ER16 DH参数：

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| i |  |  |  |  |
| 1 | 0 | 0 | 0 |  |
| 2 | -pi/2 |  | 0 | -pi/2 |
| 3 | 0 |  | 0 | +pi/2 |

关节参数限位值：

void tau( double\* tau\_out, const double\* parms, const double\* q, const double\* dq, const double\* ddq )

{

double x0 = cos(q[2]);

double x1 = sin(q[1]);

double x2 = -x1;

double x3 = dq[0]\*x2;

double x4 = sin(q[2]);

double x5 = cos(q[1]);

double x6 = dq[0]\*x5;

double x7 = -x6;

double x8 = x0\*x3 + x4\*x7;

double x9 = dq[1] + dq[2];

double x10 = x8\*x9;

double x11 = -x8;

double x12 = dq[1]\*x6;

double x13 = -ddq[0]\*x1 - x12;

double x14 = -x13;

double x15 = dq[1]\*x3;

double x16 = ddq[0]\*x5 + x15;

double x17 = -x16;

double x18 = dq[2]\*x11 + x0\*x17 + x14\*x4;

double x19 = -x4;

double x20 = x0\*x7 + x19\*x3;

double x21 = dq[2]\*x20 + x0\*x13 + x17\*x4;

double x22 = x20\*x9;

double x23 = -((x20)\*(x20));

double x24 = -((x8)\*(x8));

double x25 = a1\*ddq[0];

double x26 = x12 + x14;

double x27 = a2\*x26 + x25;

double x28 = parms[26]\*(x10 - x18) + parms[27]\*(x21 + x22) + parms[28]\*(x23 + x24) + parms[29]\*x27;

double x29 = -((x3)\*(x3));

double x30 = dq[1]\*parms[15] + parms[12]\*x6 + parms[14]\*x3;

double x31 = dq[1]\*parms[14] + parms[11]\*x6 + parms[13]\*x3;

double x32 = -a1\*((dq[0])\*(dq[0]));

double x33 = -9.8100000000000005\*x1 + x32\*x5;

double x34 = ddq[1] + ddq[2];

double x35 = parms[22]\*x8 + parms[24]\*x20 + parms[25]\*x9;

double x36 = -x0;

double x37 = x1\*x32 + 9.8100000000000005\*x5;

double x38 = a2\*(-((dq[1])\*(dq[1])) + x29) + x37;

double x39 = a2\*(ddq[1] + x3\*x6) + x33;

double x40 = x19\*x39 + x36\*x38;

double x41 = parms[21]\*x8 + parms[23]\*x20 + parms[24]\*x9;

double x42 = parms[20]\*x21 + parms[21]\*x18 + parms[22]\*x34 + parms[27]\*x27 - parms[28]\*x40 + x20\*x35 - x41\*x9;

double x43 = x0\*x39 + x19\*x38;

double x44 = parms[20]\*x8 + parms[21]\*x20 + parms[22]\*x9;

double x45 = parms[21]\*x21 + parms[23]\*x18 + parms[24]\*x34 - parms[26]\*x27 + parms[28]\*x43 + x11\*x35 + x44\*x9;

double x46 = dq[1]\*parms[12] + parms[10]\*x6 + parms[11]\*x3;

double x47 = parms[22]\*x21 + parms[24]\*x18 + parms[25]\*x34 + parms[26]\*x40 - parms[27]\*x43 - x20\*x44 + x41\*x8;

double x48 = -((x9)\*(x9));

double x49 = x20\*x8;

//

tau\_out[0] = a1\*(parms[16]\*x26 + parms[17]\*(x15 + x16) + parms[18]\*(x29 - ((x6)\*(x6))) + parms[19]\*x25 + x28) + ddq[0]\*parms[5] + x2\*(-a2\*x28 + ddq[1]\*parms[14] + dq[1]\*x46 + parms[11]\*x16 + parms[13]\*x13 - parms[16]\*x25 + parms[18]\*x37 + x0\*x42 + x19\*x45 + x30\*x7) + x5\*(ddq[1]\*parms[12] - dq[1]\*x31 + parms[10]\*x16 + parms[11]\*x13 + parms[17]\*x25 - parms[18]\*x33 + x19\*x42 + x3\*x30 + x36\*x45);

tau\_out[1] = a2\*(x0\*(parms[26]\*(x23 + x48) + parms[27]\*(-x34 + x49) + parms[28]\*(x10 + x18) + parms[29]\*x43) + x19\*(parms[26]\*(x34 + x49) + parms[27]\*(x24 + x48) + parms[28]\*(-x21 + x22) + parms[29]\*x40)) + ddq[1]\*parms[15] + parms[12]\*x16 + parms[14]\*x13 + parms[16]\*x33 - parms[17]\*x37 - x3\*x46 + x31\*x6 + x47;

tau\_out[2] = x47;

