JCTVC-G262
HM decoder complexity assessment on ARM

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Problem statement

- HM 4.0 decoder complexity assessment results on ARM processor, using a "Snowball" developer board equipped with the **ST-Ericsson Nova™ A9500**, an application processor for mobile terminals including a **dual Cortex A9 CPU at 1 GHz** clock frequency.

- The running time reported by the HM 4.0 decoder itself has been taken as complexity metric.

- Decoding time for anchor streams reported.

- Considering particularly **HE/LC ratio**.

- Comparison with Intel platform.

Systems

	Snowball	PC (computer farm)	
CPU	ARM Dual Cortex A9	Intel Xeon E5472 4 Cores	Intel Xeon X5570 4 Cores
Cache	L1 = 2x64 kB L2 = 512 kB	L1 = 4x64 kB L2 = 2x6 MB	L1 = 4x64 kB L2 = 4x256 kB L3 = 8MB
Frequency	1.00 GHz	3.00 GHz	2.93 GHz
Physical memory	802 MB	32 GB	72 GB
Swap memory	0	34 GB	122 GB
OS	Linux (2.6.35)	Linux (2.6.9)	
g++ version	4.5.2	3.4.6	

- Snowball information on http://igloocommunity.org/

Decoding results

|	Intel platform					ARM platform				
	LC time	HE time	HE/LC ratio			LC time	HE time	HE/LC ratio		
			Avg	Min	Max			Avg	Min	Max
All Intra (AI)	55.353	72.537	1.310	1.151	1.478	209.845	260.687	1.242	1.111	1.409
Random Access (RA)	29.305	40.359	1.377	1.099	1.671	120.729	147.486	1.222	1.075	1.385
Low-delay (LB)	21.934	29.402	1.340	1.160	1.541	101.398	121.995	1.203	1.082	1.302
Low-delay P-only (LP)	18.001	26.459	1.470	1.239	1.764	88.140	109.029	1.237	1.084	1.378
			1.373	**1.099**	**1.764**			**1.226**	**1.075**	**1.409**

Comments

- From previous experiments on HM 2.0 [JCTVC-E054], the HE/LC complexity ratio **consistently reduced**: was 1.77 on Intel and 1.60 on ARM (on Low Delay only); now is **1.37 on Intel** and **1.23 on ARM**.

- Max. HE/LC ratio is 1.76 on Intel and 1.41 on ARM.

- HE/LC decoding time ratio increases with spatial resolution.

- The average HE/LC value for the AI configuration is the lowest value among all configurations on Intel platform (1.310) and instead is the highest on ARM platform (1.242).

Profiling

- Performed with **Oprofile version 0.9.6** on the Snowball.

- We considered the bit-streams with maximum and minimum HE/LC ratio for RA and LB configurations.

- Class A excluded because of memory issues.

- The analyzed bit-streams for RA configuration are:

    - BQTerrace_1920x1080_60qp27   (HE/LC ratio = 1.335)

    - RaceHorses_416x240_30qp37   (HE/LC ratio = 1.075)

- The analyzed bit-streams for LB configuration are:

    - BQTerrace_1920x1080_60qp27   (HE/LC ratio = 1.302)

    - RaceHorses_416x240_30qp37   (HE/LC ratio = 1.082)

