AI SUPPORTS FLOW MEASUREMENTS

SOMMER supports the city of Schärding, Austria, to improve its flood and alert management

The city of Schärding in Upper Austria has a long history of coping with floods of the river Inn. For its flood management SOMMER has provided a flow monitoring system that overcomes the challenging conditions posed by the river. By splitting the Inn into multiple cross-sections and monitoring each section with its own sensor the inhomogeneous flow regime could be largely eliminated. A modularized monitoring station with AI-enabled flow sensors, mobile supported data logger, autonomous power supply and a dedicated cloud server provide a robust system for reliable flow monitoring and alarm management.

The 5'200 strong municipality of Schärding in Upper Austria at the border of Germany is famous for its baroque city center at the shores of the river Inn. Its history dates back to the eight century and is characterized by the mood of nature and repeated floods, inundated alleys and crippled trade.

The historic buildings of Schärding border the river with only little elevation, and a swelling Inn still leads to frequent floods. This happened again in the summer of 2021 with its heavy rains in the northern Alps.

Given the historic development, Schärding is dependent on a reliable flood management to minimize loss and damage.

Monitoring the flow of the river Inn

For proper flood management the river Inn needs to be closely monitored with reliable techniques – and this poses the challenge. The river Inn with its source in the high Alps is 250 m (800 ft) wide when it passes Schärding.

Generally, single-sensor, stationary flow measurements require steady flow conditions. These are met if the water course is straight for at least five times the river width in the upstream and downstream direction. The river inn does not offer a straight stretch, but rather flows in a large bend through Schärding.

If there is an additional water inflow, it takes up to ten times the river width until the river flow reaches steady conditions again. A Schärding the river Roth flows into the Inn with little opportunity to reach steadiness.

These conditions – river bend and confluence – are challenging and require a suitable solution.

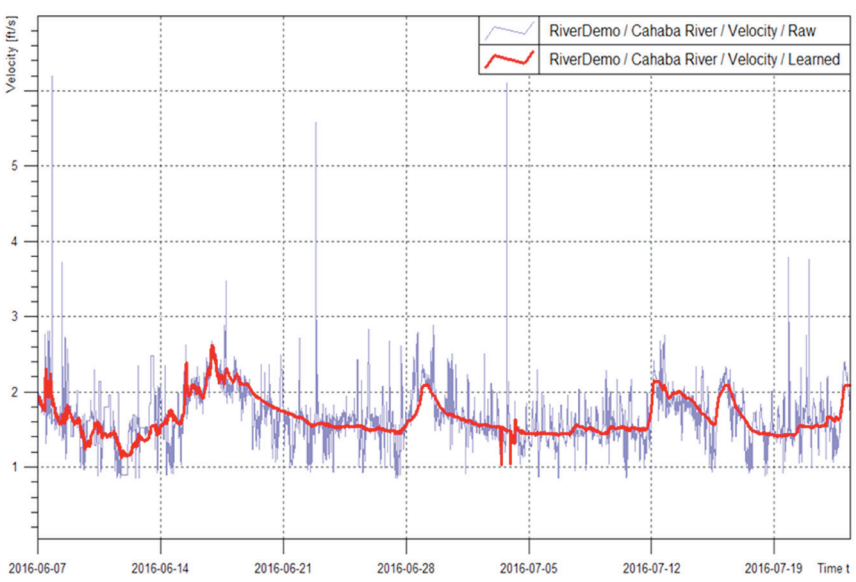
Two bridges cross the Inn in the city center, and the smaller one, closer to the confluence is to be used to carry flow monitoring equipment.

Multiple flow sections enhance accuracy

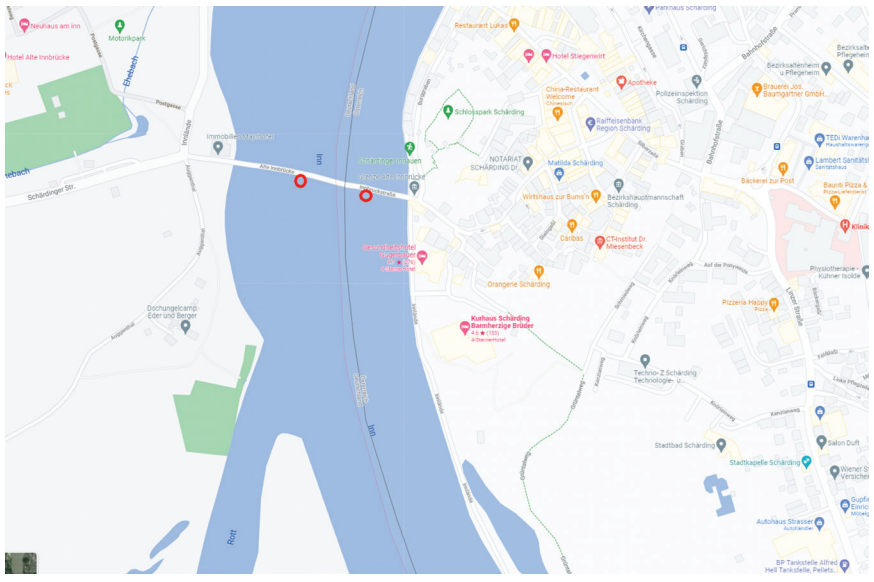
SOMMER – a specialist in non-contact flow monitoring – has met the challenge with a sensor of its RQ sensor family.

