709551616 + (5795726909949103\*fi\_1\_dot\*q13)/18446744073709551616 - (9007199254722041\*fi\_1\_dot\*q14)/9007199254740992];

C\_fr\_link2 =...

[ (1266427652570665\*theta\_2\_dot\*sin(fi\_2))/9007199254740992 - (5067133536030169\*theta\_2\_dot\*cos(fi\_2)\*sin(fi\_2))/9444732965739290427392 - (4503599627381703\*q21\*theta\_2\_dot\*sin(fi\_2)^2)/4503599627370496 + (7600980450084613\*q22\*theta\_2\_dot\*sin(fi\_2)^2)/147573952589676412928 + (2600709427658073\*q23\*theta\_2\_dot\*sin(fi\_2)^2)/36893488147419103232 + (8561737489858895\*q24\*theta\_2\_dot\*sin(fi\_2)^2)/36893488147419103232, 0, (7600980450084613\*fi\_2\_dot\*q22)/147573952589676412928 - (4503599627381703\*fi\_2\_dot\*q21)/4503599627370496 + (2600709427658073\*fi\_2\_dot\*q23)/36893488147419103232 + (8561737489858895\*fi\_2\_dot\*q24)/36893488147419103232;

 (7600980450084613\*q21\*theta\_2\_dot\*sin(fi\_2)^2)/147573952589676412928 - (3148167743914421\*theta\_2\_dot\*cos(fi\_2)\*sin(fi\_2))/295147905179352825856 - (5466165233750959\*theta\_2\_dot\*sin(fi\_2))/72057594037927936 - (4503599627362597\*q22\*theta\_2\_dot\*sin(fi\_2)^2)/4503599627370496 + (5579170998860119\*q23\*theta\_2\_dot\*sin(fi\_2)^2)/73786976294838206464 + (4537588927149065\*q24\*theta\_2\_dot\*sin(fi\_2)^2)/18446744073709551616, 0, (7600980450084613\*fi\_2\_dot\*q21)/147573952589676412928 - (4503599627362597\*fi\_2\_dot\*q22)/4503599627370496 + (5579170998860119\*fi\_2\_dot\*q23)/73786976294838206464 + (4537588927149065\*fi\_2\_dot\*q24)/18446744073709551616;

 (7580929533345111\*theta\_2\_dot\*sin(fi\_2))/144115188075855872 - (4639097744824433\*theta\_2\_dot\*cos(fi\_2)\*sin(fi\_2))/295147905179352825856 + (2600709427658073\*q21\*theta\_2\_dot\*sin(fi\_2)^2)/36893488147419103232 + (5579170998860119\*q22\*theta\_2\_dot\*sin(fi\_2)^2)/73786976294838206464 - q23\*theta\_2\_dot\*sin(fi\_2)^2 + (5795726909949103\*q24\*theta\_2\_dot\*sin(fi\_2)^2)/18446744073709551616, 0, (2600709427658073\*fi\_2\_dot\*q21)/36893488147419103232 + (5579170998860119\*fi\_2\_dot\*q22)/73786976294838206464 - fi\_2\_dot\*q23 + (5795726909949103\*fi\_2\_dot\*q24)/18446744073709551616;

 (8561737489858895\*q21\*theta\_2\_dot\*sin(fi\_2)^2)/36893488147419103232 - (3871657051539189\*theta\_2\_dot\*cos(fi\_2)\*sin(fi\_2))/73786976294838206464 - (5789705833529205\*theta\_2\_dot\*sin(fi\_2))/144115188075855872 + (4537588927149065\*q22\*theta\_2\_dot\*sin(fi\_2)^2)/18446744073709551616 + (5795726909949103\*q23\*theta\_2\_dot\*sin(fi\_2)^2)/18446744073709551616 - (9007199254722041\*q24\*theta\_2\_dot\*sin(fi\_2)^2)/9007199254740992, 0, (8561737489858895\*fi\_2\_dot\*q21)/36893488147419103232 + (4537588927149065\*fi\_2\_dot\*q22)/18446744073709551616 + (5795726909949103\*fi\_2\_dot\*q23)/18446744073709551616 - (9007199254722041\*fi\_2\_dot\*q24)/9007199254740992];

C\_fr\_link3 =...

[ (1266427652570665\*theta\_3\_dot\*sin(fi\_3))/9007199254740992 - (5067133536030169\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/9444732965739290427392 - (4503599627381703\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/4503599627370496 + (7600980450084613\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/147573952589676412928 + (2600709427658073\*q33\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232 + (8561737489858895\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232, 0, (7600980450084613\*fi\_3\_dot\*q32)/147573952589676412928 - (4503599627381703\*fi\_3\_dot\*q31)/4503599627370496 + (2600709427658073\*fi\_3\_dot\*q33)/36893488147419103232 + (8561737489858895\*fi\_3\_dot\*q34)/36893488147419103232;

 (7600980450084613\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/147573952589676412928 - (3148167743914421\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/295147905179352825856 - (5466165233750959\*theta\_3\_dot\*sin(fi\_3))/72057594037927936 - (4503599627362597\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/4503599627370496 + (5579170998860119\*q33\*theta\_3\_dot\*sin(fi\_3)^2)/73786976294838206464 + (4537588927149065\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616, 0, (7600980450084613\*fi\_3\_dot\*q31)/147573952589676412928 - (4503599627362597\*fi\_3\_dot\*q32)/4503599627370496 + (5579170998860119\*fi\_3\_dot\*q33)/73786976294838206464 + (4537588927149065\*fi\_3\_dot\*q34)/18446744073709551616;

 (7580929533345111\*theta\_3\_dot\*sin(fi\_3))/144115188075855872 - (4639097744824433\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/295147905179352825856 + (2600709427658073\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232 + (5579170998860119\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/73786976294838206464 - q33\*theta\_3\_dot\*sin(fi\_3)^2 + (5795726909949103\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616, 0, (2600709427658073\*fi\_3\_dot\*q31)/36893488147419103232 + (5579170998860119\*fi\_3\_dot\*q32)/73786976294838206464 - fi\_3\_dot\*q33 + (5795726909949103\*fi\_3\_dot\*q34)/18446744073709551616;

 (8561737489858895\*q31\*theta\_3\_dot\*sin(fi\_3)^2)/36893488147419103232 - (3871657051539189\*theta\_3\_dot\*cos(fi\_3)\*sin(fi\_3))/73786976294838206464 - (5789705833529205\*theta\_3\_dot\*sin(fi\_3))/144115188075855872 + (4537588927149065\*q32\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616 + (5795726909949103\*q33\*theta\_3\_dot\*sin(fi\_3)^2)/18446744073709551616 - (9007199254722041\*q34\*theta\_3\_dot\*sin(fi\_3)^2)/9007199254740992, 0, (8561737489858895\*fi\_3\_dot\*q31)/36893488147419103232 + (4537588927149065\*fi\_3\_dot\*q32)/18446744073709551616 + (5795726909949103\*fi\_3\_dot\*q33)/18446744073709551616 - (9007199254722041\*fi\_3\_dot\*q34)/9007199254740992];

C\_ff\_link1 =...

[ 0, 0, 0, 0;

 0, 0, 0, 0;

 0, 0, 0, 0;

 0, 0, 0, 0];

C\_ff\_link2 =...

[ 0, 0, 0, 0;

 0, 0, 0, 0;

 0, 0, 0, 0;

 0, 0, 0, 0];

C\_ff\_link3 =...

