



## Monitoring rock displacement threshold with 1-bit sensing passive RFID tag

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Billions of passive Radiofrequency tags are produced by the Radio-Frequency Identification (RFID) industry every year to identify goods remotely. Enhanced RFID adds the capacity for localisation and sensing that can be used in earth science for long-term and spatially dense monitoring with low-cost tags. Localisation has been used already to monitor displacements of coarse sediment and landslides over several metres. Sensing capabilities have been developed in laboratories, but never implemented on real fields. This work presents the first RFID sensing application in earth science, using the simplest 1-bit sensor to detect millimetric motion of unstable rocks. The application required designing custom RFID tags adapted for outdoor usage at long range, adapting the data acquisition of an existing tag microcircuit, and designing a sensor that triggers when displacement exceeds a few millimetres, which threshold displacement can be adapted for each sensor. In complement, the system embeds displacement sensing to measure larger displacements > 5 mm, using the phase-based measurement already deployed on landslides. The presentation display results from laboratory tests and from an implementation in a real site in Eastern France. The advantages and drawbacks of the method are discussed, as well as the future potential RFID sensors that could monitor unstable terrains.

Author's published work on the topic:

Le Breton, M., Baillet, L., Larose, E., Rey, E., Benech, P., Jongmans, D., Guyoton, F., 2017. Outdoor UHF RFID: Phase Stabilization for Real-World Applications. *IEEE Journal of Radio Frequency Identification* 1, 279–290.

Le Breton, M., Baillet, L., Larose, E., Rey, E., Benech, P., Jongmans, D., Guyoton, F., Jaboyedoff, M., 2019. Passive radio-frequency identification ranging, a dense and weather-robust technique for landslide displacement monitoring. *Engineering Geology* 250, 1–10.

Le Breton, M., 2019. Suivi temporel d'un glissement de terrain à l'aide d'étiquettes RFID passives, couplé à l'observation de pluviométrie et de bruit sismique ambiant (PhD Thesis). Université Grenoble Alpes, ISTerre, Grenoble, France.

Le Breton, M., Baillet, L., Larose, É., Rey, E., Jongmans, D., Guyoton, F., Benech, P., 2020. Passive RFID, a new technology for dense and long-term monitoring of unstable structures: review and

prospective. (No. EGU2020-19726). Presented at the EGU2020, Copernicus Meetings.  
<https://doi.org/10.5194/egusphere-egu2020-19726>

Le Breton M., 2020, Suivi de terrains instables à l'aide d'un réseau dense de capteurs RFID: Émergence de nouvelles applications, presented at Journées Nationales de Géotechnique et de Géologie de l'ingénieur (JNGG), Jean Goguel Award public session, 2021.