Putting Electronic Hardware Through Its Paces

Any good algorithms, from basic Fourier Transform to complex signal processing like MPEG, require an "engine" to run on. In electronics, the engine is normally in the form of an Integrated Circuit. Our research is to come up with innovative IC architectures and creative techniques to meet the challenges in speed critical and power sensitive applications. The domains of applications we cover include:

Object Detection

Object detection is an important class of image processing algorithms. Its applications can be found in surveillance, crowd control and robotics. However, the computation complexity required means that even a hardwired design may not satisfy both the accuracy and the processing speed needed.

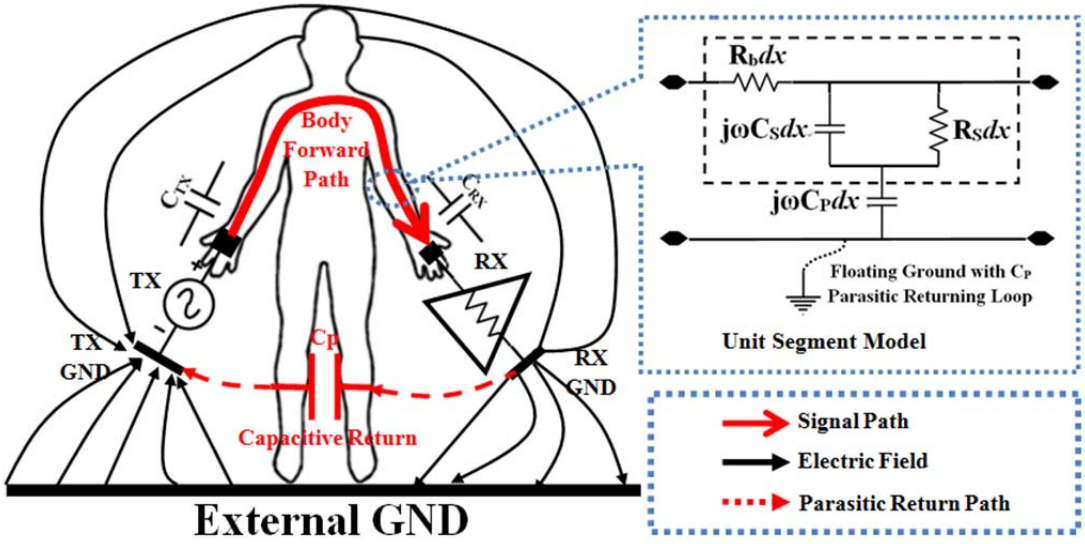
Our approach is to examine closely the arithmetic involved in the complex algorithms. We identify plenty of opportunities to trade mathematical precise with performance. The conventional wisdom is to reduce the word length by truncation at different stages of processing. We believe that a better alternative can be realized by redesigning the arithmetic units to raise speed but maintaining acceptable precision at the same time. We have already obtained encouraging results in applying idea in detection algorithm based on HOG, Histogram of Oriented Gradients.

Applications of Object Detection

Body Area Network

Wearable devices come in different functions and forms from smart watches worn over-body to bio-medical sensors implanted inside-body. There is an obvious need to connect them together. To realize such communication network, Body Area Network is considered superior over conventional wireless techniques for its low radiation, low power consumption, high data rate, wide bandwidth, small footprint and privacy.

We have developed a useful and accurate channel model for BAN based on cascading transmission lines. The model has helped to realize a high speed and low power transceiver which is able to cover the full body length. Our current endeavor is focused on channel coding method specifically for BAN to ensure the robustness of the network.

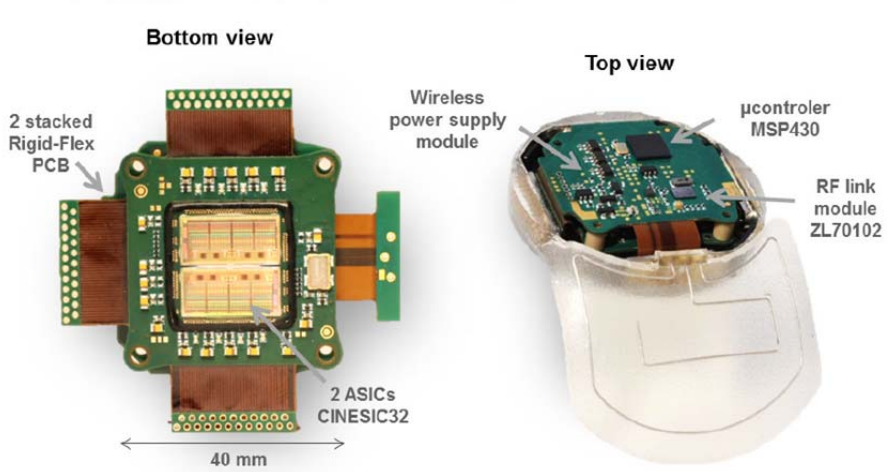


Cascaded Transmission Line Model for BAN

Neural Signal Processing

There are so much one can exploit if neural signals are readily captured and analyzed. By reading the signals, it is possible to monitor emotion, bio-events and even applying remedial measures to arrest neurological disorders like epilepsy.

Our present effort is to capture intracranial EEG as a mean to detect epileptic seizure. The difficulties in this effort are in the large number of probe channels, the weakness of the neural signals and the interpretation of the signals in both time and frequency. We are working on the design of highly efficient signal acquisition hardware occupying a small footprint for possible implantation. In detection, we have our faith in Wavelet Transform techniques which can decompose a signal into time and frequency independently so that resolution can be readily optimized for hardware complexity and performance.



Neural Recording Device (Ref: Wimagine System)