//

return;

}

void Mregress( double\* Mregress, const double\* q, const double\* dq, const double\* ddq )

{

double x0 = cos(q[1]);

double x1 = sin(q[1]);

double x2 = -x1;

double x3 = dq[0]\*x2;

double x4 = dq[1]\*x3;

double x5 = ddq[0]\*x0 + x4;

double x6 = dq[0]\*x0;

double x7 = dq[1]\*x6;

double x8 = -x7;

double x9 = x1\*x8;

double x10 = -ddq[0]\*x1 + x8;

double x11 = x4 + x5;

double x12 = x3\*x6;

double x13 = ddq[1] + x12;

double x14 = ((dq[1])\*(dq[1]));

double x15 = ((x6)\*(x6));

double x16 = -x15;

double x17 = -x4;

double x18 = -x10;

double x19 = -x14;

double x20 = ((x3)\*(x3));

double x21 = -x12;

double x22 = x18 + x7;

double x23 = a1\*ddq[0];

double x24 = -x20;

double x25 = -a1\*((dq[0])\*(dq[0]));

double x26 = x0\*x25 - 9.8100000000000005\*x1;

double x27 = 9.8100000000000005\*x0 + x1\*x25;

double x28 = cos(q[2]);

double x29 = -x6;

double x30 = sin(q[2]);

double x31 = -x30;

double x32 = x28\*x29 + x3\*x31;

double x33 = -x5;

double x34 = dq[2]\*x32 + x10\*x28 + x30\*x33;

double x35 = -x28;

double x36 = x28\*x3 + x29\*x30;

double x37 = dq[1] + dq[2];

double x38 = x36\*x37;

double x39 = -x38;

double x40 = -dq[2]\*x36 + x18\*x30 + x28\*x33;

double x41 = x39 + x40;

double x42 = x32\*x37;

double x43 = x34 + x42;

double x44 = ((x37)\*(x37));

double x45 = ((x36)\*(x36));

double x46 = -x45;

double x47 = x44 + x46;

double x48 = ddq[1] + ddq[2];

double x49 = x32\*x36;

double x50 = x48 + x49;

double x51 = x31\*x50;

double x52 = -x42;

double x53 = -x40;

double x54 = ((x32)\*(x32));

double x55 = -x44;

double x56 = x54 + x55;

double x57 = -x49;

double x58 = x48 + x57;

double x59 = x38 + x53;

double x60 = a2\*x22 + x23;

double x61 = -x60;

double x62 = -a2;

double x63 = -x54;

double x64 = x46 + x63;

double x65 = a2\*(x19 + x24) + x27;

double x66 = a2\*x13 + x26;

double x67 = x31\*x66 + x35\*x65;

double x68 = -x67;

double x69 = x28\*x66 + x31\*x65;

double x70 = x45 + x63;

double x71 = x34 + x52;

double x72 = x38 + x40;

double x73 = -x69;

//

Mregress[0] = 0;

Mregress[1] = 0;

Mregress[2] = 0;

Mregress[3] = 0;

Mregress[4] = 0;

Mregress[5] = ddq[0];

Mregress[6] = 0;

Mregress[7] = 0;

Mregress[8] = 0;

Mregress[9] = 0;

Mregress[10] = x0\*x5 + x9;

Mregress[11] = x0\*(x10 + x8) + x11\*x2;

Mregress[12] = x0\*x13 + x2\*(x14 + x16);

Mregress[13] = x0\*x17 + x1\*x18;

Mregress[14] = x0\*(x19 + x20) + x2\*(ddq[1] + x21);

Mregress[15] = x0\*x4 - x9;

Mregress[16] = a1\*x22 - x2\*x23;

Mregress[17] = a1\*x11 + x0\*x23;

Mregress[18] = a1\*(x16 + x24) - x0\*x26 + x2\*x27=0;

Mregress[19] = a1\*x23;

Mregress[20] = x0\*(x31\*x34 + x35\*x38) + x2\*(x28\*x34 + x31\*x38);

Mregress[21] = x0\*(x31\*x41 + x35\*x43) + x2\*(x28\*x41 + x31\*x43);

Mregress[22] = x0\*(x35\*x47 + x51) + x2\*(x28\*x50 + x31\*x47);

