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Measuring the dislacement of riverine pebbles, landslides and rocks using RFID

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Billions of passive radiofrequency tags are produced by the Radio-Frequency Identification (RFID) industry every year to identify goods remotely. New research and business applications are continuously arising, including recently localisation and sensing for earth science. Indeed, the cost of tags is often several orders of magnitudes below conventional outdoor sensors used in earth science, allowing to deploy up to thousands of tags with minimal investment. Furthermore, passive wireless tags require little maintenance, which fits well for years-long monitoring. This study reviews the earth science applications that are being developed today, that use RFID devices available on the market, i.e., 900 MHz far-field tags and 125 kHz near-field tags.

Ground displacements of centimetres to hundreds of meters can be monitored using RFID location techniques. Indeed, RFID tags were firstly used in earth science to track the displacement of riverine and coastal sediments due to bed loading, over meters to hundreds of meters [1]. Near-field tags inserted in pebbles can be identified typically up to 0.5 m from the reading device even when buried.. Very recently, measuring the phase difference of arrival of far-field tags allowed to estimate displacements with centimetric accuracy, with a tag-reader distance up to 50 m [2]. That allowed measuring continuously the ground displacements of centimetres to meters, relatively to a fixed reader. Alternatively, RFID tags could also be used for sensing submillimetric crack opening of a rock using for example the change of resonant frequency of a tag antenna caused by its deformation [3]. This review presents these three applications for monitoring unstable rock/earth structures using RFID.

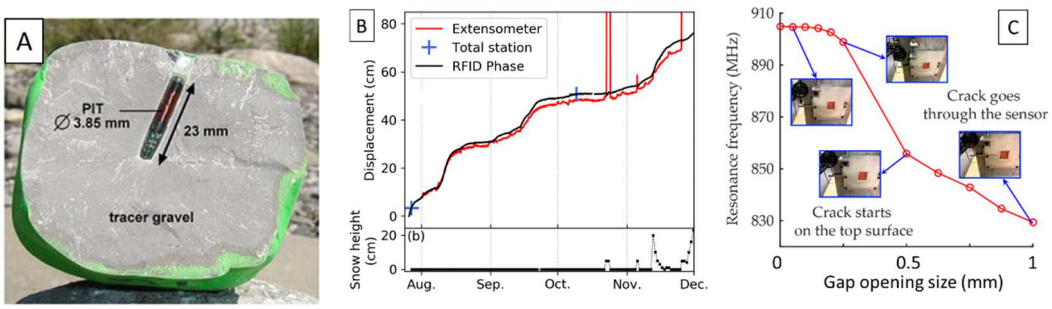

Figure 1. RFID measurement of geological displacement: (a) 1–100 m for riverine pebbles, with detection surveys (b) 0.1—1 m on landslides using phase, and (c) 0.1–1 mm on cracks using resonance frequency. [1–3]

References

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