Accurate wireless temperature measurements using passive SAW sensors and a frequency modulation interrogation approach

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A surface acoustic wave (SAW) sensor-based wireless interrogation set-up has been developed allowing for the implementation of various interrogation strategy to meet the industrial requirement for remote control of various physical parameter. We focus here on temperature measurements using various SAW sensor configurations based on resonators (using different substrates such as quartz, LGS, lithium niobate) and combined with a frequency modulation interrogation technique to improve the accuracy of resonant frequency determination and hence the accuracy of the temperature measurements. Using a phase-locked loop variant of this approach, we demonstrate the possibility to control the resonance frequency with a standard deviation of 25 Hz, limited by the stability of the resonator itself. Assuming for instance the same kind of differential sensors as currently developed by SENSeOR, these figures translate in some mK temperature measurement resolution, which is to the best of our knowledge the best resolution ever obtained for wireless interrogation of SAW sensors.