Mregress[23] = x0\*(x28\*x53 + x31\*x52) + x2\*(x28\*x52 + x31\*x40);

Mregress[24] = x0\*(x31\*x56 + x35\*x58) + x2\*(x28\*x56 + x31\*x58);

Mregress[25] = x0\*(x31\*x42 + x35\*x39) + x2\*(x28\*x42 + x31\*x39);

Mregress[26] = a1\*x59 + x0\*x35\*x61 + x2\*(x31\*x61 + x59\*x62);

Mregress[27] = a1\*x43 + x0\*x31\*x60 + x2\*(x2[[1]](#footnote-1)8\*x60 + x43\*x62);

Mregress[28] = a1\*x64 + x0\*(x31\*x68 + x35\*x69) + x2\*(x28\*x68 + x31\*x69 + x62\*x64);

Mregress[29] = a1\*x60 + a2\*x2\*x61;

Mregress[30] = 0;

Mregress[31] = 0;

Mregress[32] = 0;

Mregress[33] = 0;

Mregress[34] = 0;

Mregress[35] = 0;

Mregress[36] = 0;

Mregress[37] = 0;

Mregress[38] = 0;

Mregress[39] = 0;

Mregress[40] = x21;

Mregress[41] = x15 + x24;

Mregress[42] = x17 + x5;

Mregress[43] = x12;

Mregress[44] = x10 + x7;

Mregress[45] = ddq[1];

Mregress[46] = x26;

Mregress[47] = -x27;

Mregress[48] = 0;

Mregress[49] = 0;

Mregress[50] = x57;

Mregress[51] = x70;

Mregress[52] = x71;

Mregress[53] = x49;

Mregress[54] = x72;

Mregress[55] = x48;

Mregress[56] = a2\*(x28\*(x55 + x63) + x51) + x67;

Mregress[57] = a2\*(x28\*(-x48 + x49) + x31\*(x46 + x55)) + x73;

Mregress[58] = a2\*(x28\*x72 + x31\*(-x34 + x42));

Mregress[59] = a2\*(x28\*x69 + x31\*x67);

Mregress[60] = 0;

Mregress[61] = 0;

Mregress[62] = 0;

Mregress[63] = 0;

Mregress[64] = 0;

Mregress[65] = 0;

Mregress[66] = 0;

Mregress[67] = 0;

Mregress[68] = 0;

Mregress[69] = 0;

Mregress[70] = 0;

Mregress[71] = 0;

Mregress[72] = 0;

Mregress[73] = 0;

Mregress[74] = 0;

Mregress[75] = 0;

Mregress[76] = 0;

Mregress[77] = 0;

Mregress[78] = 0;

Mregress[79] = 0;

Mregress[80] = x57;

Mregress[81] = x70;

Mregress[82] = x71;

Mregress[83] = x49;

Mregress[84] = x72;

Mregress[85] = x48;

Mregress[86] = x67;

Mregress[87] = x73;

Mregress[88] = 0;

Mregress[89] = 0;

//

return;

}

ER3A C60

DH参数：

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| i |  |  |  |  |
| 1 | 0 | 0 | 0 |  |
| 2 | pi/2 |  | 0 | +pi/2 |
| 3 | 0 |  | 0 |  |

基本参数集：

[L\_1xx, L\_1xy, L\_1xz, L\_1yy, L\_1yz, L\_1zz, l\_1x, l\_1y, l\_1z, m\_1, L\_2xx, L\_2xy, L\_2xz, L\_2yy, L\_2yz, L\_2zz, l\_2x, l\_2y, l\_2z, m\_2, L\_3xx, L\_3xy, L\_3xz, L\_3yy, L\_3yz, L\_3zz, l\_3x, l\_3y, l\_3z, m\_3]

void tau( double\* tau\_out, const double\* parms, const double\* q, const double\* dq, const double\* ddq )

{

double x0 = cos(q[1]);

double x1 = sin(q[1]);

double x2 = -x1;

double x3 = dq[0]\*x2;

double x4 = dq[1]\*x3;

double x5 = ddq[0]\*x0 + x4;

double x6 = -ddq[0];

double x7 = dq[0]\*x0;

double x8 = dq[1]\*x7;

double x9 = x1\*x6 - x8;

double x10 = a1\*x6;

double x11 = dq[1]\*parms[15] + parms[12]\*x7 + parms[14]\*x3;

double x12 = dq[1]\*parms[14] + parms[11]\*x7 + parms[13]\*x3;

double x13 = -a1\*((dq[0])\*(dq[0]));

double x14 = -x0\*x13 - 9.8100000000000005\*x1;