[ 0, 0, 0, 0;

 0, 0, 0, 0;

 0, 0, 0, 0;

 0, 0, 0, 0];

G\_link1 =...

[

 0;

 15919584154691433/175921860444160;

 5.9533579114364651586302525603035\*q12\*sin(fi\_1) - 11.034422506133823198791357673708\*q11\*sin(fi\_1) - 6.7869269264625554427539100288413\*cos(fi\_1) - 4.1283042940884776040762861971715\*q13\*sin(fi\_1) + 3.1528676462345419592301403070061\*q14\*sin(fi\_1);

 11.03442250613382185166332262937\*cos(fi\_1);

 -5.9533579114364644318196432428751\*cos(fi\_1);

 4.1283042940884771000757869713114\*cos(fi\_1);

 -3.1528676462345415743149900428392\*cos(fi\_1)];

G\_link2 =...

[

 0;

 15919584154691433/175921860444160;

 5.9533579114364651586302525603035\*q22\*sin(fi\_2) - 11.034422506133823198791357673708\*q21\*sin(fi\_2) - 6.7869269264625554427539100288413\*cos(fi\_2) - 4.1283042940884776040762861971715\*q23\*sin(fi\_2) + 3.1528676462345419592301403070061\*q24\*sin(fi\_2);

 11.03442250613382185166332262937\*cos(fi\_2);

 -5.9533579114364644318196432428751\*cos(fi\_2);

 4.1283042940884771000757869713114\*cos(fi\_2);

 -3.1528676462345415743149900428392\*cos(fi\_2)];

G\_link3 =...

[

 0;

 15919584154691433/175921860444160;

 5.9533579114364651586302525603035\*q32\*sin(fi\_3) - 11.034422506133823198791357673708\*q31\*sin(fi\_3) - 6.7869269264625554427539100288413\*cos(fi\_3) - 4.1283042940884776040762861971715\*q33\*sin(fi\_3) + 3.1528676462345419592301403070061\*q34\*sin(fi\_3);

 11.03442250613382185166332262937\*cos(fi\_3);

 -5.9533579114364644318196432428751\*cos(fi\_3);

 4.1283042940884771000757869713114\*cos(fi\_3);

 -3.1528676462345415743149900428392\*cos(fi\_3)];

K\_link1 =...

[ 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 7496350145.4271816776958478158589, -386108.86204741519490507668714839, -528435.49024934801931208303364695, -1739650.6890483117028522301203959;

 0, 0, 0, -4054638.7826837453566311125586107, 78721301207.441472741718181524707, -5952264.5152839011125954665374164, -19364116.684383915108683005121034;

 0, 0, 0, -24156182.215079305020727489433295, -25910520.764888397381108891007517, 342677968080.99004098437727662814, -107664957.73550587809310344791337;

 0, 0, 0, -232514792.65999703170471229728365, -246458513.78228871833741562294691, -314794103.97176066339533072459074, 1001932348106.1950191362300107951];

K\_link2 =...

[ 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 7496350145.4271816776958478158589, -386108.86204741519490507668714839, -528435.49024934801931208303364695, -1739650.6890483117028522301203959;

 0, 0, 0, -4054638.7826837453566311125586107, 78721301207.441472741718181524707, -5952264.5152839011125954665374164, -19364116.684383915108683005121034;

 0, 0, 0, -24156182.215079305020727489433295, -25910520.764888397381108891007517, 342677968080.99004098437727662814, -107664957.73550587809310344791337;

 0, 0, 0, -232514792.65999703170471229728365, -246458513.78228871833741562294691, -314794103.97176066339533072459074, 1001932348106.1950191362300107951];

K\_link3 =...

[ 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 0, 0, 0, 0;

 0, 0, 0, 7496350145.4271816776958478158589, -386108.86204741519490507668714839, -528435.49024934801931208303364695, -1739650.6890483117028522301203959;

 0, 0, 0, -4054638.7826837453566311125586107, 78721301207.441472741718181524707, -5952264.5152839011125954665374164, -19364116.684383915108683005121034;

 0, 0, 0, -24156182.215079305020727489433295, -25910520.764888397381108891007517, 342677968080.99004098437727662814, -107664957.73550587809310344791337;

 0, 0, 0, -232514792.65999703170471229728365, -246458513.78228871833741562294691, -314794103.97176066339533072459074, 1001932348106.1950191362300107951];

M\_link1=[M\_rr\_link1 M\_rf\_link1;

 M\_fr\_link1 M\_ff\_link1];

M\_link2=[M\_rr\_link2 M\_rf\_link2;

 M\_fr\_link2 M\_ff\_link2];

M\_link3=[M\_rr\_link3 M\_rf\_link3;

 M\_fr\_link3 M\_ff\_link3];

C\_link1=[C\_rr\_link1 C\_rf\_link1;

 C\_fr\_link1 C\_ff\_link1];

C\_link2=[C\_rr\_link2 C\_rf\_link2;

 C\_fr\_link2 C\_ff\_link2];

C\_link3=[C\_rr\_link3 C\_rf\_link3;

 C\_fr\_link3 C\_ff\_link3];

%% setting up the dynamics of the whole RmMT

M=[M\_link1+M234\_1 zeros(7,7) zeros(7,7) zeros(7,6);

 zeros(7,7) M\_link2+M234\_2 zeros(7,7) zeros(7,6);

 zeros(7,7) zeros(7,7) M\_link3+M234\_3 zeros(7,6);

 zeros(6,7) zeros(6,7) zeros(6,7) M\_pfsp];

Q\_dot\_dot=[qt1\_dot\_dot;qt2\_dot\_dot;qt3\_dot\_dot;Ze\_dot\_dot];

C=[C\_link1+C234\_1 zeros(7,7) zeros(7,7) zeros(7,6);

 zeros(7,7) C\_link2+C234\_2 zeros(7,7) zeros(7,6);

 zeros(7,7) zeros(7,7) C\_link3+C234\_3 zeros(7,6);

 zeros(6,7) zeros(6,7) zeros(6,7) C\_pfsp];

Q\_dot=[qt1\_dot;qt2\_dot;qt3\_dot;Ze\_dot];

K=[K\_link1+K234\_1 zeros(7,7) zeros(7,7) zeros(7,6);

 zeros(7,7) K\_link2+K234\_2 zeros(7,7) zeros(7,6);

 zeros(7,7) zeros(7,7) K\_link3+K234\_3 zeros(7,6);

 zeros(6,7) zeros(6,7) zeros(6,7) K\_pfsp];

Q=[qt1;qt2;qt3;Ze];

G=[G\_link1+G234\_1;

 G\_link2+G234\_2;

 G\_link3+G234\_3;

 G\_pfsp];

%% constraint equations

const =[

 (sin(a)\*sin(c))/100 - xe - sin(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000) - (cos(a)\*sin(b))/50 + cos(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8) - (cos(a)\*cos(b)\*cos(c))/100;

 sin(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8) - (sin(a)\*sin(b))/50 - ye + cos(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000) - (cos(a)\*sin(c))/100 - (cos(b)\*cos(c)\*sin(a))/100;

 d\_1 - ze - cos(b)/50 - (3\*sin(fi\_1))/20 - cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) + (cos(c)\*sin(b))/100;

 (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 - (sin(a)\*sin(c))/200 - sin(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000) - xe - (cos(a)\*sin(b))/50 + cos(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8) + (cos(a)\*cos(b)\*cos(c))/200;

 sin(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8) - (sin(a)\*sin(b))/50 - ye + cos(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000) - (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 + (cos(a)\*sin(c))/200 + (cos(b)\*cos(c)\*sin(a))/200;

 d\_2 - ze - cos(b)/50 - (3\*sin(fi\_2))/20 - cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (cos(c)\*sin(b))/200 - (3^(1/2)\*sin(b)\*sin(c))/200;

 cos(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8) - (sin(a)\*sin(c))/200 - sin(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000) - (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 - (cos(a)\*sin(b))/50 - xe + (cos(a)\*cos(b)\*cos(c))/200;

 sin(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8) - (sin(a)\*sin(b))/50 - ye + cos(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000) + (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 + (cos(a)\*sin(c))/200 + (cos(b)\*cos(c)\*sin(a))/200;

 d\_3 - ze - cos(b)/50 - (3\*sin(fi\_3))/20 - cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (cos(c)\*sin(b))/200 + (3^(1/2)\*sin(b)\*sin(c))/200];

const\_QT =...

