Camera-based flow measuring system for stream and river monitoring

DischargeKeeper case study

Real-time stream flow monitoring, particularly during extreme events, has become more and more important in recent years. Reliable river water level, velocity and discharge data are crucial for flood monitoring and for the design of flood protection measures. Conventional measurement methods, however, reach their limits precisely then, as they often rely on a sensor installed inside the flood area.

Image-based flow measurement systems offer a flexible non-intrusive alternative with real time measurement. Unlike conventional measurement methods, the ratio of measurement signal to measurement noise is optimal for extreme events.

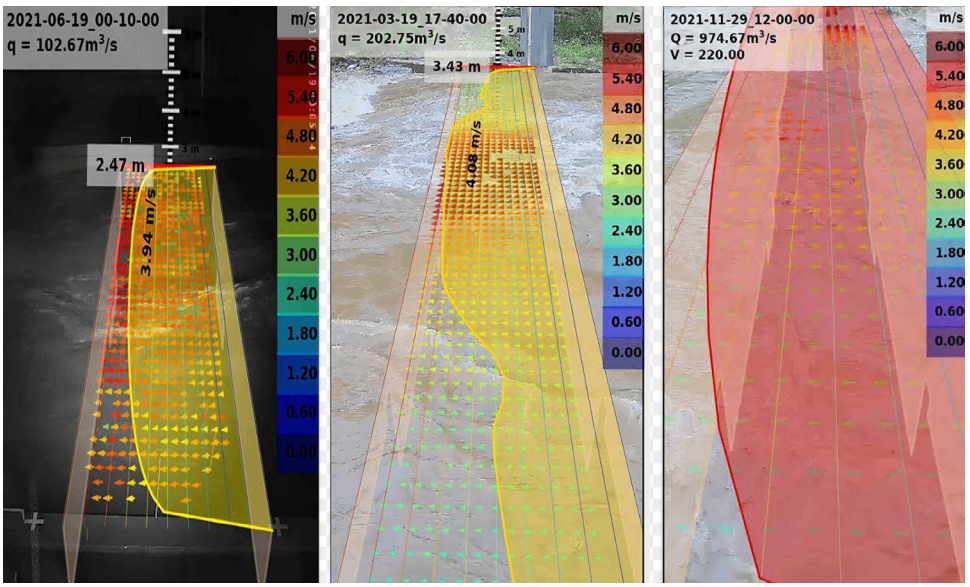

Figure 1. Proof images at different flow and lighting conditions on a DischargeKeeper site in Spain

This article presents a case study of the camera-based discharge system developed by SEBA Hydrometrie and Photrack called DischargeKeeper. The measuring system, which is based on the surface structure image velocimetry (SSIV) method, consists of an IP camera, an infrared illuminator for measuring at night and a central unit with remote data transmission.

The implemented algorithm is running in real-time on the device to provide on-site measurement and evaluation. The measuring process including recording image streams takes less than one minute. This enables very short measuring intervals which is very beneficial for flood monitoring.

In addition to the digitised measured values of the water level, mean flow velocity and discharge, proof images and videos are stored and can be transmitted to an FTP server.

A DischargeKeeper system was permanently installed in northern Spain two years ago. In November 2021 an event with a 500-year return period was recorded there. Most of the conventional measuring systems installed at this station were destroyed during the flood event, but the camera-based system remained intact because it was mounted on the side of the cross-section far enough away from the flood water. The measured discharge at the flood peak was 980 m3/s.

The high flows destroyed much of the intrusive sensors. The water even reached the house where the IP-camera was installed, but not the camera itself. Figure 1 shows three different flow conditions with discharge values from 100 m3/s to 980 m3/s. While the left image shows a sudden water level increase which occurred at night, the image in the middle shows a relatively moderate flood event with about 200 m3/s discharge. The image on the far right shows the maximum condition with about 975 m3/s discharge close to the flood peak.

It was possible to get the river stage using an existing water level sensor which is housed inside the monitoring station and was not affected by the flood. The transmitted proof images were very helpful for the optical verification of the measurement, especially during the flood events and to support the customer's early warning system.

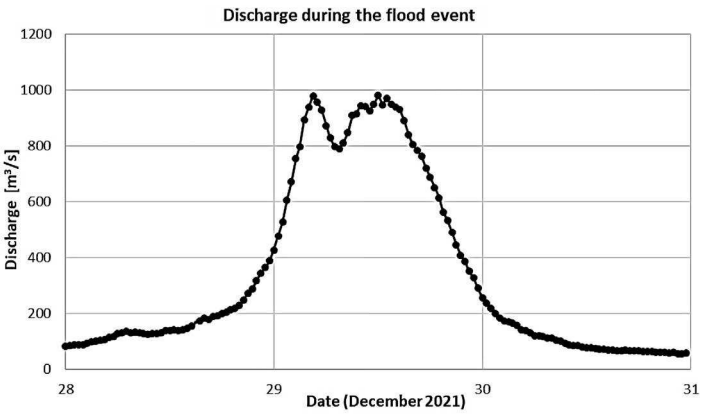

Figure 2: hydrograph of the flood event – including the peak – measured by the DischargeKeeper site in Spain

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