Title: Analog Signal Processing Gives micro-Watt Sensors milli-Watt Brains

Author: Hans Klein, Sr. VP Adv. Product Development
Affiliation: GTronix, Inc, Fremont, CA
Phone: 510-770-8300 x235
Fax: 510-770-8303
Email: hans.klein@gtronix.com

Abstract:
An ever increasing demand for sensors making products smarter, more portable, and lower cost have created a large opportunity for smart sensors. Traditionally, sensor signals get conditioned, then A/D converted, then sent to a host for further processing. An alternate and much more bandwidth-effective is to process the sensor signal prior to transmission, but traditionally this has taken substantial power. This makes it difficult, if not impossible, to operate for extended periods off of a small battery.
To reduce power consumption one or two order of magnitudes, another approach has been taken: processing the signal while it is still in the analog domain. If substantial processing can be achieved, then true micro-Watt wireless nodes with ultra long-life battery life, and self-contained "plug-and-play" sensor modules are possible.
This intriguing technology has been applied to an actual commercial product. It is an acoustic beam-forming microphone module, less than 14mm long and 2 mm high. It performs real-time acoustic directional processing of a two-microphone embedded sensor array, at a total power consumption as low as that of a single ECM microphone (~200uA). The beam-forming processor operates in the analog domain and consumes merely 20uA of current in its core although it processes multiple beam patterns in real time. Such low power consumption allows the "smart microphone" module to be mounted in a wired headset operated without any battery, where it directly replaces a traditional single ECM mic.
Another example, vibration analysis for monitoring of machine health, will be presented; it uses accelerometer signals. Unlike current approaches, which rely on very low duty cycles of data analysis to prolong battery life of a wireless monitor, this technology allows for an always-on, 100% duty cycle vibration analysis and monitoring right at the sensor. Connected to a low-power radio IC, the analog signal processor can then transmit information only when actually necessary. This dramatically increases the lifetime of a WSN node.
Using the above and additional application examples, the underlying analog signal processing technology will be illustrated.