Micro-power EEG Sensing and Processing SoC for Patient-Specific Seizure Detection Algorithm

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Technical Abstract:
Pervasive health-care requires a high-level of monitoring and therapy over large patient populations. Unfortunately, comprehensive screening and surveillance of a broad range of conditions and risk-factors can easily overload health-care providers. As a result, specialized sensing and processing nodes are critical in order to perform continuous patient risk assessment, diagnosis, event detection, and responsive therapy, while providing highly selective real-time information to physicians. Such capabilities require patient-specific observation and profiling (mimicking diagnosis methods of physicians), thus raising the need for rich algorithms with an emphasis on learning. Consequently, the sensing and processing nodes must efficiently support a diverse range of machine-learning computations targeting data-mining and classification needs. Brain monitoring systems and brain-machine interfaces are an important example since these face large amounts of sensor data (distributed over many channels), but with the critical information encoded in minute patient-specific variances.

As a demonstration, we present a seizure detection system for epilepsy patients that integrates EEG acquisition and local-processing for machine-learning classification. The SoC includes a low-power instrumentation amplifier, ADC, and spectral feature-extraction processor.
The instrumentation amplifier ensures stable EEG sensing by rejecting dynamic interface disturbances, while the feature-extraction processor provides vectors for seizure EEG learning and real-time detection on a patient-by-patient basis. The complete SoC consumes 9uJ per channel to derive a feature-vector, and vectors are derived at a rate of 0.5Hz/channel with 4-18 channels typically required per patient.