



Gravel-bed river depth mapping with cokriging using aerial high resolution images

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Water depth inside river sections is a key parameter for fish habitat mapping as well as for river morphology monitoring. In case of gravel bed rivers having small depths, bathymetry mapping techniques such as multipulses sonar are not suitable and only terrestrial topometrical surveys are available. As such local measurements are highly time consuming, only small rivers sections are studied. If suitable for small depths, bathymetry by remote sensing is an interesting technical alternative. Passive remote sensing for bathymetry issues are usually based on the exponential relationship between signal attenuation inside water, i.e. reflectance and depth. As this relation depends on bed materials albedo, turbidity, bathymetric regression models have to be calibrated for homogeneous sections regarding these physical characteristics. Moreover, in such approaches, the riverbed limit location is an informative datum usually not used to constrain depth interpolation. For these reasons, using optical image for bathymetry has to be regarded as help on depth terrestrial measurements interpolation but not as an auto-sufficient technique for bathymetry mapping.

In this study, we propose a method that allows to integrate all informative aerial image data, i.e. optical reflectances and riverbed limit locations, for water depth measurements interpolation. This method is based on geostatistical cokriging using anisotropic covariograms and heterotopic samples. The test area is a 400 m long section of the Durance River, gravel bed river located in the south of France. Reflectances are computed from a drone optical image. This image was acquired simultaneously to depth topometrical measurements with 0.5 m spatial resolution. Depth accuracy results were computed on validation samples. Results show that the depth estimation accuracy is

10 cm R.M.S even when 15 % of usual depth measurements are used for cokriging. This means that this method, with optimised sampling design, allows to map depth with an acceptable accuracy on a river section 10 times longer than usual for same time consume.