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Remote Sensing of Aerated Flows at Large Dams: Proof of Concept

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Abstract : Dams are crucial for flood control, water supply, and the creation of hydroelectric power. Every dam has a water conveyance system, such as a spillway, providing the safe discharge of catastrophic floods when necessary. Spillway design has historically been investigated in laboratory research owing to the absence of suitable full-scale flow monitoring equipment and safety problems. Prototype measurements of aerated flows are urgently needed to quantify projected scale effects and provide missing validation data for design guidelines and numerical simulations. In this work, an image-based investigation of free-surface flows on a tiered spillway was undertaken at the laboratory (fixed camera installation) and prototype size (drone video) (drone footage) (drone footage). The drone videos were generated using data from citizen science. Analyses permitted the measurement of the free-surface aeration inception point, air-water surface velocities, fluctuations, and residual energy at the chute's downstream end from a remote site. The prototype observations offered full-scale proof of concept, while laboratory results were efficiently confirmed against invasive phase-detection probe data. This paper stresses the efficacy of image-based analyses at prototype spillways. It highlights how citizen science data may enable academics better understand real-world air-water flow dynamics and offers a framework for a small collection of long-missing prototype data.

Keywords : remote sensing, aerated flows, large dams, proof of concept, dam spillways, air-water flows, prototype operation, remote sensing, inception point, optical flow, turbulence, residual energy
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