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Signal- and System-Modelling of a Wireless Sensor for Detecting Buried Human Beings

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The disaster-risk-management community continues to remain in search of wireless sensors that are capable of detecting human beings buried either underground or in debris. Ideally, the sensor should be capable of being mounted on autonomously functioning drones or rovers. The sought wireless sensors should be able to transmit and receive signals that are capable of traversing through the embedding debris (or ground) and returning signals scattered back from a buried human body with a beating heart. The wireless sensor should therefore be able to meet the various challenges posed by the wave propagation through the attenuating earth-type of medium and the analysis of the backscattered signal received from the buried human body.

In this paper, we shall develop a propagation model for obtaining power budget for estimating signal strength of echoes arising from a buried human being. In this model, we shall duly consider how the beating heart of the buried person will modify the backscattered signal, particularly in the frequency domain. This heartbeat-based signal modulation will, therefore, be considered to be the sought 'key-signal' required for the detection of the buried human being. The model to be reported, as expected, will also detail the scattering model for simulating the echo-signal characteristics resulting from the beating heart. Based on the findings obtained from this modelling work, a sensor system-concept with specifications appropriate for the hardware-realisation of the sensor will be proposed. The anticipated achievable performance parameters of this humanitarian sensor will be quantified and summarised.