BQTerrace @ QP=27 (RA HE)
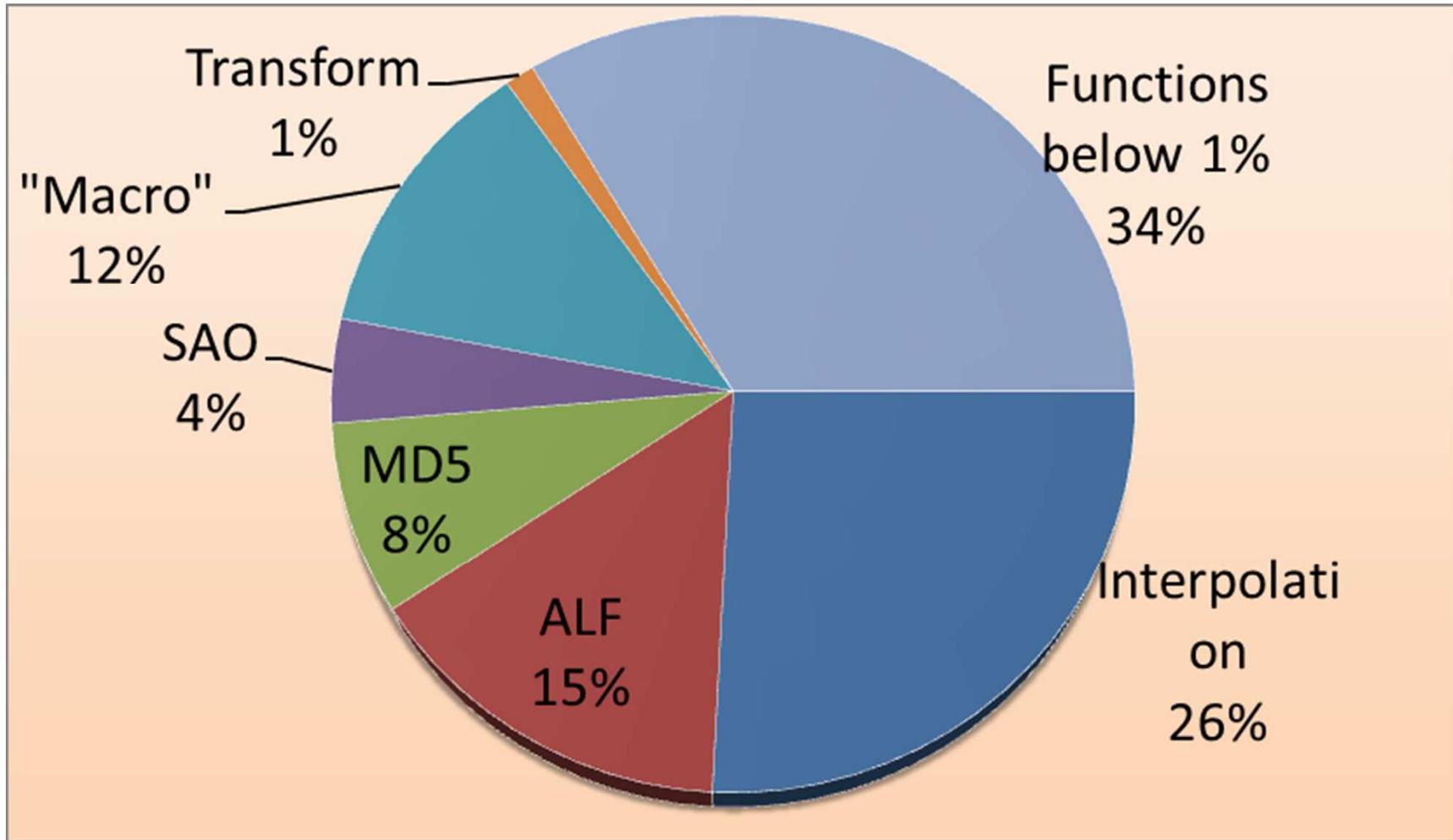
BQTerrace @ QP=27 (RA LC)
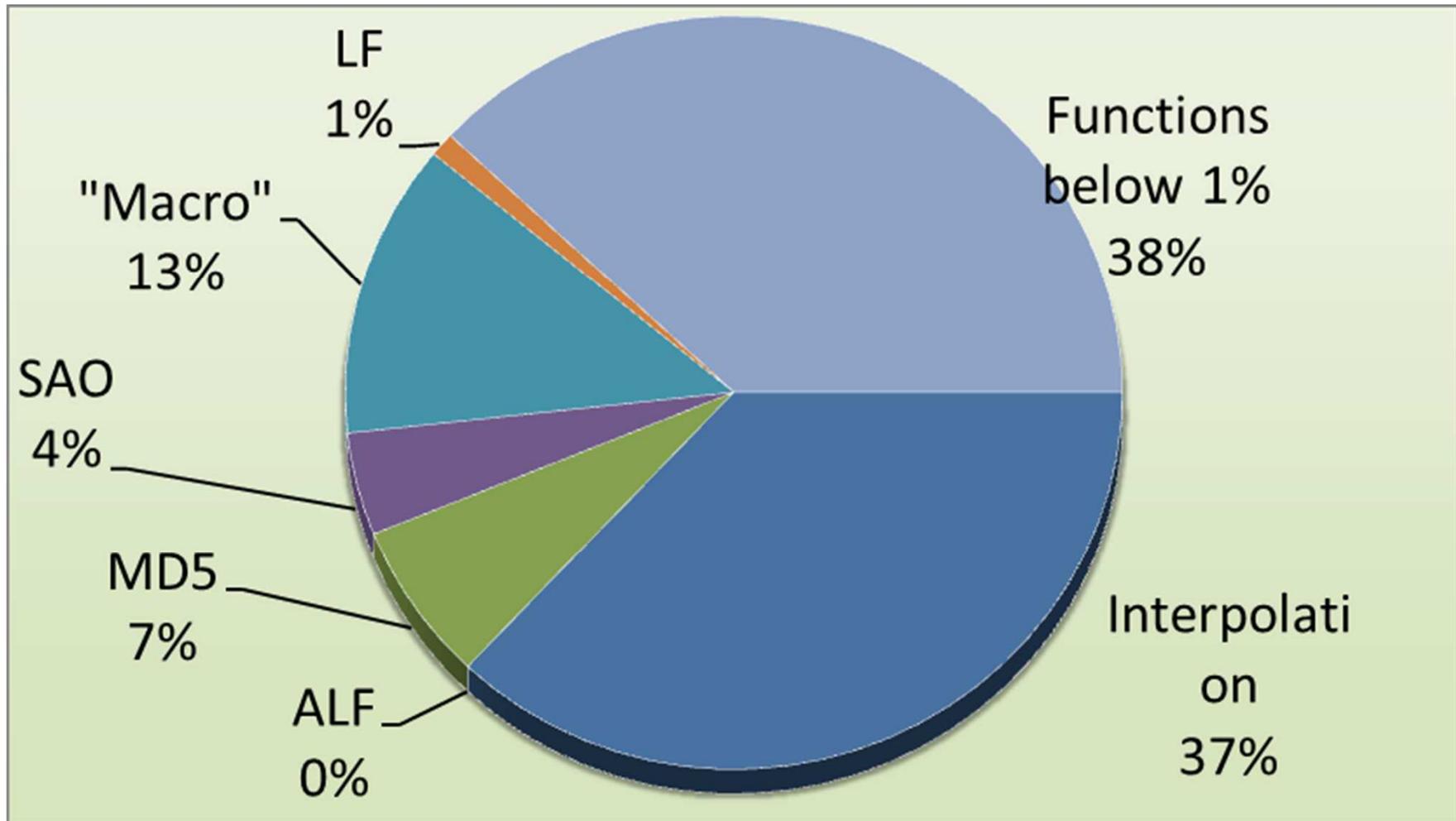
Comments

- The complexity is spread among many different functions. The cumulative complexity of HM functions giving an individual contribution below 1% of total decoding runtime is typically **between 30% and 45%**.

- The most significant contribution is given by **interpolation functions**.

- The contribution of **ALF** in HE configurations is **very variable**, depending on the sequence characteristics and QP, ranging typically from about 3% to 15%.

- The **inverse transform** gives a very minimal contribution to the overall software decoder complexity.

- **MD5** computation can reach a significant percentage of total HM runtime complexity, i.e. **around 8%**.

Thank you