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Automatic detection of river bankfull parameters from high density lidar data

Alexandre Rétat, Nathalie Thommeret[2], Frédéric Gob[3], Thomas Depret[1], Jean-Stéphane Bailly[4], Laurent Lespez[2], and Karl Kreutzenberger[5]

[1]CNRS UMR 8591, Laboratoire de Géographie Physique
[2]Université Paris-Est Créteil, Laboratoire de Géographie Physique (UMR 8591)
[3]Université Paris 1 Panthéon-Sorbonne, Laboratoire de Géographie Physique (UMR 8591)
[4]LISAH, Université Montpellier, AgrosParisTech, INRAE, Institut Agro, IRD, Montpellier, France
[5]Office français de la biodiversité

The European Water Framework Directive (WFD), adopted in 2000, set out requirements for a better understanding of aquatic environments and ecosystems. In 2006, following the transposition of
the WFD into French law (LEMA), France began work on a field protocol for the geomorphological characterization of watercourses, as part of a partnership between the Centre National de la Recherche
Scientifique (CNRS) and the Office Français de la Biodiversité (OFB). This protocol, known as "Carhyce"
(For « River Hydromorphological Caracterisation »), has been tested, strengthened and approved over
the last 15 years at more than 2500 reaches. It consists of collecting standardised qualitative and quantitative data in the field, essential for the caracterisation of a watercourse: channel geometry, substrate, riparian vegetation... However, certain rivers that are difficult to survey (too deep or too wide) pose problems for data collection.
To address these issues, and to extend the analysis to a wider scale (full river section), using remote sensing, and in particular LiDAR data, was considered. The major advantages of LiDAR over passive optical sensors are better geometric accuracy and especially under vegetation. For a long time,
LiDAR data rarely exists at national scale with data density similar to passive imagery. Today, the French
LiDAR HD dataset (10 pulses per meter square) program run by the French mapping agency offers an
unprecedented amount of data at this scale. Thanks to them, a national 3D coverage of the ground can
be used, and numerous geomorphological measurements can be carried out on a more or less large
scale. This is the case for hydromorphological parameters such as water level and width.

The aim of this study is therefore to use this high-density lidar to automatically determine the hydromorphological parameters sought in the Carhyce protocol. In particular, we have developed a lidar-based algorithm to reconstruct the topography from point cloud and automatically identify the bankfull level at reach scale. Designed to be applicable to every French river, the method must be robust to all river features such as longitudinal slope, width, sinuosity, multi-channel etc… For validation purposes, the bankfull geometry calculated by the algorithm has been compared with field measurements at some twenty Carhyce stations across France. To determine the test stations, we looked for the diversity of situations in terms of river characteristics describe above to observed the influence of this features on the results.