[ - sin(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8) - cos(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000), cos(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8) - sin(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000), 0, 0, 0, 0, 0, 0, 0;

 0, 0, 1, 0, 0, 0, 0, 0, 0;

 cos(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)), sin(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)), sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20, 0, 0, 0, 0, 0, 0;

 -(1317\*sin(theta\_1))/2000, (1317\*cos(theta\_1))/2000, 0, 0, 0, 0, 0, 0, 0;

 (1647\*cos(theta\_1)\*sin(fi\_1))/2500, (1647\*sin(fi\_1)\*sin(theta\_1))/2500, -(1647\*cos(fi\_1))/2500, 0, 0, 0, 0, 0, 0;

 (6581\*sin(theta\_1))/10000, -(6581\*cos(theta\_1))/10000, 0, 0, 0, 0, 0, 0, 0;

 (6581\*cos(theta\_1)\*sin(fi\_1))/10000, (6581\*sin(fi\_1)\*sin(theta\_1))/10000, -(6581\*cos(fi\_1))/10000, 0, 0, 0, 0, 0, 0;

 0, 0, 0, - sin(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8) - cos(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000), cos(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8) - sin(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000), 0, 0, 0, 0;

 0, 0, 0, 0, 0, 1, 0, 0, 0;

 0, 0, 0, cos(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)), sin(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)), sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20, 0, 0, 0;

 0, 0, 0, -(1317\*sin(theta\_2))/2000, (1317\*cos(theta\_2))/2000, 0, 0, 0, 0;

 0, 0, 0, (1647\*cos(theta\_2)\*sin(fi\_2))/2500, (1647\*sin(fi\_2)\*sin(theta\_2))/2500, -(1647\*cos(fi\_2))/2500, 0, 0, 0;

 0, 0, 0, (6581\*sin(theta\_2))/10000, -(6581\*cos(theta\_2))/10000, 0, 0, 0, 0;

 0, 0, 0, (6581\*cos(theta\_2)\*sin(fi\_2))/10000, (6581\*sin(fi\_2)\*sin(theta\_2))/10000, -(6581\*cos(fi\_2))/10000, 0, 0, 0;

 0, 0, 0, 0, 0, 0, - sin(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8) - cos(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000), cos(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8) - sin(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000), 0;

 0, 0, 0, 0, 0, 0, 0, 0, 1;

 0, 0, 0, 0, 0, 0, cos(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)), sin(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)), sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20;

 0, 0, 0, 0, 0, 0, -(1317\*sin(theta\_3))/2000, (1317\*cos(theta\_3))/2000, 0;

 0, 0, 0, 0, 0, 0, (1647\*cos(theta\_3)\*sin(fi\_3))/2500, (1647\*sin(fi\_3)\*sin(theta\_3))/2500, -(1647\*cos(fi\_3))/2500;

 0, 0, 0, 0, 0, 0, (6581\*sin(theta\_3))/10000, -(6581\*cos(theta\_3))/10000, 0;

 0, 0, 0, 0, 0, 0, (6581\*cos(theta\_3)\*sin(fi\_3))/10000, (6581\*sin(fi\_3)\*sin(theta\_3))/10000, -(6581\*cos(fi\_3))/10000;

 -1, 0, 0, -1, 0, 0, -1, 0, 0;

 0, -1, 0, 0, -1, 0, 0, -1, 0;

 0, 0, -1, 0, 0, -1, 0, 0, -1;

 (sin(a)\*sin(b))/50 + (cos(a)\*sin(c))/100 + (cos(b)\*cos(c)\*sin(a))/100, (sin(a)\*sin(c))/100 - (cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/100, 0, (sin(a)\*sin(b))/50 + (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (cos(a)\*sin(c))/200 - (cos(b)\*cos(c)\*sin(a))/200, (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 - (sin(a)\*sin(c))/200 - (cos(a)\*sin(b))/50 + (cos(a)\*cos(b)\*cos(c))/200, 0, (sin(a)\*sin(b))/50 - (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (cos(a)\*sin(c))/200 - (cos(b)\*cos(c)\*sin(a))/200, (cos(a)\*cos(b)\*cos(c))/200 - (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 - (cos(a)\*sin(b))/50 - (sin(a)\*sin(c))/200, 0;

 (cos(a)\*cos(c)\*sin(b))/100 - (cos(a)\*cos(b))/50, (cos(c)\*sin(a)\*sin(b))/100 - (cos(b)\*sin(a))/50, sin(b)/50 + (cos(b)\*cos(c))/100, - (cos(a)\*cos(b))/50 - (cos(a)\*cos(c)\*sin(b))/200 - (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200, - (cos(b)\*sin(a))/50 - (cos(c)\*sin(a)\*sin(b))/200 - (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200, sin(b)/50 - (cos(b)\*cos(c))/200 - (3^(1/2)\*cos(b)\*sin(c))/200, (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200 - (cos(a)\*cos(c)\*sin(b))/200 - (cos(a)\*cos(b))/50, (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200 - (cos(c)\*sin(a)\*sin(b))/200 - (cos(b)\*sin(a))/50, sin(b)/50 - (cos(b)\*cos(c))/200 + (3^(1/2)\*cos(b)\*sin(c))/200;

 (cos(c)\*sin(a))/100 + (cos(a)\*cos(b)\*sin(c))/100, (cos(b)\*sin(a)\*sin(c))/100 - (cos(a)\*cos(c))/100, -(sin(b)\*sin(c))/100, - (3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 - (cos(c)\*sin(a))/200 - (cos(a)\*cos(b)\*sin(c))/200, (3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 + (cos(a)\*cos(c))/200 - (cos(b)\*sin(a)\*sin(c))/200, (sin(b)\*sin(c))/200 - (3^(1/2)\*cos(c)\*sin(b))/200, (3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 - (cos(c)\*sin(a))/200 - (cos(a)\*cos(b)\*sin(c))/200, (cos(a)\*cos(c))/200 - (3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 - (cos(b)\*sin(a)\*sin(c))/200, (sin(b)\*sin(c))/200 + (3^(1/2)\*cos(c)\*sin(b))/200];

const\_dot =...