double x15 = cos(q[2]);

double x16 = sin(q[2]);

double x17 = -x16;

double x18 = x15\*x3 + x17\*x7;

double x19 = dq[2]\*x18 + x15\*x5 + x16\*x9;

double x20 = x15\*x7 + x16\*x3;

double x21 = -x20;

double x22 = dq[2]\*x21 + x15\*x9 - x16\*x5;

double x23 = ddq[1] + ddq[2];

double x24 = x8 - x9;

double x25 = a2\*x24 + x10;

double x26 = dq[1] + dq[2];

double x27 = parms[22]\*x20 + parms[24]\*x18 + parms[25]\*x26;

double x28 = a2\*(ddq[1] + x3\*x7) + x14;

double x29 = 9.8100000000000005\*x0 + x13\*x2;

double x30 = -((x3)\*(x3));

double x31 = a2\*(-((dq[1])\*(dq[1])) + x30) + x29;

double x32 = x15\*x28 + x17\*x31;

double x33 = parms[21]\*x20 + parms[23]\*x18 + parms[24]\*x26;

double x34 = parms[20]\*x19 + parms[21]\*x22 + parms[22]\*x23 + parms[27]\*x25 - parms[28]\*x32 + x18\*x27 - x26\*x33;

double x35 = x15\*x31 + x16\*x28;

double x36 = parms[20]\*x20 + parms[21]\*x18 + parms[22]\*x26;

double x37 = parms[21]\*x19 + parms[23]\*x22 + parms[24]\*x23 - parms[26]\*x25 + parms[28]\*x35 + x21\*x27 + x26\*x36;

double x38 = x20\*x26;

double x39 = x18\*x26;

double x40 = -((x18)\*(x18));

double x41 = -((x20)\*(x20));

double x42 = parms[26]\*(-x22 + x38) + parms[27]\*(x19 + x39) + parms[28]\*(x40 + x41) + parms[29]\*x25;

double x43 = dq[1]\*parms[12] + parms[10]\*x7 + parms[11]\*x3;

double x44 = parms[22]\*x19 + parms[24]\*x22 + parms[25]\*x23 + parms[26]\*x32 - parms[27]\*x35 - x18\*x36 + x20\*x33;

double x45 = -((x26)\*(x26));

double x46 = x18\*x20;

//

tau\_out[0] = a1\*(-parms[16]\*x24 - parms[17]\*(x4 + x5) - parms[18]\*(x30 - ((x7)\*(x7))) - parms[19]\*x10 - x42) + ddq[0]\*parms[5] + x0\*(ddq[1]\*parms[12] - dq[1]\*x12 + parms[10]\*x5 + parms[11]\*x9 + parms[17]\*x10 - parms[18]\*x14 + x11\*x3 + x15\*x34 + x17\*x37) + x2\*(-a2\*x42 + ddq[1]\*parms[14] + dq[1]\*x43 + parms[11]\*x5 + parms[13]\*x9 - parms[16]\*x10 + parms[18]\*x29 - x11\*x7 + x15\*x37 + x16\*x34);

tau\_out[1] = a2\*(x15\*(parms[26]\*(x23 + x46) + parms[27]\*(x41 + x45) + parms[28]\*(-x19 + x39) + parms[29]\*x32) + x16\*(parms[26]\*(x40 + x45) + parms[27]\*(-x23 + x46) + parms[28]\*(x22 + x38) + parms[29]\*x35)) + ddq[1]\*parms[15] + parms[12]\*x5 + parms[14]\*x9 + parms[16]\*x14 - parms[17]\*x29 + x12\*x7 - x3\*x43 + x44;

tau\_out[2] = x44;

//

return;

}

基本参数集系数：

void Mregress( double\* Mregress, const double\* q, const double\* dq, const double\* ddq )

{

double x0 = sin(q[1]);

double x1 = -x0;

double x2 = cos(q[1]);

double x3 = dq[0]\*x2;

double x4 = dq[1]\*x3;

double x5 = dq[0]\*x1;

double x6 = dq[1]\*x5;

double x7 = ddq[0]\*x2 + x6;

double x8 = -x4;

double x9 = -ddq[0];

double x10 = x0\*x9 + x8;

double x11 = x6 + x7;

double x12 = x3\*x5;

double x13 = ddq[1] + x12;

double x14 = ((dq[1])\*(dq[1]));

double x15 = ((x3)\*(x3));

double x16 = -x15;

double x17 = -x6;

double x18 = -x14;

double x19 = ((x5)\*(x5));

double x20 = -x12;

