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Accuracy of Large-Scale Particle Image Velocimetry (LSPIV) techniques applied on low seeding density flows

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River discharge is one of the most important variables for hydraulic and hydrologic analysis. Currently, there are growing needs of cost-effective methods for more accurate and reliable streamflow estimations with high spatial and temporal resolution. In this context, the use of unmanned aerial systems (UAS) combined with Large-Scale Particle Image Velocimetry (LSPIV) provide one of the greatest alternatives for hydraulic monitoring, allowing to estimate surface flow velocities based on video acquisitions.
Nowadays the accuracy of LSPIV techniques tends to be sensitive to the environmental conditions and the occurrence of floating materials onto the stream surface. In most practical cases, low seeding density occurs during monitoring surveys especially near river banks where a fewer number of tracers transit.
This research seeks to study the influence of seeding density and number of considered frames on LSPIV results, with the aim to establish better and practical guidelines for field campaigns. Numerical simulations were performed using Matlab to generate particles with colour noise and spatially-distributed following a Poisson distribution. Numerical findings provided useful insights that were corroborated and validated within two field experiments, performed in low flow conditions. Tracers were manually distributed onto the water-surface and videos acquired from UASs. Conventional measurements were also measured for benchmark purposes. Recorded videos were processed with LSPIV to derive surface flow velocities. Results show high sensitivity to the seeding density, interrogation area, and number of frames employed in the analysis. The use of specific experimental settings has allowed mitigating the effects of tracer scarcity, obtaining measurements that are in closer agreement with benchmark velocities in both field experiments.