M1/M2 Intership position
Analyzing the river bedload transport with compressed sensing

Key-words – Compressed sensing, sparsity, RFID, river bedload transport.

Location: SISYPH team, Laboratoire de Physique de l'ENS Lyon
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When : 4-6 month between february and september 2021.

Context – Radio frequency identification (RFID) technologies, which allow wireless detection of individual buried or immersed tracers, represent a step forward in sediment tracking, especially passive integrated transponders (PIT tags) that have been widely used. Despite their widespread adoption in the scientific community, they typically have low efficiency when deployed in river systems with active bedload transport or deep wet channels, attributed to their technical specifications. A recent evaluation of active ultra-high frequency transponders (a-UHF tags) assessed their larger detection range and provided a methodology for their geopositioning. In [1], M. Cassel and collaborators tested different survey methods (one including an unmanned aerial vehicle as illustrated in Figure 1) and compare them in terms of recovery rate.
On the other hand compressed sensing offers a theoretical framework to recover sparse data (i.e. the immersed tracers location in the context of this internship) from partial measures. Among the numerous applications in image processing, magnetic resonance imaging (MRI) is probably one of the most successful application fields of compressed sensing as in [2] where the authors tackle the question that "given a set of sampling constraints (e.g., measuring along physically plausible trajectories), how to optimally design a sampling pattern". In the framework of this internship similar idea will be explored to design an optimal path to recover all the immersed tracers and offer theoretical guarantees.

Subject – This internship is devoted to the design of an optimal path to recover the locations of all the immersed tracers. The main steps of these internship will be

- to deeply understand the theory of compressed sensing in particular the contribution in [2];
- adapt [2] to the specificities of immersed tracers identifications;
- propose a new pathways strategy for the next deployed experiments.

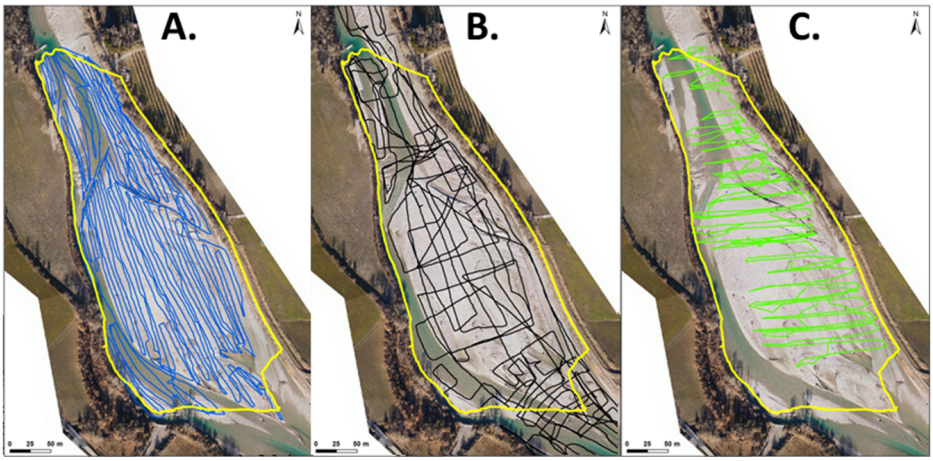

Figure 1: *Pathways of three prospection methods tested in [1]*

Skills: The candidate must have skills in some of the following areas: Signal and Image Processing, Data science, Probability, Statistics, and Modeling.

Application: Applicants must send by email a CV and a statement of interest to Nelly Pustelnik. For further information, candidate can contact us with questions related to this position.

References:

[1] M. Cassel, H. Piégay, G. Fantino, J. Lejot, L. Bultingaire, K. Michel, and F. Perret. Comparison of ground-based and UAV a-UHFartificial tracer mobility monitoring methods on abraided river, Earth Surf. Process. Landforms, 2020.

[2] C. Boyer, N. Chauffert, P. Ciuciu, J. Kahn, P. Weiss, On the Generation of Sampling Schemes for Magnetic Resonance Imaging, SIAM J. Imaging Sciences, 9(4):2039-2072, 2016. (PDF)