I2R Home Task 4

Aidar Ahmetshin

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1 Irreducible model

Transformation matrix:

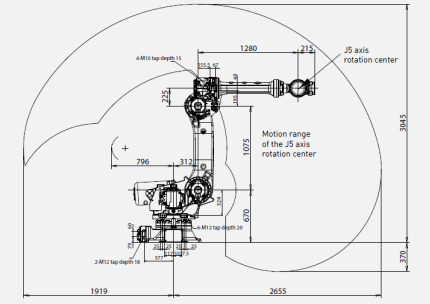
$$T = T_z(l1) * R_z(q1) * T_y(l2) * R_x(q2) * T_z(l3) * R_x(q3) * T_z(l4) \\ *T_y(l5) * R_y(q4) * R_x(q5) * T_y(l6) * R_y(q6) \tag{1}$$

Complete Irreducible model:

$$T = Tbase * Trobot * Ttool \tag{2}$$

$$T = Tbase * T_z(l1) * R_z(q(1)) * [T_x(param(1)) * T_y(param(2)) * R_y(param(3))] \\ *R_x(q(2) + param(4)) * [T_y(l2) * R_y(param(5)) * R_z(param(6))] \\ *R_x(q(3) + param(7)) * [T_y(param(8)) * T_z(l3) * R_z(param(9))] \\ *Ry_(q(4) + param(10)) * [T_x(param(11)) * T_z(l4) * R_z(param(12))] \\ *R_x(q(5) + param(13)) * [T_y(l5) * T_z(param(14)) * R_z(param(15))] \\ *R_y(q(6)) * Ttool \tag{3}$$

All real parameters for model taken from datasheet, also to configure 30 example, robot limits were took into account.



Link to GitHub: https://github.com/brooky56/I2R

2 Real and Estimated parameters

Real params:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.0100	0.0200	0	0.0500	1.0000	0	0.7500	0.1750	2.0000	0.8900	1.2100	0	0.5500	0.5600	0.6500

Estimated params:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.2137	0.0475	-0.0002	0.0004	-0.0004	-0.0010	0.0007	0.2440	0.0001	-0.0017	5.0495	0.0014	-0.0028	-0.5136	-0.0031

Jacobians:

90×15 double

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-0.8578	-0.5140	-328.2730	196.6814	-750.0031	-42.8366	37.9290	-0.1196	-112.6486	179.4233	0.3045	23.2781	115.7985	-0.5717	326.3432
2	0.5140	-0.8578	196.6814	328.2730	441.3784	24.5292	63.3057	-0.1996	65.6167	-115.3371	-0.9397	-149.9026	23.8589	-0.0498	-1.3762e+03
3	0	0	-6.9130	-824.5056	-0.9744	6.8439	-868.4827	0.9725	6.7231	-1.6089	-0.1555	113.2227	82.6086	-0.8189	-144.1550
4	0.4308	-0.9025	-423.9444	-888.2079	534.2115	265.7151	-1.1143e+03	0.7486	72.7079	129.1410	0.4029	55.8938	-144.5494	0.8970	582.7818
5	0.9025	0.4308	-888.2079	423.9444	1.2899e+03	429.9143	531.8369	-0.3573	-24.0562	389.3264	0.9141	-16.0463	68.4191	-0.3847	1.2847e+03
6	0	0	-91.5962	-1.0058e+03	54.6136	73.5338	-819.7280	0.5585	51.1572	75.9790	0.0448	39.2425	-96.1100	-0.2178	131.1161
7	0.8654	0.5012	1.1307e+03	-654.8623	1.1693e+03	-95.2063	-669.2395	0.4867	78.7182	240.2364	0.4646	-61.2812	-44.6034	0.7593	690.3918
8	-0.5012	0.8654	-654.8623	-1.1307e+03	-704.9466	355.8693	-1.1556e+03	0.8405	247.7301	-211.0601	-0.4799	-33.9691	-162.6888	0.6484	-721.9384
9	0	0	-261.3444	695.8285	-260.2373	-24.0297	385.1502	-0.2382	-62.2423	-253.8243	-0.7442	58.9482	77.0763	0.0558	-1.0049e+03
10	0.6240	-0.7814	-160.4814	-200.9776	-119.5258	362.3945	-267.0104	0.3518	47.8853	-292.2001	-0.4930	-66.5111	-22.0165	0.1718	-822.4097
11	0.7814	0.6240	-200.9776	160.4814	-114.0928	580.3529	213.2089	-0.2809	0.7970	-248.5857	-0.8665	14.6715	24.3742	-0.1853	-1.1583e+03
12	0	0	-82.0056	-309.5507	-78.9406	22.2103	-609.8896	0.8929	73.2235	36.9221	-0.0784	-133.0221	-130.9954	0.9676	-75.7481
13	0.3185	0.9479	-82.2934	244.8798	-180.1133	542.9541	182.3716	-0.1455	-26.7473	228.9824	0.8579	30.6107	-11.4861	-0.0242	1.1403e+03
14	-0.9479	0.3185	244.8798	82.2934	326.8251	-648.5237	61.2871	-0.0489	-72.3025	296.3858	0.4913	22.4715	58.2704	-0.2542	814.7343
15	0	0	-315.2033	-542.5560	-308.0825	-66.6205	-847.5075	0.9881	311.4674	48.3859	0.1506	150.7959	-124.6402	0.9668	242.7390
16	-0.9802	0.1979	-389.5135	-78.6332	-731.1859	-341.7913	-28.0351	0.0773	-182.8631	267.6030	0.9925	190.9642	14.8395	-0.1220	1.4050e+03
17	-0.1979	-0.9802	-78.6332	389.5135	-168.2540	-83.4346	138.8731	-0.3830	-46.7596	30.8338	-0.0585	-30.2624	189.0283	-0.5563	-124.3607
18	0	0	-24.6935	-637.3323	-14.1499	20.2373	-816.1149	0.9205	22.7301	-9.6494	-0.1077	25.9435	34.1499	-0.8220	-124.2990
19	-0.4235	-0.9059	-357.4001	764.5991	-427.0482	-222.6147	653.8073	-0.8584	-254.9370	46.6397	0.2331	95.0378	165.0356	-0.3688	393.4492
20	0.9059	-0.4235	764.5991	357.4001	705.8845	-11.2566	305.6122	-0.4012	43.3033	-269.2152	-0.8601	-98.2089	-0.6529	0.3535	-1.1911e+03
21	0	0	-224.3945	-111.8560	-206.4370	87.9584	-398.8876	0.3197	71.7493	-212.6145	-0.4537	-89.4019	86.0125	-0.8596	-658.6221
22	-0.7584	-0.6518	-636.4111	546.9844	-638.4123	675.7598	356.0811	-0.2382	81.5490	-110.7940	-0.4280	31.2145	71.6447	0.2443	-533.1475
23	0.6518	-0.7584	546.9844	636.4111	502.3134	-563.7697	414.2969	-0.2771	-88.1483	49.2235	0.8903	-129.3059	5.4558	0.2797	1.2897e+03
24	0	0	-37.4787	-1.1727e+03	12.9184	35.1820	-1.0651e+03	0.9308	34.8870	-13.6951	0.1555	59.0158	165.9366	-0.9285	248.1770
25	0.9524	0.3049	405.0558	-129.6646	916.7682	354.1321	-47.0585	0.0204	-81.6541	-44.4310	-0.2206	19.7340	87.7129	0.3204	-280.3810
26	-0.3049	0.9524	-129.6646	-405.0558	-270.9826	-100.5236	-147.0048	0.0637	27.8715	40.0610	0.9737	-81.7930	30.1082	0.0165	1.3856e+03
27	0	0	-24.6632	-857.7183	-12.2283	21.4182	-1.0124e+03	0.9978	24.6079	-1.6503	-0.0577	39.3984	172.7766	-0.9471	-70.7276
28	-0.7271	-0.6865	-965.5724	911.6644	-484.3310	609.9798	720.9342	-0.6856	-114.0522	11.1633	-0.5743	-96.9457	-92.0653	0.0544	-896.9303
29	0.6865	-0.7271	911.6644	965.5724	312.8141	-649.7593	763.5641	-0.7261	-54.3488	-18.9199	0.4959	-52.3105	-140.8491	0.8170	671.3480
30	0	0	-117.9740	41.9931	-53.6862	105.0508	-99.9880	0.0516	6.0931	-117.8166	-0.6514	-24.3843	-26.0594	0.5740	-870.5193
31	0.1961	0.9806	125.1671	-625.8072	316.8531	356.4769	-471.8196	0.4698	141.1621	244.7370	0.5592	141.1774	72.5422	-0.2490	900.2095
32	-0.9806	0.1961	-625.8072	-125.1671	-959.5648	-709.9544	-94.3682	0.0940	-111.1879	-134.3376	-0.8011	-96.5717	76.6479	-0.4079	-1.0732e+03
33	0	0	-243.3918	-897.2405	-210.3142	122.5052	-1.1668e+03	0.8777	213.6371	-116.6139	-0.2135	91.7414	-97.5801	0.8784	-243.2595
34	0.9447	-0.3278	-295.1316	-102.4075	-530.2013	835.1753	-64.9068	0.0260	109.3683	-32.4038	0.3029	34.1694	116.1185	-0.9488	433.7532

3 Summary

As we can concluded from estimated parameters, not all params influence into our module. We can analyze each configuration and choose the best one depending on out minimized function. Also it can be some troubles with calculating all necessary steps. Callibration is very important and one of the complex tasks in this time.