[

 (6581\*q13\_dot\*sin(theta\_1))/10000 - theta\_1\_dot\*(sin(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8) + cos(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000)) - (1317\*q11\_dot\*sin(theta\_1))/2000 - xe\_dot - b\_dot\*((cos(a)\*cos(b))/50 - (cos(a)\*cos(c)\*sin(b))/100) + c\_dot\*((cos(c)\*sin(a))/100 + (cos(a)\*cos(b)\*sin(c))/100) + a\_dot\*((sin(a)\*sin(b))/50 + (cos(a)\*sin(c))/100 + (cos(b)\*cos(c)\*sin(a))/100) + fi\_1\_dot\*cos(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\*cos(theta\_1)\*sin(fi\_1))/2500 + (6581\*q14\_dot\*cos(theta\_1)\*sin(fi\_1))/10000;

 (1317\*q11\_dot\*cos(theta\_1))/2000 - theta\_1\_dot\*(sin(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000) - cos(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8)) - ye\_dot - (6581\*q13\_dot\*cos(theta\_1))/10000 - a\_dot\*((cos(a)\*sin(b))/50 - (sin(a)\*sin(c))/100 + (cos(a)\*cos(b)\*cos(c))/100) - c\_dot\*((cos(a)\*cos(c))/100 - (cos(b)\*sin(a)\*sin(c))/100) - b\_dot\*((cos(b)\*sin(a))/50 - (cos(c)\*sin(a)\*sin(b))/100) + fi\_1\_dot\*sin(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\*sin(fi\_1)\*sin(theta\_1))/2500 + (6581\*q14\_dot\*sin(fi\_1)\*sin(theta\_1))/10000;

 d\_1\_dot - ze\_dot + b\_dot\*(sin(b)/50 + (cos(b)\*cos(c))/100) - fi\_1\_dot\*((3\*cos(fi\_1))/20 - sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) - (1647\*q12\_dot\*cos(fi\_1))/2500 - (6581\*q14\_dot\*cos(fi\_1))/10000 - (c\_dot\*sin(b)\*sin(c))/100;

 (6581\*q23\_dot\*sin(theta\_2))/10000 - theta\_2\_dot\*(sin(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8) + cos(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000)) - c\_dot\*((3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(c)\*sin(a))/200 + (cos(a)\*cos(b)\*sin(c))/200) - (1317\*q21\_dot\*sin(theta\_2))/2000 - xe\_dot + a\_dot\*((sin(a)\*sin(b))/50 + (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (cos(a)\*sin(c))/200 - (cos(b)\*cos(c)\*sin(a))/200) - b\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 + (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200) + fi\_2\_dot\*cos(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\*cos(theta\_2)\*sin(fi\_2))/2500 + (6581\*q24\_dot\*cos(theta\_2)\*sin(fi\_2))/10000;

 (1317\*q21\_dot\*cos(theta\_2))/2000 - b\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 + (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) - theta\_2\_dot\*(sin(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000) - cos(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8)) - ye\_dot - (6581\*q23\_dot\*cos(theta\_2))/10000 - a\_dot\*((sin(a)\*sin(c))/200 - (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 + (cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/200) + c\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 + (cos(a)\*cos(c))/200 - (cos(b)\*sin(a)\*sin(c))/200) + fi\_2\_dot\*sin(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\*sin(fi\_2)\*sin(theta\_2))/2500 + (6581\*q24\_dot\*sin(fi\_2)\*sin(theta\_2))/10000;

 d\_2\_dot - ze\_dot + c\_dot\*((sin(b)\*sin(c))/200 - (3^(1/2)\*cos(c)\*sin(b))/200) - fi\_2\_dot\*((3\*cos(fi\_2))/20 - sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) - (1647\*q22\_dot\*cos(fi\_2))/2500 - (6581\*q24\_dot\*cos(fi\_2))/10000 - b\_dot\*((cos(b)\*cos(c))/200 - sin(b)/50 + (3^(1/2)\*cos(b)\*sin(c))/200);

 (6581\*q33\_dot\*sin(theta\_3))/10000 - theta\_3\_dot\*(sin(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8) + cos(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000)) - c\_dot\*((cos(c)\*sin(a))/200 - (3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(a)\*cos(b)\*sin(c))/200) - (1317\*q31\_dot\*sin(theta\_3))/2000 - xe\_dot - a\_dot\*((3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (sin(a)\*sin(b))/50 + (cos(a)\*sin(c))/200 + (cos(b)\*cos(c)\*sin(a))/200) - b\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 - (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200) + fi\_3\_dot\*cos(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\*cos(theta\_3)\*sin(fi\_3))/2500 + (6581\*q34\_dot\*cos(theta\_3)\*sin(fi\_3))/10000;

 (1317\*q31\_dot\*cos(theta\_3))/2000 - b\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 - (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) - theta\_3\_dot\*(sin(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000) - cos(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8)) - ye\_dot - (6581\*q33\_dot\*cos(theta\_3))/10000 - a\_dot\*((sin(a)\*sin(c))/200 + (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 + (cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/200) - c\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 - (cos(a)\*cos(c))/200 + (cos(b)\*sin(a)\*sin(c))/200) + fi\_3\_dot\*sin(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\*sin(fi\_3)\*sin(theta\_3))/2500 + (6581\*q34\_dot\*sin(fi\_3)\*sin(theta\_3))/10000;

 d\_3\_dot - ze\_dot + c\_dot\*((sin(b)\*sin(c))/200 + (3^(1/2)\*cos(c)\*sin(b))/200) - fi\_3\_dot\*((3\*cos(fi\_3))/20 - sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) - (1647\*q32\_dot\*cos(fi\_3))/2500 - (6581\*q34\_dot\*cos(fi\_3))/10000 + b\_dot\*(sin(b)/50 - (cos(b)\*cos(c))/200 + (3^(1/2)\*cos(b)\*sin(c))/200)];

const\_dot\_dot =...

[

 b\_dot\*(b\_dot\*((cos(a)\*sin(b))/50 + (cos(a)\*cos(b)\*cos(c))/100) + a\_dot\*((cos(b)\*sin(a))/50 - (cos(c)\*sin(a)\*sin(b))/100) - (c\_dot\*cos(a)\*sin(b)\*sin(c))/100) - xe\_dot\_dot - c\_dot\*(c\_dot\*((sin(a)\*sin(c))/100 - (cos(a)\*cos(b)\*cos(c))/100) - a\_dot\*((cos(a)\*cos(c))/100 - (cos(b)\*sin(a)\*sin(c))/100) + (b\_dot\*cos(a)\*sin(b)\*sin(c))/100) + q12\_dot\*((1647\*fi\_1\_dot\*cos(fi\_1)\*cos(theta\_1))/2500 - (1647\*theta\_1\_dot\*sin(fi\_1)\*sin(theta\_1))/2500) + q14\_dot\*((6581\*fi\_1\_dot\*cos(fi\_1)\*cos(theta\_1))/10000 - (6581\*theta\_1\_dot\*sin(fi\_1)\*sin(theta\_1))/10000) - theta\_1\_dot\_dot\*(sin(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8) + cos(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000)) - theta\_1\_dot\*((1317\*q11\_dot\*cos(theta\_1))/2000 - theta\_1\_dot\*(sin(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000) - cos(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8)) - (6581\*q13\_dot\*cos(theta\_1))/10000 + fi\_1\_dot\*sin(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\*sin(fi\_1)\*sin(theta\_1))/2500 + (6581\*q14\_dot\*sin(fi\_1)\*sin(theta\_1))/10000) - (1317\*q11\_dot\_dot\*sin(theta\_1))/2000 + (6581\*q13\_dot\_dot\*sin(theta\_1))/10000 + a\_dot\*(a\_dot\*((cos(a)\*sin(b))/50 - (sin(a)\*sin(c))/100 + (cos(a)\*cos(b)\*cos(c))/100) + c\_dot\*((cos(a)\*cos(c))/100 - (cos(b)\*sin(a)\*sin(c))/100) + b\_dot\*((cos(b)\*sin(a))/50 - (cos(c)\*sin(a)\*sin(b))/100)) - b\_dot\_dot\*((cos(a)\*cos(b))/50 - (cos(a)\*cos(c)\*sin(b))/100) + c\_dot\_dot\*((cos(c)\*sin(a))/100 + (cos(a)\*cos(b)\*sin(c))/100) + a\_dot\_dot\*((sin(a)\*sin(b))/50 + (cos(a)\*sin(c))/100 + (cos(b)\*cos(c)\*sin(a))/100) + fi\_1\_dot\*(fi\_1\_dot\*cos(theta\_1)\*((3\*cos(fi\_1))/20 - sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\*cos(fi\_1)\*cos(theta\_1))/2500 + (6581\*q14\_dot\*cos(fi\_1)\*cos(theta\_1))/10000 - theta\_1\_dot\*sin(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000))) - (1317\*q11\_dot\*theta\_1\_dot\*cos(theta\_1))/2000 + (6581\*q13\_dot\*theta\_1\_dot\*cos(theta\_1))/10000 + fi\_1\_dot\_dot\*cos(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\_dot\*cos(theta\_1)\*sin(fi\_1))/2500 + (6581\*q14\_dot\_dot\*cos(theta\_1)\*sin(fi\_1))/10000;