double x21 = -x10 + x4;

double x22 = a1\*x9;

double x23 = -x22;

double x24 = -a1\*((dq[0])\*(dq[0]));

double x25 = -g\*x0 - x2\*x24;

double x26 = -a1;

double x27 = -x19;

double x28 = x1\*x24 + g\*x2;

double x29 = cos(q[2]);

double x30 = sin(q[2]);

double x31 = -x30;

double x32 = x29\*x5 + x3\*x31;

double x33 = dq[2]\*x32 + x10\*x30 + x29\*x7;

double x34 = x29\*x3 + x30\*x5;

double x35 = dq[1] + dq[2];

double x36 = x34\*x35;

double x37 = -x36;

double x38 = -dq[2]\*x34 + x10\*x29 - x30\*x7;

double x39 = x37 + x38;

double x40 = x32\*x35;

double x41 = x33 + x40;

double x42 = ddq[1] + ddq[2];

double x43 = x32\*x34;

double x44 = x42 + x43;

double x45 = x29\*x44;

double x46 = ((x35)\*(x35));

double x47 = ((x34)\*(x34));

double x48 = -x47;

double x49 = x46 + x48;

double x50 = -x40;

double x51 = ((x32)\*(x32));

double x52 = -x46;

double x53 = x51 + x52;

double x54 = -x43;

double x55 = x42 + x54;

double x56 = a2\*x21 + x22;

double x57 = -x56;

double x58 = x36 - x38;

double x59 = a2\*x13 + x25;

double x60 = a2\*(x18 + x27) + x28;

double x61 = x29\*x59 + x31\*x60;

double x62 = -x61;

double x63 = x29\*x60 + x30\*x59;

double x64 = -x51;

double x65 = x48 + x64;

double x66 = x47 + x64;

double x67 = x33 + x50;

double x68 = x36 + x38;

double x69 = -x63;

//

Mregress[0] = 0;

Mregress[1] = 0;

Mregress[2] = 0;

Mregress[3] = 0;

Mregress[4] = 0;

Mregress[5] = ddq[0];

Mregress[6] = 0;

Mregress[7] = 0;

Mregress[8] = 0;

Mregress[9] = 0;

Mregress[10] = x1\*x4 + x2\*x7;

Mregress[11] = x1\*x11 + x2\*(x10 + x8);

Mregress[12] = x1\*(x14 + x16) + x13\*x2;

Mregress[13] = x1\*x10 + x17\*x2;

Mregress[14] = x1\*(ddq[1] + x20) + x2\*(x18 + x19);

Mregress[15] = x1\*x8 + x2\*x6;

Mregress[16] = -a1\*x21 + x1\*x23;

Mregress[17] = -a1\*x11 + x2\*x22;

Mregress[18] = x1\*x28 - x2\*x25 + x26\*(x16 + x27);

Mregress[19] = a1\*x23;

Mregress[20] = x1\*(x29\*x36 + x30\*x33) + x2\*(x29\*x33 + x31\*x36);

Mregress[21] = x1\*(x29\*x41 + x30\*x39) + x2\*(x29\*x39 + x31\*x41);

Mregress[22] = x1\*(x29\*x49 + x30\*x44) + x2\*(x31\*x49 + x45);

Mregress[23] = x1\*(x29\*x38 + x30\*x50) + x2\*(x29\*x50 + x31\*x38);

Mregress[24] = x1\*(x29\*x55 + x30\*x53) + x2\*(x29\*x53 + x31\*x55);

Mregress[25] = x1\*(x29\*x37 + x30\*x40) + x2\*(x29\*x40 + x31\*x37);

Mregress[26] = x1\*(-a2\*x58 + x29\*x57) + x2\*x31\*x57 + x26\*x58;

Mregress[27] = x1\*(-a2\*x41 + x30\*x56) + x2\*x29\*x56 + x26\*x41;

Mregress[28] = x1\*(-a2\*x65 + x29\*x63 + x30\*x62) + x2\*(x29\*x62 + x31\*x63) + x26\*x65;

Mregress[29] = a2\*x1\*x57 + x26\*x56;

Mregress[30] = 0;

Mregress[31] = 0;

Mregress[32] = 0;

Mregress[33] = 0;

Mregress[34] = 0;

Mregress[35] = 0;

Mregress[36] = 0;

Mregress[37] = 0;

Mregress[38] = 0;

Mregress[39] = 0;

Mregress[40] = x20;

Mregress[41] = x15 + x27;

Mregress[42] = x17 + x7;

Mregress[43] = x12;

Mregress[44] = x10 + x4;

