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Micro-Miniaturized Passively Powered Wireless Telemetry

Very small implantable wireless telemetry systems have the potential to become a tool for continuous in vivo biomonitoring, implant monitoring and drug delivery. Such minimally invasive devices may provide a practical way of continuously monitoring of brain and central nervous system function, thusly enabling continuous physiological and biomarker monitoring and supporting the development of man-machine interfaces. Conventional biopotential electrodes with implanted wires are often heavy, cumbersome, and limit a person's mobility. Electrodes that must pass through the skin to contact the brain or nervous system are sites of infection and injury when strained.

In an exciting development at ASU, Dr. Bruce Towe has invented a simple strategy to achieve wireless biotelemetry through the use of miniature semiconductor varactor parametric amplifiers. The device is excited with an external source of radio frequency signal which causes it to resonate and re-radiate a signal which allows the recovery of a biopotential signal, and does not require an internal power-source. This circuit has the advantage of small size, wide bandwidth, high sensitivity and does not rely on an internal power source.

Potential Applications

- The market for biotelemetric devices is poised to grow rapidly, fueled by the need for miniature, implantable devices that can perform a variety of tasks:
 - Monitoring heart, brain, nervous system functionality – electrical waveforms of these systems can be recorded through biotelemetry.
 - Biochemical and biophysical sensors – Implantable microminiature sensors for pH, pressure, temperature, and osmolarity
 - Implant diagnostics – status and device health monitoring of implanted devices (stents, catheters, bio-structural materials and devices).
 - Drug delivery – wireless control of implanted drug-release devices

Benefits and Advantages

- Small size – can be implanted with a syringe needle
- No batteries – powered by external radio frequency
- Wireless – no requirement for internal power source (smaller size, very long implant time, no explant required for battery replacement)
- Possibility of multichannel, multifrequency operation - reduces quantity of implantable devices to achieve specific tasks
- Wide bandwidth/high sensitivity – sensitive to microvolt level modulations, no preamplification necessary