 fi\_1\_dot\*(theta\_1\_dot\*cos(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + fi\_1\_dot\*sin(theta\_1)\*((3\*cos(fi\_1))/20 - sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\*cos(fi\_1)\*sin(theta\_1))/2500 + (6581\*q14\_dot\*cos(fi\_1)\*sin(theta\_1))/10000) - ye\_dot\_dot - b\_dot\*(a\_dot\*((cos(a)\*cos(b))/50 - (cos(a)\*cos(c)\*sin(b))/100) - b\_dot\*((sin(a)\*sin(b))/50 + (cos(b)\*cos(c)\*sin(a))/100) + (c\_dot\*sin(a)\*sin(b)\*sin(c))/100) + c\_dot\*(a\_dot\*((cos(c)\*sin(a))/100 + (cos(a)\*cos(b)\*sin(c))/100) + c\_dot\*((cos(a)\*sin(c))/100 + (cos(b)\*cos(c)\*sin(a))/100) - (b\_dot\*sin(a)\*sin(b)\*sin(c))/100) + q12\_dot\*((1647\*fi\_1\_dot\*cos(fi\_1)\*sin(theta\_1))/2500 + (1647\*theta\_1\_dot\*cos(theta\_1)\*sin(fi\_1))/2500) + q14\_dot\*((6581\*fi\_1\_dot\*cos(fi\_1)\*sin(theta\_1))/10000 + (6581\*theta\_1\_dot\*cos(theta\_1)\*sin(fi\_1))/10000) - theta\_1\_dot\_dot\*(sin(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000) - cos(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8)) + theta\_1\_dot\*((6581\*q13\_dot\*sin(theta\_1))/10000 - (1317\*q11\_dot\*sin(theta\_1))/2000 - theta\_1\_dot\*(sin(theta\_1)\*(sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000) - (3\*cos(fi\_1))/20 + 1/8) + cos(theta\_1)\*((1317\*q11)/2000 - (6581\*q13)/10000)) + fi\_1\_dot\*cos(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\*cos(theta\_1)\*sin(fi\_1))/2500 + (6581\*q14\_dot\*cos(theta\_1)\*sin(fi\_1))/10000) + (1317\*q11\_dot\_dot\*cos(theta\_1))/2000 - (6581\*q13\_dot\_dot\*cos(theta\_1))/10000 + a\_dot\*(c\_dot\*((cos(c)\*sin(a))/100 + (cos(a)\*cos(b)\*sin(c))/100) - b\_dot\*((cos(a)\*cos(b))/50 - (cos(a)\*cos(c)\*sin(b))/100) + a\_dot\*((sin(a)\*sin(b))/50 + (cos(a)\*sin(c))/100 + (cos(b)\*cos(c)\*sin(a))/100)) - a\_dot\_dot\*((cos(a)\*sin(b))/50 - (sin(a)\*sin(c))/100 + (cos(a)\*cos(b)\*cos(c))/100) - c\_dot\_dot\*((cos(a)\*cos(c))/100 - (cos(b)\*sin(a)\*sin(c))/100) - b\_dot\_dot\*((cos(b)\*sin(a))/50 - (cos(c)\*sin(a)\*sin(b))/100) - (1317\*q11\_dot\*theta\_1\_dot\*sin(theta\_1))/2000 + (6581\*q13\_dot\*theta\_1\_dot\*sin(theta\_1))/10000 + fi\_1\_dot\_dot\*sin(theta\_1)\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\_dot\*sin(fi\_1)\*sin(theta\_1))/2500 + (6581\*q14\_dot\_dot\*sin(fi\_1)\*sin(theta\_1))/10000;

 d\_1\_dot\_dot - ze\_dot\_dot + fi\_1\_dot\*(fi\_1\_dot\*((3\*sin(fi\_1))/20 + cos(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) + (1647\*q12\_dot\*sin(fi\_1))/2500 + (6581\*q14\_dot\*sin(fi\_1))/10000) + b\_dot\_dot\*(sin(b)/50 + (cos(b)\*cos(c))/100) - fi\_1\_dot\_dot\*((3\*cos(fi\_1))/20 - sin(fi\_1)\*((1647\*q12)/2500 + (6581\*q14)/10000)) - (1647\*q12\_dot\_dot\*cos(fi\_1))/2500 - (6581\*q14\_dot\_dot\*cos(fi\_1))/10000 + b\_dot\*(b\_dot\*(cos(b)/50 - (cos(c)\*sin(b))/100) - (c\_dot\*cos(b)\*sin(c))/100) - c\_dot\*((b\_dot\*cos(b)\*sin(c))/100 + (c\_dot\*cos(c)\*sin(b))/100) + (1647\*fi\_1\_dot\*q12\_dot\*sin(fi\_1))/2500 + (6581\*fi\_1\_dot\*q14\_dot\*sin(fi\_1))/10000 - (c\_dot\_dot\*sin(b)\*sin(c))/100;

