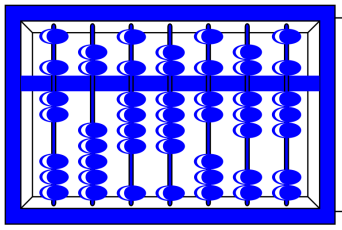

NASoftware Limited

Incorporating InfoSAR

INTEL AVX SARMTI BENCHMARKS.

N*A. Software Ltd*

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1. Introduction.

In 2011, NA Software Ltd (NAS) produced some radar processing software for the Intel Corporation called the SARMTI demo. This software package uses Synthetic Aperture Radar (SAR) radar data from an airborne radar system illuminating the ground as it flies along to:

a) Show the user the raw SAR radar data;
b) Azimuth compresses the SAR data to produce a large high resolution focussed image of the ground;
c) Shows the user a search area within this image;
d) Calls a SARMTI processor to detect moving ground targets within the search area;
e) Displays the target in data together with ground truth information;

This demonstration program has been used by the Intel and Kontron Corporations to demonstrate the efficiency of their hardware at a number of conferences and events around the world. In this report we benchmark this software over the following data sets of interest:

- Demo 1: C Band radar system with data size 512 by 128 complex cells.
- Demo 2: C Band radar system with data size 512 by 256 complex cells.
- Demo 3: C Band radar system with data size 512 by 512 complex cells.
- Demo 4: C Band radar system with data size 1K by 1K complex cells.

All four data sets are to be benchmarked on an Ivy Bridge system and the latest Haswell system. The two test platform details are as follows:

Table 2: Test Platform Information.

Platform 1.	Type:	Ivy Bridge.
	Bit:	64
	Operating Frequency:	2.3 GHz.
	Turbo boost:	Enabled.
	Operating System:	Linux Fedora 15.
	Physical Cores:	4
Platform 2.	Type:	Haswell.
	Bit:	64
	Operating Frequency:	2.4 GHz.
	Turbo boost:	Enabled.
	Operating System:	Linux Fedora 17.
	Physical Cores:	4

The following four versions of the SARMTI processor were compiled, two optimised for Ivy Bridge and two optimised for Haswell:

- Version 1: uses NAS DSP libraries optimised for Ivy Bridge (AVX1);
- Version 2: uses MKL DSP libraries optimised for Ivy Bridge (AVX1);
- Version 3: uses NAS DSP libraries optimised for Haswell (AVX2);
- Version 4 uses MKL DSP libraries optimised for Haswell (AVX2);

The version information associated with the above compilations is given below:

Table 3: Version Information.

AVX1 Timing Code Compiler	GCC Version 4.6.1
AVX1 MKL DSP library	MKL Version 10.3.4
AVX1 NAS DSP library	NAS Version 4.0.1
AVX2 Timing Code Compiler	GCC Version 4.7.1
AVX2 MKL DSP library	MKL Version 11.0.3
AVX2 NAS DSP library	NAS Version 4.1.0

This report is organised into the following sections:

Section 1: Introduction – this introduction.

Section 2: SARMTI Benchmarks – gives timings for all four demos running on Ivy Bridge and Haswell.

Section 3: Conclusions – gives conclusions.

2. SARMTI Benchmarks.

The following tables show the benchmark results of running optimised versions of the SARMTI processor on both a Ivy Bridge system and a Haswell system.

2.1. Demo 1 Benchmarks.

Demo 1 has a data size of 512 by 128 complex cells and the SARMTI processor successfully detects and locates two targets within this data when it is executed as part of this demo. The tables below shows that the Haswell system executes the processor between 1.29 and 1.53 times quicker than the Ivy Bridge system. Both systems have same cache size and the same number of cores (4 physical, 8 with hyper-threading). The operating frequency of the Ivy Bridge system is 2.3GHz and the Haswell system is 2.4 GHz.

Table 3: Demo 1 NAS timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	6.66	4.99	1.33
2	3.67	2.71	1.35
4	2.37	1.55	1.53
8	2.09	1.38	1.48

Table 4: Demo 1 MKL timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	6.97	5.34	1.30
2	3.85	2.98	1.29
4	2.46	1.70	1.45
8	2.00	1.57	1.27

2.2. Demo 2 Benchmarks.

Demo 2 has a data size of 512 by 256 complex cells and the SARMTI processor successfully detects 5 moving targets from within this SAR data. The tables below shows that the Haswell system runs the software between 1.29 and 1.52 times quicker than the Ivy Bridge system, depending on the number of threads.

Table 5: Demo 2 NAS timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	14.29	10.73	1.33
2	7.81	5.76	1.36
4	4.52	3.31	1.37
8	4.07	2.96	1.38

Table 6: Demo 2 MKL timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	14.24	11.45	1.30
2	8.26	6.38	1.29
4	5.52	3.63	1.52
8	4.49	3.33	1.35

2.3. Demo 3 Benchmarks.

Demo 3 has a data size of 512 by 512 complex cells and the SARMTI processor successfully detects 8 moving targets from within this SAR data. The tables below shows that the Haswell system runs the software between 1.26 and 1.53 times quicker than the Ivy Bridge system, depending on the number of threads.

Table 7: Demo 3 NAS timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	28.23	21.26	1.33
2	15.55	11.49	1.35
4	8.88	6.55	1.36
8	8.02	5.86	1.37

Table 8: Demo 3 MKL timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	29.19	23.19	1.26
2	16.73	12.49	1.34
4	10.76	7.03	1.53
8	8.71	6.34	1.37

2.4. Demo 4 Benchmarks.

Demo 4 has a data size of 1K by 1K complex cells and the SARMTI processor successfully detects 16 moving targets from within this SAR data. The table below shows that the Haswell system runs the software between 1.29 and 1.37 times quicker than the Ivy Bridge system, depending on the number of threads.

Table 9: Demo 4 NAS timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	71.47	53.36	1.34
2	40.42	30.19	1.34
4	22.19	16.95	1.31
8	20.54	15.71	1.31

Table 10: Demo 4 MKL timings in seconds.

Threads	*Ivy Bridge*	*Haswell*	*Speed Up Ratio*
1	75.35	57.18	1.30
2	41.01	31.78	1.29
4	24.32	18.05	1.35
8	22.60	26.52	1.37

3. Conclusions.

This report has shown that the SARMTI processor executes faster on the Haswell platform over all software demonstration datasets and over all thread counts from 1 to 8. The following table shows the maximum and minimum speed up obtained by Haswell:

Table 11: SARMTI Haswell Speed Ups.

SARMTI demo.	*Minimum Haswell Speed Up Ratio.*	*Maximum Haswell Speed Up Ratio.*	*MKL Average Haswell Speed Up Ratio.*	*NAS Average Haswell Speed Up Ratio.*
Demo 1.	1.29	1.53	1.33	1.42
Demo 2.	1.29	1.52	1.37	1.36
Demo 3.	1.26	1.53	1.38	1.35
Demo 4.	1.29	1.37	1.33	1.33

The table shows that the SARMTI processor runs over 30% quicker on Haswell on average and can go over 50% quicker in certain configurations.