Corrigendum: Experimental Energy Profiling of Energy-Critical Embedded Applications

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Due to an oversight in connecting the negative analog input signal (AI-) of the NI 9215 voltage-measurement module to the common reference connection to isolated ground (COM) port [1], some of the experimental values quoted in our SoftCOM2017 paper [2] and related comments are incorrect. Even though the global findings of our work still remain valid, the following corrections should be taken into account when referring to our published paper.

Corrections

1) Figure 7 and Figure 8 in our published work [2] are to be replaced with the following Figure 7 and Figure 8, respectively.

2) Section IV, subsection B, paragraph 1:
~~Each of these settings corresponds to a different supply voltage (1.06 V, 1.16 V, and 1.21 V, respectively).~~
Each of these settings corresponds to a different supply voltage (0.98 V, 1.09 V, and 1.23 V, respectively).

3) Section V, paragraph 3:
~~Figure 7 shows that the average power per millisecond increases steadily with the frequency for all three benchmarks (SHA, Blowfish and Gold-Rader) in an almost-linear fashion.~~
Figure 7 shows that the average power increases steadily with the increase in frequency for all three benchmarks (SHA, Blowfish and Gold-Rader).

4) Section V, paragraph 4:
~~It is obvious that the energy consumption curves are convex, each having an optimal frequency point (f_{opt}) where the energy consumption is minimized.~~
It is obvious that the energy consumption curves are convex, each having the same optimal frequency point (f_{opt}) where the energy consumption is minimized.

5) Section V, paragraph 5:
~~In our experiments, we set the CPU target voltage to 1.21 V for the entire frequency range to observe the effect of frequency scaling in isolation. Although the target voltage is fixed, the actual voltage can be anywhere between 0.95 V and 1.25 V.~~
In our experiments, the target voltage is set to 0.98V, 1.09V and 1.23V for the OPP_NOM, OPP_OD and OPP_HIGH frequency operating points, respectively; the voltage is held constant between those operating frequency points. Note, however, that the actual voltage supplied by the PMU on the power rails may still vary by a small amount from those imposed by the set operating points.

6) Section V, paragraph 6 is replaced with:
The total energy consumption curves presented in Figure 8 are relatively flat in the OPP_HIGH region. This suggests that time performance can be increased while maintaining energy efficiency. For instance, the time performance of the Gold-rader, Blowfish and SHA benchmarks can be improved by 15.53%, 20.00%, and 20.18%, respectively, by increasing the clock frequency from 1200 MHz to 1500 MHz. The energy consumption stays almost unchanged and only decreases by a few joules. Note also that the OPP_OD operating point presents a perfect balance between energy consumption and performance.

7) Section V, paragraph 7 is replaced with:
It can also be seen from the curves for the total energy consumption that the optimal frequency point (f_{opt}) lies at 1000 MHz. This is the frequency point where energy consumption is minimised for each of the benchmarks. This optimal frequency point does not vary across different benchmarks. So, when a new workload enters into the system and wakes

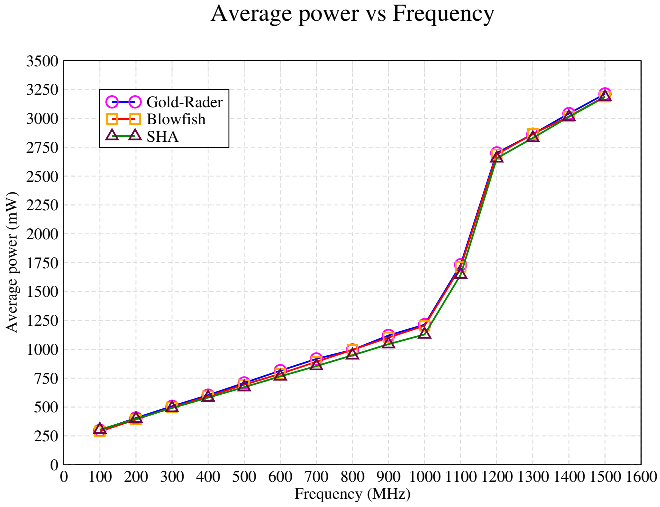

Fig. 7. Average power vs. Frequency: Power consumption of the benchmarks with varying clock frequency on the TI AM572x platform.

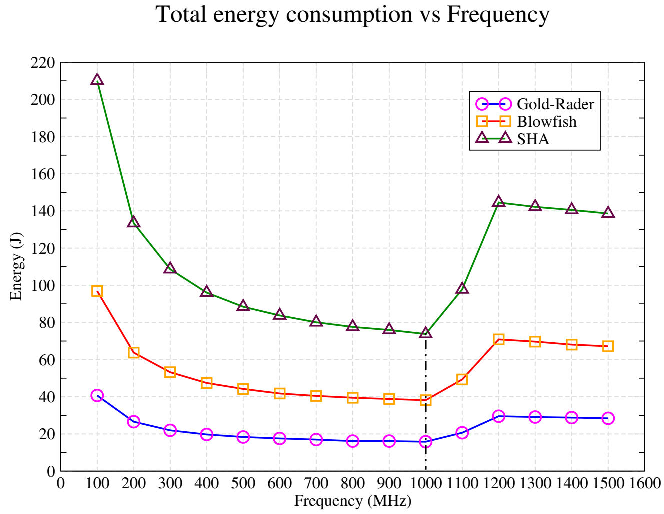

Fig. 8. Total energy vs. Frequency: energy consumption of our three benchmarks with varying clock frequency on the TI AM572x platform. The dotted line represents the optimum frequency for each of the benchmarks.

up the PMU from the sleep states, minimizing the energy consumption would require having an energy-management strategy that reaches the f_{opt} operating point as fast as possible, depending on the current operating frequency. More generally, by taking into account the energy-performance goals of an incoming application on a given architecture, the operating system can use the same kind of energy-frequency data presented here to decide which energy management strategy is best for that particular application.

References

[1] "NI-9215: Getting started guide", National Instruments.
[2] K. R. Vaddina, F. Brandner, G. Memmi and P. Jouvelot. "Experimental energy profiling of energy-critical embedded applications". 2017 25th International Conference on Software, Telecommunications and Computer Networks (SoftCOM),