 q22\_dot\*((1647\*fi\_2\_dot\*cos(fi\_2)\*cos(theta\_2))/2500 - (1647\*theta\_2\_dot\*sin(fi\_2)\*sin(theta\_2))/2500) - xe\_dot\_dot + q24\_dot\*((6581\*fi\_2\_dot\*cos(fi\_2)\*cos(theta\_2))/10000 - (6581\*theta\_2\_dot\*sin(fi\_2)\*sin(theta\_2))/10000) + b\_dot\*(c\_dot\*((cos(a)\*sin(b)\*sin(c))/200 - (3^(1/2)\*cos(a)\*cos(c)\*sin(b))/200) + a\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 + (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) - b\_dot\*((cos(a)\*cos(b)\*cos(c))/200 - (cos(a)\*sin(b))/50 + (3^(1/2)\*cos(a)\*cos(b)\*sin(c))/200)) - theta\_2\_dot\_dot\*(sin(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8) + cos(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000)) - theta\_2\_dot\*((1317\*q21\_dot\*cos(theta\_2))/2000 - theta\_2\_dot\*(sin(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000) - cos(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8)) - (6581\*q23\_dot\*cos(theta\_2))/10000 + fi\_2\_dot\*sin(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\*sin(fi\_2)\*sin(theta\_2))/2500 + (6581\*q24\_dot\*sin(fi\_2)\*sin(theta\_2))/10000) - c\_dot\*(a\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 + (cos(a)\*cos(c))/200 - (cos(b)\*sin(a)\*sin(c))/200) - b\_dot\*((cos(a)\*sin(b)\*sin(c))/200 - (3^(1/2)\*cos(a)\*cos(c)\*sin(b))/200) + c\_dot\*((3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 - (sin(a)\*sin(c))/200 + (cos(a)\*cos(b)\*cos(c))/200)) + a\_dot\*(b\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 + (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) + a\_dot\*((sin(a)\*sin(c))/200 - (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 + (cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/200) - c\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 + (cos(a)\*cos(c))/200 - (cos(b)\*sin(a)\*sin(c))/200)) - c\_dot\_dot\*((3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(c)\*sin(a))/200 + (cos(a)\*cos(b)\*sin(c))/200) - (1317\*q21\_dot\_dot\*sin(theta\_2))/2000 + (6581\*q23\_dot\_dot\*sin(theta\_2))/10000 + a\_dot\_dot\*((sin(a)\*sin(b))/50 + (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (cos(a)\*sin(c))/200 - (cos(b)\*cos(c)\*sin(a))/200) + fi\_2\_dot\*(fi\_2\_dot\*cos(theta\_2)\*((3\*cos(fi\_2))/20 - sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\*cos(fi\_2)\*cos(theta\_2))/2500 + (6581\*q24\_dot\*cos(fi\_2)\*cos(theta\_2))/10000 - theta\_2\_dot\*sin(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000))) - b\_dot\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 + (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200) - (1317\*q21\_dot\*theta\_2\_dot\*cos(theta\_2))/2000 + (6581\*q23\_dot\*theta\_2\_dot\*cos(theta\_2))/10000 + fi\_2\_dot\_dot\*cos(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\_dot\*cos(theta\_2)\*sin(fi\_2))/2500 + (6581\*q24\_dot\_dot\*cos(theta\_2)\*sin(fi\_2))/10000;

 fi\_2\_dot\*(theta\_2\_dot\*cos(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + fi\_2\_dot\*sin(theta\_2)\*((3\*cos(fi\_2))/20 - sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\*cos(fi\_2)\*sin(theta\_2))/2500 + (6581\*q24\_dot\*cos(fi\_2)\*sin(theta\_2))/10000) - ye\_dot\_dot - b\_dot\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 + (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) + q22\_dot\*((1647\*fi\_2\_dot\*cos(fi\_2)\*sin(theta\_2))/2500 + (1647\*theta\_2\_dot\*cos(theta\_2)\*sin(fi\_2))/2500) + q24\_dot\*((6581\*fi\_2\_dot\*cos(fi\_2)\*sin(theta\_2))/10000 + (6581\*theta\_2\_dot\*cos(theta\_2)\*sin(fi\_2))/10000) - b\_dot\*(b\_dot\*((cos(b)\*cos(c)\*sin(a))/200 - (sin(a)\*sin(b))/50 + (3^(1/2)\*cos(b)\*sin(a)\*sin(c))/200) - c\_dot\*((sin(a)\*sin(b)\*sin(c))/200 - (3^(1/2)\*cos(c)\*sin(a)\*sin(b))/200) + a\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 + (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200)) - theta\_2\_dot\_dot\*(sin(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000) - cos(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8)) + theta\_2\_dot\*((6581\*q23\_dot\*sin(theta\_2))/10000 - (1317\*q21\_dot\*sin(theta\_2))/2000 - theta\_2\_dot\*(sin(theta\_2)\*(sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000) - (3\*cos(fi\_2))/20 + 1/8) + cos(theta\_2)\*((1317\*q21)/2000 - (6581\*q23)/10000)) + fi\_2\_dot\*cos(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\*cos(theta\_2)\*sin(fi\_2))/2500 + (6581\*q24\_dot\*cos(theta\_2)\*sin(fi\_2))/10000) - a\_dot\*(c\_dot\*((3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(c)\*sin(a))/200 + (cos(a)\*cos(b)\*sin(c))/200) - a\_dot\*((sin(a)\*sin(b))/50 + (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (cos(a)\*sin(c))/200 - (cos(b)\*cos(c)\*sin(a))/200) + b\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 + (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200)) + (1317\*q21\_dot\_dot\*cos(theta\_2))/2000 - (6581\*q23\_dot\_dot\*cos(theta\_2))/10000 - a\_dot\_dot\*((sin(a)\*sin(c))/200 - (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 + (cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/200) + c\_dot\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 + (cos(a)\*cos(c))/200 - (cos(b)\*sin(a)\*sin(c))/200) - c\_dot\*(a\_dot\*((3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(c)\*sin(a))/200 + (cos(a)\*cos(b)\*sin(c))/200) - b\_dot\*((sin(a)\*sin(b)\*sin(c))/200 - (3^(1/2)\*cos(c)\*sin(a)\*sin(b))/200) + c\_dot\*((cos(a)\*sin(c))/200 - (3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 + (cos(b)\*cos(c)\*sin(a))/200)) - (1317\*q21\_dot\*theta\_2\_dot\*sin(theta\_2))/2000 + (6581\*q23\_dot\*theta\_2\_dot\*sin(theta\_2))/10000 + fi\_2\_dot\_dot\*sin(theta\_2)\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\_dot\*sin(fi\_2)\*sin(theta\_2))/2500 + (6581\*q24\_dot\_dot\*sin(fi\_2)\*sin(theta\_2))/10000;

 d\_2\_dot\_dot - ze\_dot\_dot + fi\_2\_dot\*(fi\_2\_dot\*((3\*sin(fi\_2))/20 + cos(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) + (1647\*q22\_dot\*sin(fi\_2))/2500 + (6581\*q24\_dot\*sin(fi\_2))/10000) + c\_dot\*(b\_dot\*((cos(b)\*sin(c))/200 - (3^(1/2)\*cos(b)\*cos(c))/200) + c\_dot\*((cos(c)\*sin(b))/200 + (3^(1/2)\*sin(b)\*sin(c))/200)) + b\_dot\*(c\_dot\*((cos(b)\*sin(c))/200 - (3^(1/2)\*cos(b)\*cos(c))/200) + b\_dot\*(cos(b)/50 + (cos(c)\*sin(b))/200 + (3^(1/2)\*sin(b)\*sin(c))/200)) + c\_dot\_dot\*((sin(b)\*sin(c))/200 - (3^(1/2)\*cos(c)\*sin(b))/200) - fi\_2\_dot\_dot\*((3\*cos(fi\_2))/20 - sin(fi\_2)\*((1647\*q22)/2500 + (6581\*q24)/10000)) - (1647\*q22\_dot\_dot\*cos(fi\_2))/2500 - (6581\*q24\_dot\_dot\*cos(fi\_2))/10000 - b\_dot\_dot\*((cos(b)\*cos(c))/200 - sin(b)/50 + (3^(1/2)\*cos(b)\*sin(c))/200) + (1647\*fi\_2\_dot\*q22\_dot\*sin(fi\_2))/2500 + (6581\*fi\_2\_dot\*q24\_dot\*sin(fi\_2))/10000;

