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Optimising Quantisation Noise in Energy Measurement

1 Genetic Improvement for Longer Battery Life

Mobil devices emphasis the importance of software energy consumption. Programming mobile smart phones is already hard, yet we now want programmers to optimise their code for non-functional properties, like energy use as well. Hence the use of evolution to improve human written code.

Low cost analogue to digital converters can measure real (rather than simulated) performance of mutated designs, particularly energy used by mutated software. However ADC have limited resolution and sampling rates.
Our model of ADC bit resolution and LAN network jitter shows typically ADC quantisation noise dominates and suggests mutants need to exceed discretisation noise (58μA). Then mutant code need only be run for about 1.7/Δk seconds (where Δk is the mutants impact on energy consumption in units of the ADC's resolution).

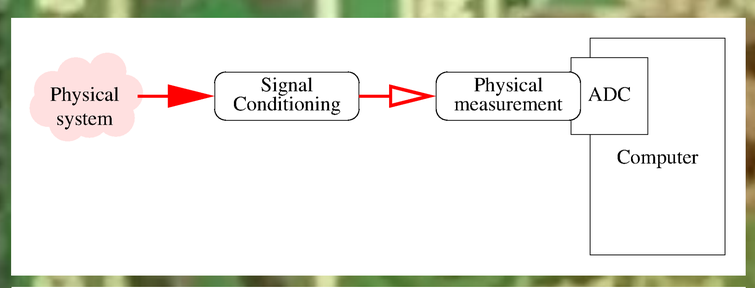


Figure 1: Physical measurement (e.g. thermocouple, resistor) converts signal to voltage, which ADC converts to number (e.g. 0 to 4095).

2 Analogue to Digital Converter

Figure 2: MAGEEC power measurement board http://mageec.org/

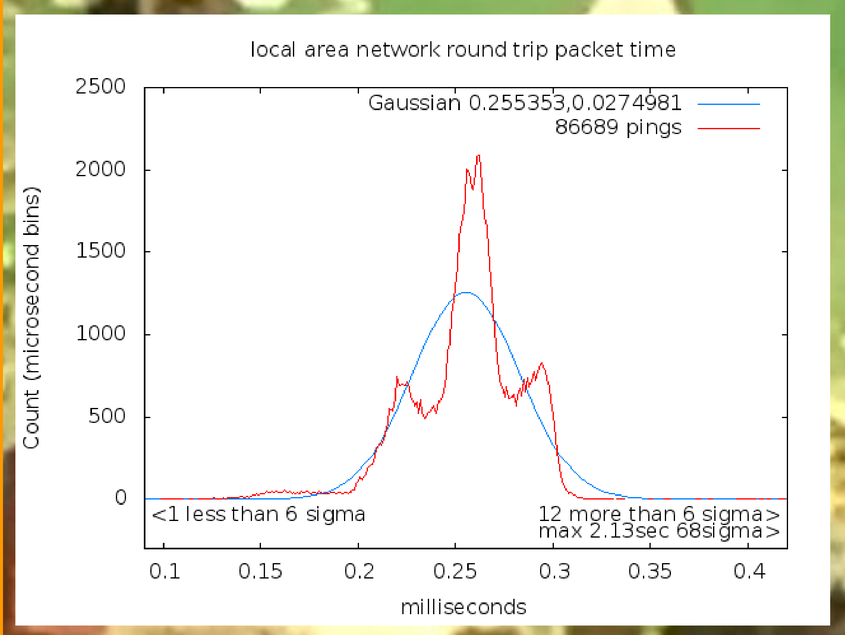


Figure 3: Distribution of network delays over one day. Notice approximately Normal distribution but very long tails (especially long delays).

3 ADC Directly connected to fitness tester

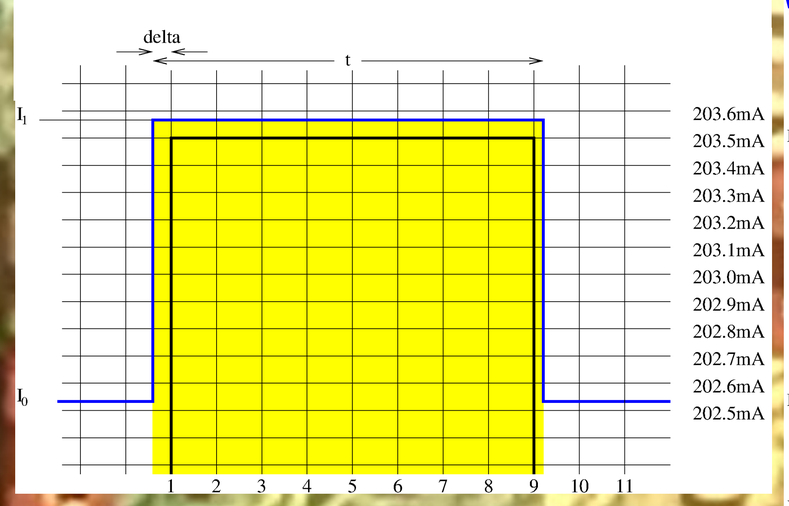


Figure 3: Energy used is area under curve (yellow) but only area inside quantised rectangles is recorded. E.g. noise = 7%

