Cortex-R4 DSP Software Library Benchmarks

ARM Confidential

1. Introduction

This document covers the cycles and memory benchmarking of DSP Library on Cortex-R4 for the library **arm_math_Cortex_R4_bspf.lib** which is compiled on Cortex-R4 for **b**ig-endian **s**ingle **p**recision **f**loating point.

1.1. Platform

Hardware:
- TMS570 LS20216

Software:
- Keil MDK 4.21
- ARM C compiler with v561 .

Release :
- Cortex R DSP Library_2.0.0

Tested on:
- TMS570 LS20216

2. Benchmarking informtion

2.1. Cortex-R4 DSP Library benchmarks

		Q7		Q15		Q31		F32	
	Configuration	**Memory**	**Cycles**	**Memory**	**Cycles**	**Memory**	**Cycles**	**Memory**	**Cycles**
Basic Math									
Addtion	B - 32	256	91	136	145	200	190	316	212
Subtraction	B - 32	256	84	136	130	188	191	316	216
Scale	B - 32	384	267	260	257	252	616	264	161
Absolute	B - 32	200	201	200	191	200	196	152	147
Dot Product	B - 32	132	137	238	125	488	302	296	177
Offset	B - 32	144	91	108	126	144	139	252	157
Negate	B - 32	116	68	116	102	160	163	260	169
Shift	B - 32	612	225	556	201	276	226	---	---
Multiplication	B - 32	384	248	260	203	256	316	328	197
Complex Math									
Complex Conjugate	B - 32	---	---	292	191	316	236	304	244
Complex Magnitude Sqr	B - 32	---	---	132	179	320	316	300	272
Complex Magnitude	B - 32	---	---	496	3851	548	4467	268	826
Complex Dot Product	B - 32	---	---	404	319	648	570	332	277
Complex by Real Multiplication	B - 32	---	---	324	336	304	482	288	362
Complex by Complex Multiplication	B - 32	---	---	340	482	336	553	268	377

	Configuration	Q7		Q15		Q31		F32	
		Memory	Cycles	Memory	Cycles	Memory	Cycles	Memory	Cycles
Statistics Functions									
Power	B - 32	192	118	104	86	424	308	228	125
Mean	B - 32	216	124	224	124	296	324	224	130
Var	B - 32	---	---	360	250	448	248	356	215
RMS	B - 32	---	---	420	342	552	288	260	155
Std	B - 32	---	---	580	417	732	403	376	245
Min	B - 32	208	209	208	213	212	215	236	274
Max	B - 32	216	225	216	227	212	215	236	275
Filter Functions									
FIR	B - 32 T - 32	1044	2660	800	2257	1012	4138	700	2086
Biquad-DF1	B - 32 S - 4	---	---	316	2214	516	3038	752	1258
Biquad-DF2T	B - 32 S - 4	---	---	---	---	---	---	348	1654
Biquad 32X64	B - 32 S - 4	---	---	---	---	1592	12152	---	----
Convolution	B1-32 B2-64	1108	6401	1168	6843	1704	11490	1460	8879
Partial Convolution	B1-32 B2-64, 10 – N	1116	1507	1192	1537	1836	831	1596	708
Correlation	B1-32 B2-64	1292	6747	1364	7312	1808	11618	1492	9146
FIR Decimation	B - 32 T - 32 D - 4	---	---	968	994	1528	1728	1264	1295
FIR Interpolation	B - 32 T - 32 I - 4	---	---	1272	1751	876	1668	880	929
FIR Sparse	B - 64 T - 5	1432	5137	1428	6208	1280	5201	1068	4662
FIR lattice	B - 32 T - 7	---	---	376	2133	376	2107	700	1205
IIR lattice	B - 32 S - 8	---	---	752	5105	700	4954	628	3645
LMS	B - 32 T - 8	---	---	996	4991	1076	6374	880	3673
LMS Norm	B - 32 T - 8	---	---	1188	6738	1356	9176	940	4282
Support Functions									
Q31 to Q15	B - 32	---	---	----	----	240	150	----	----
Q31 to Q7	B - 32	---	---	----	----	268	175	----	----
Q15 to Q31	B - 32	---	---	----	----	256	166	----	----
Q7 to Q15	B - 32	---	---	----	----	252	151	----	----
Q15 to Q7	B - 32	---	---	----	----	252	145	----	----
Q7 to Q31	B - 32	---	---	----	----	244	151	----	----
Copy	B - 32	212	77	164	120	140	120	140	111
Fill	B - 32	188	81	184	82	212	125	216	119
Fast Math Functions									
Cosine	B - 32	---	**---**	176	2273	164	2177	208	2754
Sine	B - 32	---	**---**	176	2267	164	2170	208	2747
Sqrt	B - 32	---	**---**	284	3893	304	4309	140	1261

		Q7		Q15		Q31		F32	
	Configuration	Memory	Cycles	Memory	Cycles	Memory	Cycles	Memory	Cycles
Controller Functions									
PID	B - 1	---	---	84	34	76	34	60	28
Sine Cosine	B - 1	---	---	---	---	152	53	116	54
Clarke	B - 1	---	---	---	---	36	20	36	16
Park	B - 1	---	---	---	---	84	35	28	18
Inverse Clarke	B - 1	---	---	---	---	56	25	32	16
Inverse Park	B - 1	---	---	---	---	84	35	28	18
Transform Functions									
CFFT	B - 64	---	---	2016	3236	2896	5407	1944	2996
CFFT Mag	B - 64	---	---	1576	10961	1976	14277	1292	4125
RFFT	B - 128	---	---	2852	4811	3884	7639	2978	4827
DCT	B - 128	---	---	4664	11066	5632	15948	4360	9256
Matrix Functions									
Matrix Addtion	8x8	---	---	220	215	280	356	412	388
Matrix Subtraction	8x8	---	---	216	218	276	391	412	406
Matrix Scale	8x8	---	---	404	408	412	578	332	276
Matrix Multiplication	8x8	---	---	444	3138	372	3990	308	3328
Matrix Inverse	8x8	---	---	---	---	---	---	1412	11845
Matrix Transpose	8x8	---	---	208	511	228	388	228	400
Complex Mat Mult	8x8	---	---	536	8846	572	9800	456	6081
Interpolation Functions									
Bilinear Interpolation	B - 32	264	1264	276	2228	212	1601	228	1546
Linear Interpolation	B - 32	104	2577	108	728	108	772	156	666

2.2. Cortex-R4 DSP Library Fast Versions

Function		Fast Q15		Fast Q31	
	Configuration	Memory	Cycles	Memory	Cycles
FIR	32 – B 32 – T	588	1976	876	3578
Biquad-DF1	B - 32 S - 4	280	1750	400	2568
Convolution	32 – B1 , 64 – B2	1044	5839	1644	11307
Partial convolution	32 – B1, 64 – B2, 10 – N	1080	1394	2060	956
Correlation	32 – B1, 64 – B2	856	5949	1820	11845
FIR decimation	32 – B, 32 – T, 4 – D	936	980	1192	1670
Matrix Multiplication	8x8	424	3114	356	3883

Note :-

1. **B** Block size
2. **T** Num taps
3. **D** Decimation factor
4. **I** Interpolation factor
5. **S** Stages
6. **B1** Block size of first vector
7. **B2** Block size of second vector
8. **----** Module does not exist
9. Memory in bytes