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Using citizens recorded videos to estimate water surface velocity and dischargefor urban flash flood monitoring

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Flash floods in Mediterranean regions pose significant threats to lives, infrastructures, and economies. Recent episodes of extreme rainfall in one such region led to devastating flash floods, resulting in loss of life, destruction of homes, and widespread disruption of transportation networks. Therefore, there is a critical need for advanced methods to monitor and analyze the flood dynamics, especially in urban areas. This study investigates the use of two advanced image-based techniques, Fudaa-LSPIV (Coz et al., 2014) and SSISM-Flow (Ljubičić et al., 2024) for surface velocity and discharge estimation of urban flash floods. The research used videos or images of historical urban flood events and estimated the surface velocity. To analyze the urban floods, Matera, a city of southern Italy, was selected as case study. Matera was chosen because its historical city center, the “Sassi”, was affected by extreme rainfall events in the last few years, e.g. 2014, 2018, 2019, and 2023. Five extreme past flood events occurred on 3 Aug 2018, 12 Nov 2019, 2 Jun 2023, and 2 & 21 July 2024 were recorded for estimation of surface velocity. Fudaa-LSPIV works according to the Particle Image Velocimetry (PIV) principles, while SSISM-Flow is a user-friendly and Python-based innovative tool with OpenCV integration for precise surface velocity filed extraction. These methods involve steps such as image stabilization, camera calibration, orthorectifications, and velocity calculation. Both techniques were evaluated based on their accuracy, performance, and application to overcome the limitations of analyzing the surface flow of urban floods. This study is innovative in comparing methods to estimate surface velocity of real-time flash floods in urban areas. Using these techniques, the surface velocities were estimated along key transects, and results were cross-validated using the Float Time method as benchmark. The outcomes of both approaches turned out to be consistent with benchmark data, confirming their reliability in monitoring urban floods. This comprehensive flow analysis provided insights for calibrating flood models and enhanced risk management. This study introduced a novel application of these techniques in real-time urban flood monitoring. Furthermore, it contributes to the development of an early warning system, enhances management strategies, and mitigates flood risks in vulnerable areas.

Reference

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