Mregress[45] = ddq[1];

Mregress[46] = x25;

Mregress[47] = -x28;

Mregress[48] = 0;

Mregress[49] = 0;

Mregress[50] = x54;

Mregress[51] = x66;

Mregress[52] = x67;

Mregress[53] = x43;

Mregress[54] = x68;

Mregress[55] = x42;

Mregress[56] = a2\*(x30\*(x52 + x64) + x45) + x61;

Mregress[57] = a2\*(x29\*(x48 + x52) + x30\*(-x42 + x43)) + x69;

Mregress[58] = a2\*(x29\*(-x33 + x40) + x30\*x68);

Mregress[59] = a2\*(x29\*x61 + x30\*x63);

Mregress[60] = 0;

Mregress[61] = 0;

Mregress[62] = 0;

Mregress[63] = 0;

Mregress[64] = 0;

Mregress[65] = 0;

Mregress[66] = 0;

Mregress[67] = 0;

Mregress[68] = 0;

Mregress[69] = 0;

Mregress[70] = 0;

Mregress[71] = 0;

Mregress[72] = 0;

Mregress[73] = 0;

Mregress[74] = 0;

Mregress[75] = 0;

Mregress[76] = 0;

Mregress[77] = 0;

Mregress[78] = 0;

Mregress[79] = 0;

Mregress[80] = x54;

Mregress[81] = x66;

Mregress[82] = x67;

Mregress[83] = x43;

Mregress[84] = x68;

Mregress[85] = x42;

Mregress[86] = x61;

Mregress[87] = x69;

Mregress[88] = 0;

Mregress[89] = 0;

//

return;

}

LR4

DH参数：

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| i |  |  |  |  |
| 1 | 0 | 0 | 0 |  |
| 2 | -pi/2 | 20 | 0 | -pi/2 |
| 3 | 0 | 475 | 0 |  |
| 4 | Pi/2 | 20 | 90 |  |
| 5 | Pi/2 | 0 | 0 |  |
| 6 | Pi/2 | 0 | 78 |  |

void tau( double\* tau\_out, const double\* parms, const double\* q, const double\* dq, const double\* ddq )

{

double x0 = cos(q[1]);

double x1 = dq[0]\*x0;

double x2 = cos(q[2]);

double x3 = sin(q[2]);

double x4 = sin(q[1]);

double x5 = -x4;

double x6 = dq[0]\*x5;

double x7 = x1\*x2 + x3\*x6;

double x8 = dq[1] + dq[2];

double x9 = x7\*x8;

double x10 = dq[1]\*x1;

double x11 = -ddq[0]\*x4 - x10;

double x12 = -x7;

double x13 = dq[1]\*x6;

double x14 = ddq[0]\*x0 + x13;

double x15 = dq[2]\*x12 + x11\*x2 - x14\*x3;

double x16 = -x3;

double x17 = x1\*x16 + x2\*x6;

double x18 = dq[2]\*x17 + x11\*x3 + x14\*x2;

double x19 = x17\*x8;

double x20 = -((x17)\*(x17));

double x21 = -((x7)\*(x7));

double x22 = a1\*ddq[0];

double x23 = x10 - x11;

double x24 = a2\*x23 + x22;

double x25 = parms[26]\*(-x15 + x9) + parms[27]\*(x18 + x19) + parms[28]\*(x20 + x21) + parms[29]\*x24;

double x26 = -((x6)\*(x6));

double x27 = dq[1]\*parms[15] + parms[12]\*x1 + parms[14]\*x6;

double x28 = dq[1]\*parms[14] + parms[11]\*x1 + parms[13]\*x6;

double x29 = -a1\*((dq[0])\*(dq[0]));

double x30 = x0\*x29 - 9.8100000000000005\*x4;

double x31 = ddq[1] + ddq[2];

double x32 = parms[22]\*x7 + parms[24]\*x17 + parms[25]\*x8;

double x33 = a2\*(ddq[1] + x1\*x6) + x30;

double x34 = 9.8100000000000005\*x0 + x29\*x4;

double x35 = a2\*(-((dq[1])\*(dq[1])) + x26) + x34;

double x36 = x16\*x35 + x2\*x33;

double x37 = parms[21]\*x7 + parms[23]\*x17 + parms[24]\*x8;

double x38 = parms[20]\*x18 + parms[21]\*x15 + parms[22]\*x31 + parms[27]\*x24 - parms[28]\*x36 + x17\*x32 - x37\*x8;

double x39 = x2\*x35 + x3\*x33;

double x40 = parms[20]\*x7 + parms[21]\*x17 + parms[22]\*x8;

double x41 = parms[21]\*x18 + parms[23]\*x15 + parms[24]\*x31 - parms[26]\*x24 + parms[28]\*x39 + x12\*x32 + x40\*x8;

double x42 = dq[1]\*parms[12] + parms[10]\*x1 + parms[11]\*x6;

double x43 = parms[22]\*x18 + parms[24]\*x15 + parms[25]\*x31 + parms[26]\*x36 - parms[27]\*x39 - x17\*x40 + x37\*x7;

double x44 = x17\*x7;

double x45 = -((x8)\*(x8));