 q32\_dot\*((1647\*fi\_3\_dot\*cos(fi\_3)\*cos(theta\_3))/2500 - (1647\*theta\_3\_dot\*sin(fi\_3)\*sin(theta\_3))/2500) - xe\_dot\_dot + q34\_dot\*((6581\*fi\_3\_dot\*cos(fi\_3)\*cos(theta\_3))/10000 - (6581\*theta\_3\_dot\*sin(fi\_3)\*sin(theta\_3))/10000) + b\_dot\*(c\_dot\*((cos(a)\*sin(b)\*sin(c))/200 + (3^(1/2)\*cos(a)\*cos(c)\*sin(b))/200) + a\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 - (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) + b\_dot\*((cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/200 + (3^(1/2)\*cos(a)\*cos(b)\*sin(c))/200)) - theta\_3\_dot\_dot\*(sin(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8) + cos(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000)) - theta\_3\_dot\*((1317\*q31\_dot\*cos(theta\_3))/2000 - theta\_3\_dot\*(sin(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000) - cos(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8)) - (6581\*q33\_dot\*cos(theta\_3))/10000 + fi\_3\_dot\*sin(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\*sin(fi\_3)\*sin(theta\_3))/2500 + (6581\*q34\_dot\*sin(fi\_3)\*sin(theta\_3))/10000) + c\_dot\*(b\_dot\*((cos(a)\*sin(b)\*sin(c))/200 + (3^(1/2)\*cos(a)\*cos(c)\*sin(b))/200) + a\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 - (cos(a)\*cos(c))/200 + (cos(b)\*sin(a)\*sin(c))/200) + c\_dot\*((sin(a)\*sin(c))/200 + (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 - (cos(a)\*cos(b)\*cos(c))/200)) + a\_dot\*(b\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 - (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) + a\_dot\*((sin(a)\*sin(c))/200 + (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 + (cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/200) + c\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 - (cos(a)\*cos(c))/200 + (cos(b)\*sin(a)\*sin(c))/200)) - c\_dot\_dot\*((cos(c)\*sin(a))/200 - (3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(a)\*cos(b)\*sin(c))/200) - (1317\*q31\_dot\_dot\*sin(theta\_3))/2000 + (6581\*q33\_dot\_dot\*sin(theta\_3))/10000 - a\_dot\_dot\*((3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (sin(a)\*sin(b))/50 + (cos(a)\*sin(c))/200 + (cos(b)\*cos(c)\*sin(a))/200) + fi\_3\_dot\*(fi\_3\_dot\*cos(theta\_3)\*((3\*cos(fi\_3))/20 - sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\*cos(fi\_3)\*cos(theta\_3))/2500 + (6581\*q34\_dot\*cos(fi\_3)\*cos(theta\_3))/10000 - theta\_3\_dot\*sin(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000))) - b\_dot\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 - (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200) - (1317\*q31\_dot\*theta\_3\_dot\*cos(theta\_3))/2000 + (6581\*q33\_dot\*theta\_3\_dot\*cos(theta\_3))/10000 + fi\_3\_dot\_dot\*cos(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\_dot\*cos(theta\_3)\*sin(fi\_3))/2500 + (6581\*q34\_dot\_dot\*cos(theta\_3)\*sin(fi\_3))/10000;

 fi\_3\_dot\*(theta\_3\_dot\*cos(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + fi\_3\_dot\*sin(theta\_3)\*((3\*cos(fi\_3))/20 - sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\*cos(fi\_3)\*sin(theta\_3))/2500 + (6581\*q34\_dot\*cos(fi\_3)\*sin(theta\_3))/10000) - ye\_dot\_dot - b\_dot\_dot\*((cos(b)\*sin(a))/50 + (cos(c)\*sin(a)\*sin(b))/200 - (3^(1/2)\*sin(a)\*sin(b)\*sin(c))/200) + q32\_dot\*((1647\*fi\_3\_dot\*cos(fi\_3)\*sin(theta\_3))/2500 + (1647\*theta\_3\_dot\*cos(theta\_3)\*sin(fi\_3))/2500) + q34\_dot\*((6581\*fi\_3\_dot\*cos(fi\_3)\*sin(theta\_3))/10000 + (6581\*theta\_3\_dot\*cos(theta\_3)\*sin(fi\_3))/10000) + b\_dot\*(b\_dot\*((sin(a)\*sin(b))/50 - (cos(b)\*cos(c)\*sin(a))/200 + (3^(1/2)\*cos(b)\*sin(a)\*sin(c))/200) + c\_dot\*((sin(a)\*sin(b)\*sin(c))/200 + (3^(1/2)\*cos(c)\*sin(a)\*sin(b))/200) - a\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 - (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200)) - theta\_3\_dot\_dot\*(sin(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000) - cos(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8)) + theta\_3\_dot\*((6581\*q33\_dot\*sin(theta\_3))/10000 - (1317\*q31\_dot\*sin(theta\_3))/2000 - theta\_3\_dot\*(sin(theta\_3)\*(sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000) - (3\*cos(fi\_3))/20 + 1/8) + cos(theta\_3)\*((1317\*q31)/2000 - (6581\*q33)/10000)) + fi\_3\_dot\*cos(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\*cos(theta\_3)\*sin(fi\_3))/2500 + (6581\*q34\_dot\*cos(theta\_3)\*sin(fi\_3))/10000) - a\_dot\*(c\_dot\*((cos(c)\*sin(a))/200 - (3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(a)\*cos(b)\*sin(c))/200) + a\_dot\*((3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 - (sin(a)\*sin(b))/50 + (cos(a)\*sin(c))/200 + (cos(b)\*cos(c)\*sin(a))/200) + b\_dot\*((cos(a)\*cos(b))/50 + (cos(a)\*cos(c)\*sin(b))/200 - (3^(1/2)\*cos(a)\*sin(b)\*sin(c))/200)) + (1317\*q31\_dot\_dot\*cos(theta\_3))/2000 - (6581\*q33\_dot\_dot\*cos(theta\_3))/10000 - a\_dot\_dot\*((sin(a)\*sin(c))/200 + (3^(1/2)\*(cos(c)\*sin(a) + cos(a)\*cos(b)\*sin(c)))/200 + (cos(a)\*sin(b))/50 - (cos(a)\*cos(b)\*cos(c))/200) - c\_dot\_dot\*((3^(1/2)\*(cos(a)\*sin(c) + cos(b)\*cos(c)\*sin(a)))/200 - (cos(a)\*cos(c))/200 + (cos(b)\*sin(a)\*sin(c))/200) - c\_dot\*(a\_dot\*((cos(c)\*sin(a))/200 - (3^(1/2)\*(sin(a)\*sin(c) - cos(a)\*cos(b)\*cos(c)))/200 + (cos(a)\*cos(b)\*sin(c))/200) - b\_dot\*((sin(a)\*sin(b)\*sin(c))/200 + (3^(1/2)\*cos(c)\*sin(a)\*sin(b))/200) + c\_dot\*((3^(1/2)\*(cos(a)\*cos(c) - cos(b)\*sin(a)\*sin(c)))/200 + (cos(a)\*sin(c))/200 + (cos(b)\*cos(c)\*sin(a))/200)) - (1317\*q31\_dot\*theta\_3\_dot\*sin(theta\_3))/2000 + (6581\*q33\_dot\*theta\_3\_dot\*sin(theta\_3))/10000 + fi\_3\_dot\_dot\*sin(theta\_3)\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\_dot\*sin(fi\_3)\*sin(theta\_3))/2500 + (6581\*q34\_dot\_dot\*sin(fi\_3)\*sin(theta\_3))/10000;

