Wireless Interdigitated Near-Field Sensors for Concrete Moisture Content Measurement

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The concrete in airport runways, luggage tunnel etc. are exposed to moisture ingress from the soil below. The moisture penetrating the concrete results in eventual degradation of the structure. Since real-time in-situ monitoring is not possible such structures are typically replaced within scheduled intervals whether necessary or not. The use of embedded wireless moisture sensors can provide significant advantages over the existing method of maintenance and monitoring.

Interdigitated sensors are near-field dielectrometry sensors that can be used to measure the dielectric constant variation in materials with the use of a low frequency electric field that penetrates the specimen under test. A time-varying voltage, V_D is applied to the driving electrode (*D*) of the sensor, which develops electric field lines in the specimen with controlled penetration depths. Once the dielectric constant of the specimen changes (higher moisture means higher dielectric constant) a variable output voltage develops in the sensing electrode (*S*). This voltage is then amplified (V_s) using an inverting amplifier and a known capacitor, C_F.

In this work we will present the design and experimental results of an interdigitated sensor [R.H. Bhuiyan, R. Dougal, and M. Ali, "Proximity Coupled Interdigitated Sensors to Detect Insulation Damage in Power System Cables,'' *IEEE Sensors Journal*, vol. 7, no. 12, pp. 1579-1586, December 2007] that was used to measure the moisture penetration in concrete as function of time. Output voltage data corresponding to the moisture penetration in concrete were measured as function of time, digitized, and then wirelessly transmitted to a receiver nearby. Similarly the reverse case was also measured when a wet concrete specimen was drying as function of time. It was observed that moisture penetration can be predicted from the output voltage variation quite satisfactorily.