//

tau\_out[0] = a1\*(parms[16]\*x23 + parms[17]\*(x13 + x14) + parms[18]\*(-((x1)\*(x1)) + x26) + parms[19]\*x22 + x25) + ddq[0]\*parms[5] + x0\*(ddq[1]\*parms[12] - dq[1]\*x28 + parms[10]\*x14 + parms[11]\*x11 + parms[17]\*x22 - parms[18]\*x30 + x16\*x41 + x2\*x38 + x27\*x6) + x5\*(-a2\*x25 + ddq[1]\*parms[14] + dq[1]\*x42 + parms[11]\*x14 + parms[13]\*x11 - parms[16]\*x22 + parms[18]\*x34 - x1\*x27 + x2\*x41 + x3\*x38);

tau\_out[1] = a2\*(x2\*(parms[26]\*(x31 + x44) + parms[27]\*(x21 + x45) + parms[28]\*(-x18 + x19) + parms[29]\*x36) + x3\*(parms[26]\*(x20 + x45) + parms[27]\*(-x31 + x44) + parms[28]\*(x15 + x9) + parms[29]\*x39)) + ddq[1]\*parms[15] + parms[12]\*x14 + parms[14]\*x11 + parms[16]\*x30 - parms[17]\*x34 + x1\*x28 - x42\*x6 + x43;

tau\_out[2] = x43;

//

return;

}

void Mregress( double\* Mregress, const double\* q, const double\* dq, const double\* ddq )

{

double x0 = cos(q[1]);

double x1 = sin(q[1]);

double x2 = -x1;

double x3 = dq[0]\*x2;

double x4 = dq[1]\*x3;

double x5 = ddq[0]\*x0 + x4;

double x6 = dq[0]\*x0;

double x7 = dq[1]\*x6;

double x8 = -x7;

double x9 = x1\*x8;

double x10 = -ddq[0]\*x1 + x8;

double x11 = x4 + x5;

double x12 = x3\*x6;

double x13 = ddq[1] + x12;

double x14 = ((dq[1])\*(dq[1]));

double x15 = ((x6)\*(x6));

double x16 = -x15;

double x17 = -x4;

double x18 = -x10;

double x19 = -x14;

double x20 = ((x3)\*(x3));

double x21 = -x12;

double x22 = x18 + x7;

double x23 = a1\*ddq[0];

double x24 = -x20;

double x25 = -a1\*((dq[0])\*(dq[0]));

double x26 = x0\*x25 - 9.8100000000000005\*x1;

double x27 = 9.8100000000000005\*x0 + x1\*x25;

double x28 = cos(q[2]);

double x29 = sin(q[2]);

double x30 = -x29;

double x31 = x28\*x3 + x30\*x6;

double x32 = dq[2]\*x31 + x10\*x29 + x28\*x5;

double x33 = x28\*x6 + x29\*x3;

double x34 = dq[1] + dq[2];

double x35 = x33\*x34;

double x36 = -x35;

double x37 = -dq[2]\*x33 + x10\*x28 - x29\*x5;

double x38 = x36 + x37;

double x39 = x31\*x34;

double x40 = x32 + x39;

double x41 = ddq[1] + ddq[2];

double x42 = x31\*x33;

double x43 = x41 + x42;

double x44 = x28\*x43;

double x45 = ((x34)\*(x34));

double x46 = ((x33)\*(x33));

double x47 = -x46;

double x48 = x45 + x47;

double x49 = -x39;

double x50 = ((x31)\*(x31));

double x51 = -x45;

double x52 = x50 + x51;

double x53 = -x42;

double x54 = x41 + x53;

double x55 = x35 - x37;

double x56 = a2\*x22 + x23;

double x57 = -x56;

double x58 = -a2;

double x59 = -x50;

double x60 = x47 + x59;

double x61 = a2\*x13 + x26;

double x62 = a2\*(x19 + x24) + x27;

double x63 = x28\*x61 + x30\*x62;

double x64 = -x63;

double x65 = x28\*x62 + x29\*x61;

double x66 = x46 + x59;

double x67 = x32 + x49;

double x68 = x35 + x37;

double x69 = -x65;