 d\_3\_dot\_dot - ze\_dot\_dot + fi\_3\_dot\*(fi\_3\_dot\*((3\*sin(fi\_3))/20 + cos(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) + (1647\*q32\_dot\*sin(fi\_3))/2500 + (6581\*q34\_dot\*sin(fi\_3))/10000) + c\_dot\*(b\_dot\*((cos(b)\*sin(c))/200 + (3^(1/2)\*cos(b)\*cos(c))/200) + c\_dot\*((cos(c)\*sin(b))/200 - (3^(1/2)\*sin(b)\*sin(c))/200)) + b\_dot\*(c\_dot\*((cos(b)\*sin(c))/200 + (3^(1/2)\*cos(b)\*cos(c))/200) + b\_dot\*(cos(b)/50 + (cos(c)\*sin(b))/200 - (3^(1/2)\*sin(b)\*sin(c))/200)) + c\_dot\_dot\*((sin(b)\*sin(c))/200 + (3^(1/2)\*cos(c)\*sin(b))/200) - fi\_3\_dot\_dot\*((3\*cos(fi\_3))/20 - sin(fi\_3)\*((1647\*q32)/2500 + (6581\*q34)/10000)) - (1647\*q32\_dot\_dot\*cos(fi\_3))/2500 - (6581\*q34\_dot\_dot\*cos(fi\_3))/10000 + b\_dot\_dot\*(sin(b)/50 - (cos(b)\*cos(c))/200 + (3^(1/2)\*cos(b)\*sin(c))/200) + (1647\*fi\_3\_dot\*q32\_dot\*sin(fi\_3))/2500 + (6581\*fi\_3\_dot\*q34\_dot\*sin(fi\_3))/10000];

Q\_dot\_dot=-M\(C\*Q\_dot+K\*Q+G-const\_QT\*la);

w1=Q\_dot\_dot(1,1);

w2=Q\_dot\_dot(2,1);

w3=Q\_dot\_dot(3,1);

w4=Q\_dot\_dot(4,1);

w5=Q\_dot\_dot(5,1);

w6=Q\_dot\_dot(6,1);

w7=Q\_dot\_dot(7,1);

w8=Q\_dot\_dot(8,1);

w9=Q\_dot\_dot(9,1);

w10=Q\_dot\_dot(10,1);

w11=Q\_dot\_dot(11,1);

w12=Q\_dot\_dot(12,1);

w13=Q\_dot\_dot(13,1);

w14=Q\_dot\_dot(14,1);

w15=Q\_dot\_dot(15,1);

w16=Q\_dot\_dot(16,1);

w17=Q\_dot\_dot(17,1);

w18=Q\_dot\_dot(18,1);

w19=Q\_dot\_dot(19,1);

w20=Q\_dot\_dot(20,1);

w21=Q\_dot\_dot(21,1);

w22=Q\_dot\_dot(22,1);

w23=Q\_dot\_dot(23,1);

w24=Q\_dot\_dot(24,1);

w25=Q\_dot\_dot(25,1);

w26=Q\_dot\_dot(26,1);

w27=Q\_dot\_dot(27,1);

w28=const(1,1);

w29=const(2,1);

w30=const(3,1);

w31=const(4,1);

w32=const(5,1);

w33=const(6,1);

w34=const(7,1);

w35=const(8,1);

w36=const(9,1);

%

% Dconst1=const\_dot(1,1);

% Dconst2=const\_dot(2,1);

% Dconst3=const\_dot(3,1);

% Dconst4=const\_dot(4,1);

% Dconst5=const\_dot(5,1);

% Dconst6=const\_dot(6,1);

% Dconst7=const\_dot(7,1);

% Dconst8=const\_dot(8,1);

% Dconst9=const\_dot(9,1);

M0=subs(M,{theta\_1,theta\_2,theta\_3,d\_1,d\_2,d\_3,fi\_1,fi\_2,fi\_3,q11,q12,q13,q14,q21,q22,q23,q24,q31,q32,q33,q34,xe,ye,ze,a,b,c},...

 {0.0150,1.7920,1.3404,0.1686,0.1655,0.1385,0.7271,0.6876,0.4707,0,0,0,0,0,0,0,0,0,0,0,0,.1,0,.05,.1,.1,-.1});

C0=subs(C,{theta\_1,theta\_2,theta\_3,d\_1,d\_2,d\_3,fi\_1,fi\_2,fi\_3,q11,q12,q13,q14,q21,q22,q23,q24,q31,q32,q33,q34,xe,ye,ze,a,b,c,...

 theta\_1\_dot,theta\_2\_dot,theta\_3\_dot,d\_1\_dot,d\_2\_dot,d\_3\_dot,fi\_1\_dot,fi\_2\_dot,fi\_3\_dot,q11\_dot,q12\_dot,q13\_dot,q14\_dot,q21\_dot,q22\_dot,q23\_dot,q24\_dot,q31\_dot,q32\_dot,q33\_dot,q34\_dot,xe\_dot,ye\_dot,ze\_dot,a\_dot,b\_dot,c\_dot},...

 {0.0150,1.7920,1.3404,0.1686,0.1655,0.1385,0.7271,0.6876,0.4707,0,0,0,0,0,0,0,0,0,0,0,0,.1,0,.05,.1,.1,-.1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0});

K0=subs(K,{q11,q12,q13,q14,q21,q22,q23,q24,q31,q32,q33,q34},{0,0,0,0,0,0,0,0,0,0,0,0});

G0=subs(G,{theta\_1,theta\_2,theta\_3,d\_1,d\_2,d\_3,fi\_1,fi\_2,fi\_3,q11,q12,q13,q14,q21,q22,q23,q24,q31,q32,q33,q34,xe,ye,ze,a,b,c},...

 {0.0150,1.7920,1.3404,0.1686,0.1655,0.1385,0.7271,0.6876,0.4707,0,0,0,0,0,0,0,0,0,0,0,0,.1,0,.05,.1,.1,-.1});

const\_QT0=subs(const\_QT,{theta\_1,theta\_2,theta\_3,d\_1,d\_2,d\_3,fi\_1,fi\_2,fi\_3,q11,q12,q13,q14,q21,q22,q23,q24,q31,q32,q33,q34,xe,ye,ze,a,b,c},...

 {0.0150,1.7920,1.3404,0.1686,0.1655,0.1385,0.7271,0.6876,0.4707,0,0,0,0,0,0,0,0,0,0,0,0,.1,0,.05,.1,.1,-.1});

const\_Q0=const\_QT0.';

Q0=subs(Q,{theta\_1,theta\_2,theta\_3,d\_1,d\_2,d\_3,fi\_1,fi\_2,fi\_3,q11,q12,q13,q14,q21,q22,q23,q24,q31,q32,q33,q34,xe,ye,ze,a,b,c},...

 {0.0150,1.7920,1.3404,0.1686,0.1655,0.1385,0.7271,0.6876,0.4707,0,0,0,0,0,0,0,0,0,0,0,0,.1,0,.05,.1,.1,-.1});

% Q0=[0.0150,1.7920,1.3404,0.1686,0.1655,0.1385,0.7271,0.6876,0.4707,0,0,0,0,0,0,0,0,0,0,0,0,.1,0,.05,.1,.1,-.1];

M11=det(M0(1:7,1:7));

M22=det(M0(8:14,8:14));

M33=det(M0(15:21,15:21));

M44=det(M0(22:27,22:27));