LANDSLIDE DISPLACEMENT MONITORING WITH PASSIVE RFID

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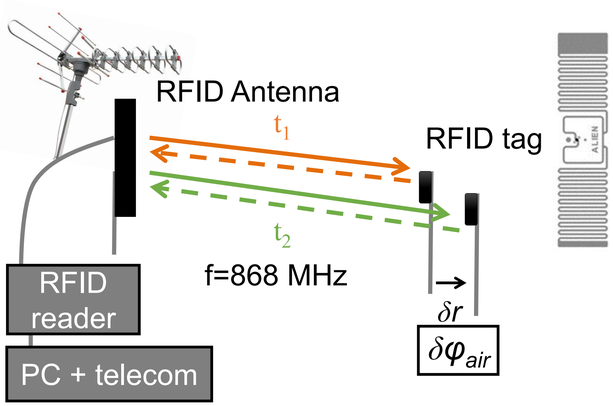
Can we get **dense displacement** data of a landslide at **low-cost**, with RFID?

What is new:
For RFID localization : outdoors, long periods
For landslides : passive RFID localization

What is RFID?

(Radio-Frequency identification)



Phase-Distance equivalence

$$\delta\varphi_{air} = -2\pi \frac{\delta r}{\lambda / 2}$$

With
φ_{air} phase shift in the air (rad);
r tag-base distance (m);
λ wavelength (m).

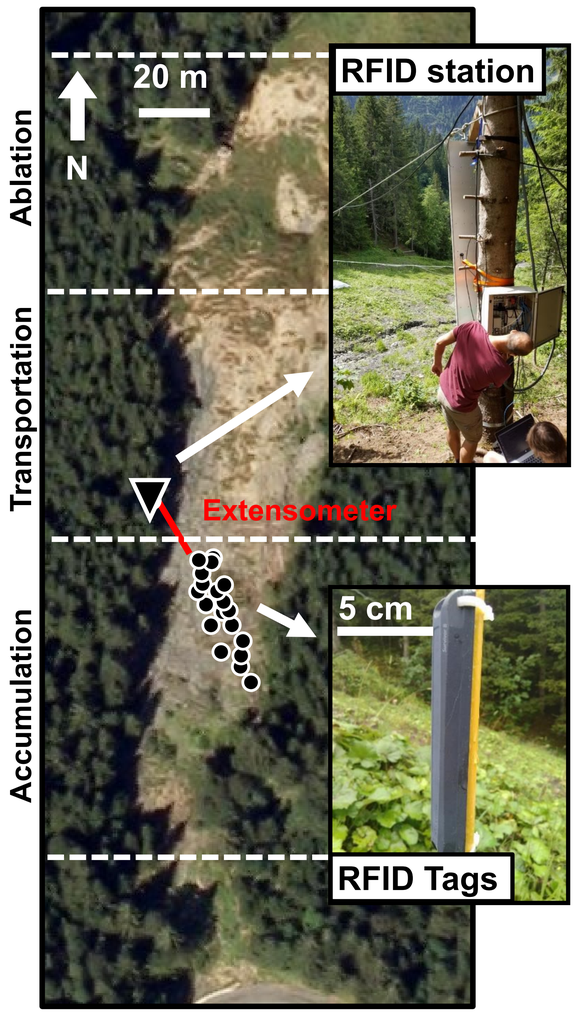
Variation of phase → **Relative displacement**

References

- Nikitin, P.V., Martinez, R., Ramamurthy, S., Leland, H., Spiess, G., Rao, K.V.S., 2010. Phase based spatial identification of UHF RFID tags, in: IEEE Int. Conf. RFID, pp. 102–109.
- 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.
- Lucianaz, C., Greco, G., Bertoldo, S., Allegretti, M., 2015. Real time outdoor localization of buried RFID tags through statistical methods. in: Int. Conf. on Electromagnetics in Advanced Applications. (ICEAA), pp. 1152–1154.

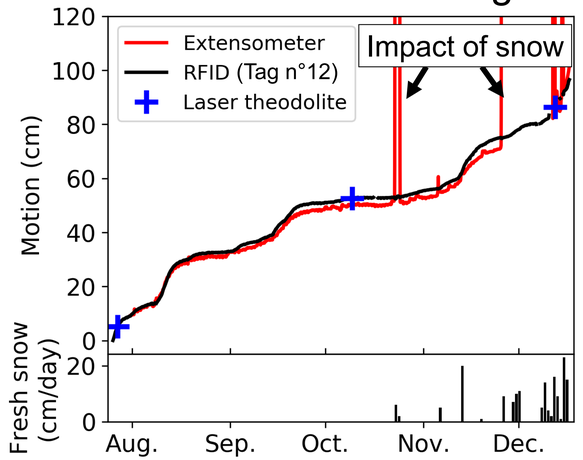
Installation on an active landslide

(Pont-Bourquin, Switzerland)



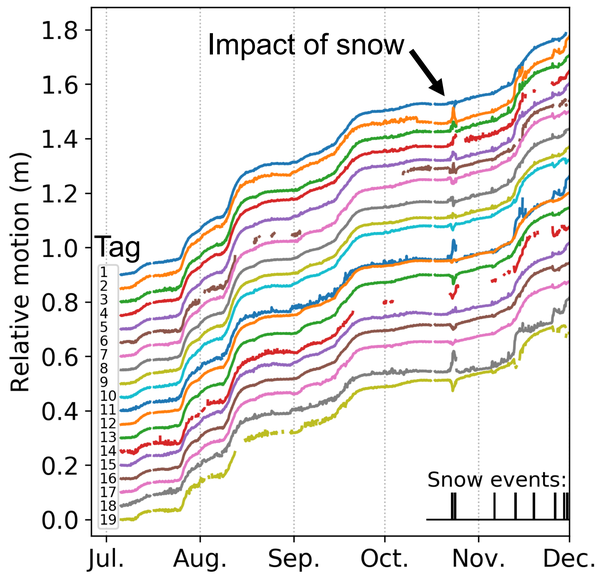
- Clayey landslide, active since 2005;
- Moves a few meters per year;
- Station installed on a stable zone.

Validation on one tag



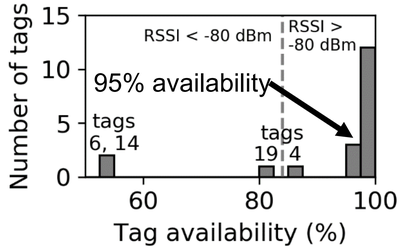
- Displacement is coherent with standard techniques;
- RFID is more stable than the wire extensometer.

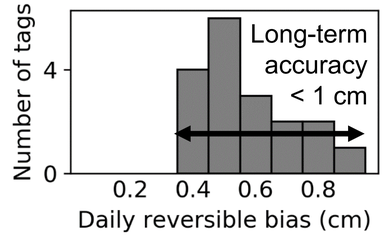
Observations on several tags



- The technique functions with multiple tags.

Statistics on performances





Characteristics

- Real-time : 20-400 points / seconds (+++);
- Low-cost : 5k€ + 20€/point (++);
- Works with rain / snow (+);
- Reliable : 95% availability (+);
- Accuracy < 1cm;
- Range ≈ 100 m.

Future works

- Increase the range;
- 1D –> 3D;
- Snow interactions.

Conclusion

RFID is adequate to monitor small landslides, with dense data (in space and time), at a low cost, even during bad meteorological conditions.