4 Distributed Power measurement

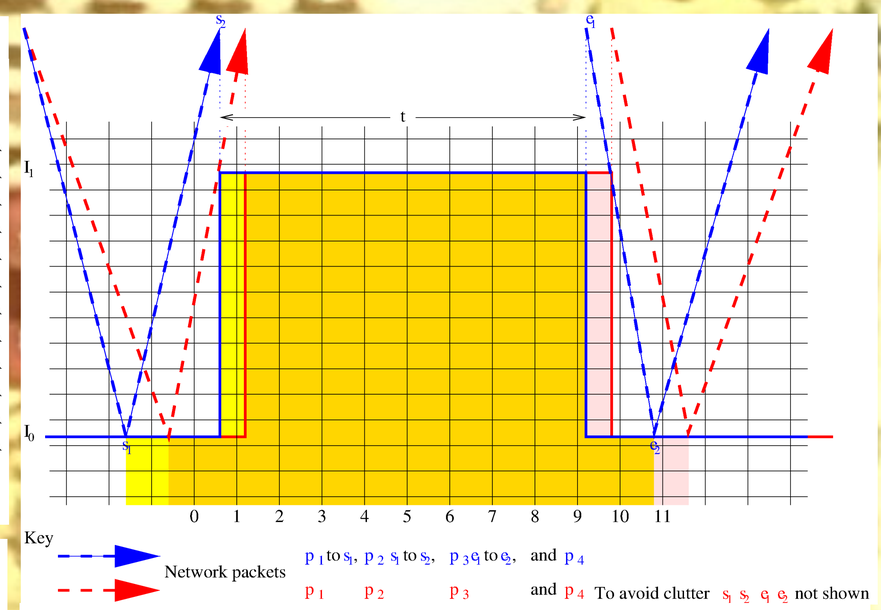
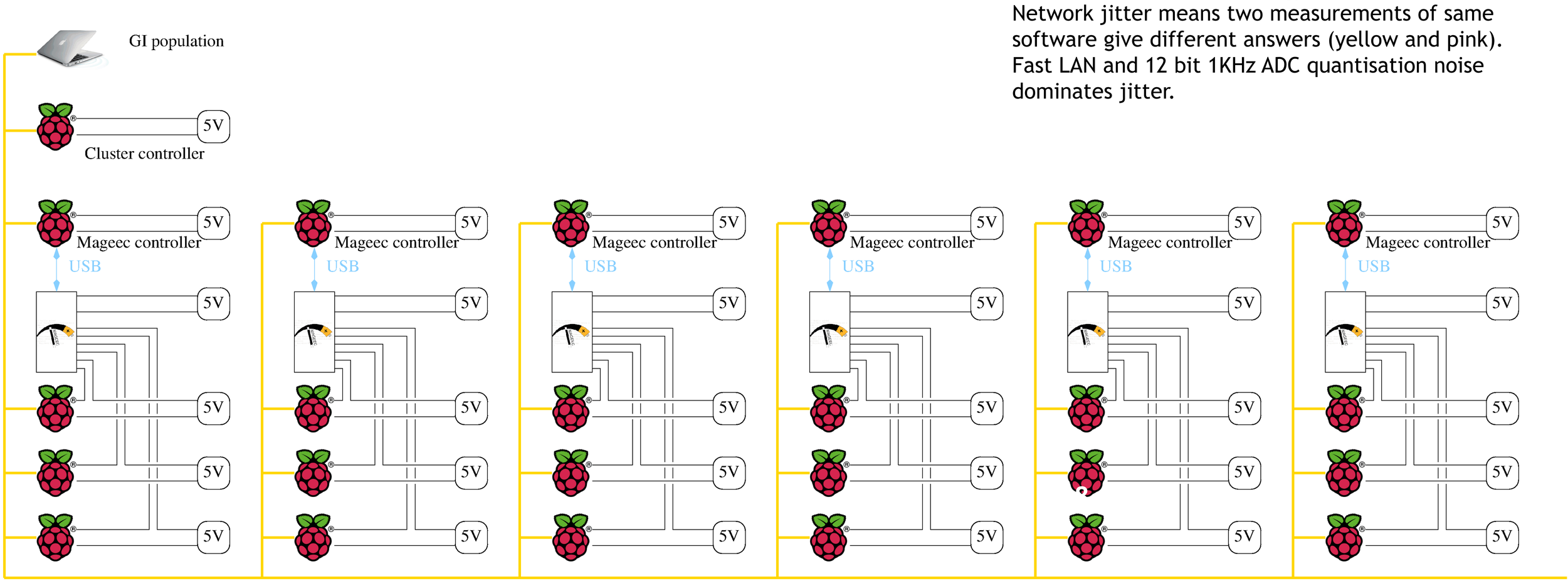


Figure 4: Start and stop network messages (arrows) are used in distributed energy measurement. Network jitter means two measurements of same software give different answers (yellow and pink). Fast LAN and 12 bit 1KHz ADC quantisation noise dominates jitter.



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