//

Mregress[0] = 0;

Mregress[1] = 0;

Mregress[2] = 0;

Mregress[3] = 0;

Mregress[4] = 0;

Mregress[5] = ddq[0];

Mregress[6] = 0;

Mregress[7] = 0;

Mregress[8] = 0;

Mregress[9] = 0;

Mregress[10] = x0\*x5 + x9;

Mregress[11] = x0\*(x10 + x8) + x11\*x2;

Mregress[12] = x0\*x13 + x2\*(x14 + x16);

Mregress[13] = x0\*x17 + x1\*x18;

Mregress[14] = x0\*(x19 + x20) + x2\*(ddq[1] + x21);

Mregress[15] = x0\*x4 - x9;

Mregress[16] = a1\*x22 - x2\*x23;

Mregress[17] = a1\*x11 + x0\*x23;

Mregress[18] = a1\*(x16 + x24) - x0\*x26 + x2\*x27;

Mregress[19] = a1\*x23;

Mregress[20] = x0\*(x28\*x32 + x30\*x35) + x2\*(x28\*x35 + x29\*x32);

Mregress[21] = x0\*(x28\*x38 + x30\*x40) + x2\*(x28\*x40 + x29\*x38);

Mregress[22] = x0\*(x30\*x48 + x44) + x2\*(x28\*x48 + x29\*x43);

Mregress[23] = x0\*(x28\*x49 + x30\*x37) + x2\*(x28\*x37 + x29\*x49);

Mregress[24] = x0\*(x28\*x52 + x30\*x54) + x2\*(x28\*x54 + x29\*x52);

Mregress[25] = x0\*(x28\*x39 + x30\*x36) + x2\*(x28\*x36 + x29\*x39);

Mregress[26] = a1\*x55 + x0\*x30\*x57 + x2\*(x28\*x57 + x55\*x58);

Mregress[27] = a1\*x40 + x0\*x28\*x56 + x2\*(x29\*x56 + x40\*x58);

Mregress[28] = a1\*x60 + x0\*(x28\*x64 + x30\*x65) + x2\*(x28\*x65 + x29\*x64 + x58\*x60);

Mregress[29] = a1\*x56 + a2\*x2\*x57;

Mregress[30] = 0;

Mregress[31] = 0;

Mregress[32] = 0;

Mregress[33] = 0;

Mregress[34] = 0;

Mregress[35] = 0;

Mregress[36] = 0;

Mregress[37] = 0;

Mregress[38] = 0;

Mregress[39] = 0;

Mregress[40] = x21;

Mregress[41] = x15 + x24;

Mregress[42] = x17 + x5;

Mregress[43] = x12;

Mregress[44] = x10 + x7;

Mregress[45] = ddq[1];

Mregress[46] = x26;

Mregress[47] = -x27;

Mregress[48] = 0;

Mregress[49] = 0;

Mregress[50] = x53;

Mregress[51] = x66;

Mregress[52] = x67;

Mregress[53] = x42;

Mregress[54] = x68;

Mregress[55] = x41;

Mregress[56] = a2\*(x29\*(x51 + x59) + x44) + x63;

Mregress[57] = a2\*(x28\*(x47 + x51) + x29\*(-x41 + x42)) + x69;

Mregress[58] = a2\*(x28\*(-x32 + x39) + x29\*x68);

Mregress[59] = a2\*(x28\*x63 + x29\*x65);

Mregress[60] = 0;

Mregress[61] = 0;

Mregress[62] = 0;

Mregress[63] = 0;

Mregress[64] = 0;

Mregress[65] = 0;

Mregress[66] = 0;

Mregress[67] = 0;

Mregress[68] = 0;

Mregress[69] = 0;

Mregress[70] = 0;

Mregress[71] = 0;

Mregress[72] = 0;

Mregress[73] = 0;

Mregress[74] = 0;

Mregress[75] = 0;

Mregress[76] = 0;

Mregress[77] = 0;

Mregress[78] = 0;

Mregress[79] = 0;

Mregress[80] = x53;

Mregress[81] = x66;

Mregress[82] = x67;

Mregress[83] = x42;

Mregress[84] = x68;

Mregress[85] = x41;

Mregress[86] = x63;

Mregress[87] = x69;

Mregress[88] = 0;

Mregress[89] = 0;

//

return;

}

1. [↑](#footnote-ref-1)