Wireless Communication Using Magnetic Waves in the Human Body

Tech ID: 28755 / UC Case 2016-050-0

BACKGROUND

Medical devices and wearable consumer products have fundamental anatomically-driven size constraints that necessitate small form factors. Since most patients and consumers desire long battery life, and battery volume is limited by anatomy, one of the only ways to increase lifetime is to reduce the power of the underlying circuits. The power consumption of wireless communication circuits is often large, and while power can be minimized by restricting the communication distance to just a few meters from sensor nodes to a personal base station as part of a body-area network (BAN), it can still dominate the overall energy budget of a wearable device. Current human body communication (HBC) systems communicate using capacitive electrodes that are placed on the body and generate electric fields that then have fringing currents that travel through conductive biological tissues (in one embodiment – galvanic coupling) or fringing fields that interact with the surrounding environment (in another embodiment – capacitive coupling). Both techniques have slightly better path loss than conventional far-field RF techniques, but suffer from electrode impedance variation, environmental variation, or both, making the design of ultra-low power HBC systems difficult. Establishing methods that improve path gain and thus reduced power consumption will aid the functionality of industry devices greatly.

TECHNOLOGY DESCRIPTION

Researchers at UCSD have created an invention which offers a method and apparatus for human body communication using magnetic resonant coupling for wireless body-area network (BAN). This magnetic human body communication provides significantly improved path gain around the human body, compared to other conventional wireless communication techniques. As a result, this invention can reduce the communication power consumption for delivering the information between a transmitter and a receiver. In addition, by using the human body as a physical communication channel, this communication technique provides a higher level of security compared to broadcasting wireless communication systems (e.g., Bluetooth).
Since magnetic fields are only minimally affected by biological tissue, coil impedances are relatively constant and thus resonant matching networks can be easily designed. In addition, the human body acts as a waveguide that helps the magnetic fields travel along the body with low loss, while enabling tight fall-off away from the body for limited broadcasting, and therefore good communication security. The invention therefore offers an ultra-low-power method to communication information around the body.

APPLICATIONS

Any wearable device that needs to wirelessly communicate information around the body with ultra-low power:

- wearable sensors
- activity trackers
- smartwatches
- EEG headsets

ADVANTAGES

- Significantly improved path gain around the human body compared to conventional methods
- Reduced communication power consumption for information delivery
- Higher level of security compared to broadcasting wireless communication systems

STATE OF DEVELOPMENT

The concept of invention has been validated by measurements using a demonstrated functional prototype. The prototype model for the practical wireless communication application is currently being developed.

INTELLECTUAL PROPERTY INFO

A Provisional and PCT Patent have been submitted and the technology is available for licensing.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20180241483	08/23/2018	2016-050

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OTHER INFORMATION

KEYWORDS

human body communication, wireless communication,magnetic waves, magnet resonant coupling

CATEGORIZED AS

- **Communications**
  - Wireless
- **Engineering**
  - Engineering
- **Sensors & Instrumentation**
  - Other

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