A standard flow sensor like the RQ-30 can be used as a stationary of mobile instrument to monitor water flows of small and large rivers alike. Sometimes however, a single sensor is not suitable to capture the water flow correctly. This is the case at Schärding

Measurement site with an RQ-30 at an Alpine river in Austria. It's primarily used to monitor snow melt in spring and early summer as one component of a flood warning and water management network. Monitoring stations high upstream extend the response time during potential flood conditions.



This graph illustrates the performance of the implemented AI algorithms of the RQ sensor family. The blue line shows the raw velocity values at a measurement site. The red line shows the AI-enhanced, filtered velocity. Interference by wind has been removed and a robust velocity signal is returned.



The flow monitoring site in Schärding. The two red circles show the location of the RQ-30d primary and secondary devices on the bridge.

All-in-one RQ-30 station in the Austrian Alps. This unit can be operated stationary or mobile, for example during weather events with fast moving storm fronts. It contains an RQ-30, a data logger with mobile data transmission and an autonomous power supply in one housing. It can run on battery with an optional solar panel for longer monitoring periods. The unit may be deployed for a couple of days before it is moved to another monitoring site.

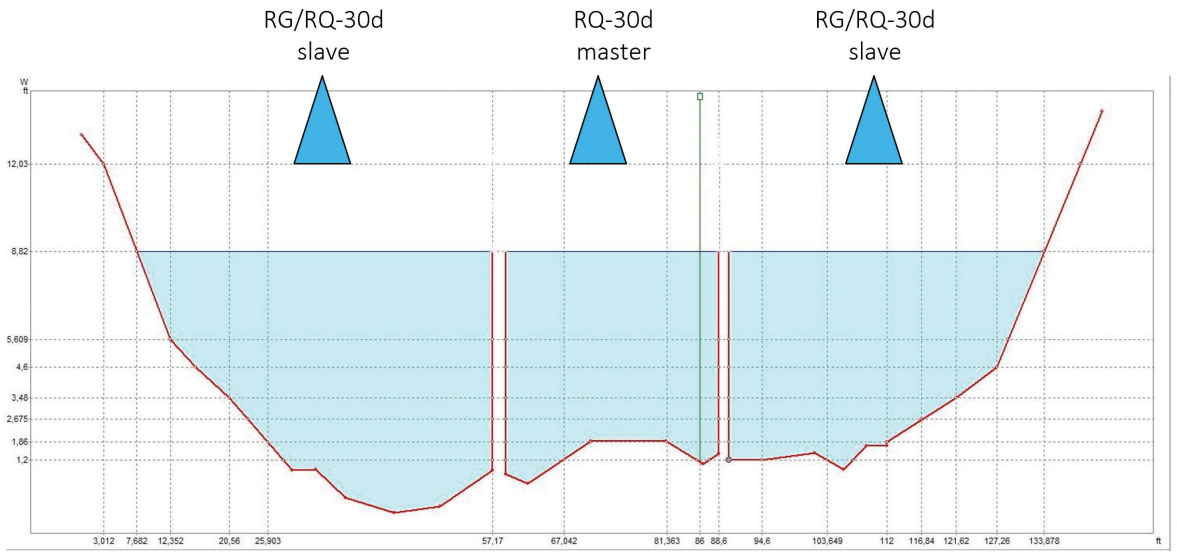


Illustration of a river cross-section split into three sub-sections. The primary device is located in the center with the secondary devices to the left and right. The cross-section may be further divided if flow conditions require. The implemented AI algorithms control the aggregation of the sub-flows to the total flow.

where a wide river has a very inhomogeneous flow pattern.

For such applications, SOMMER has developed an enhanced flow sensor, the RQ-30d, a multi-sensor device with the features of the popular RQ-30. It combines a section-by-section approach with artificial intelligence (AI) to meet the most challenging flow conditions.

The basic principle is a primary-secondary concept by which multiple secondary devices communicate with a primary device that controls the required measurement tasks. Each of the secondary devices monitors the water flow of a subsection of the river cross-section and the primary device computes the total flow. In this way an irregular flow pattern is divided into multiple parts with less inhomogeneity.

In Schärding SOMMER has installed a multi-sensor RQ-30d with one primary and one secondary unit to cover the total river width. This setup is a compromise between accuracy and cost, keeping in mind that a setup with three or four units would be advantageous.

Application of a multi-sensor RQ-30d in China. Five RQ devices mounted to street lamps cover the whole river cross-section. One primary unit operates with five secondary units.

AI tames difficult flow conditions

To alleviate the effects of difficult flow conditions the sensors of the RQ family are equipped with various AI features. They are able to handle flows at very low and very high water levels and eliminate the interference of wind that generates ripples that are not related to the actual water flow. That is especially crucial as in low water levels or super slow flow conditions the water surface may be more affected by wind. In high flow conditions the AI is normally not used or necessary due to the high quality of the SOMMER hydraulic model inside the RQ-family.

Monitoring architectures with AI enabled RQ-30d devices offer a single point of access to all sensors and allow interfacing with any data acquisition system.

A tuned data flow for top reliability

Once the challenges of monitoring situation had been resolved, an adequate data acquisition and management scheme as well as a reliable alert system had to be implemented.

As no mains power was available on the bridge that carried all monitoring devices, an autonomous solar power supply with rechargeable batteries was selected. The SOMMER RQ flow sensors feature an advanced power saving mode that is activated between measurements. Combined with a SOMMER MRL data logger the power consumption of the entire monitoring station could be reduced to less than 1 mA in idle mode, thus prolonging battery life and enhancing reliability.

The SOMMER MRL data logger triggers the measurements, acquires level, velocity and flow data, and triggers notifications by SMS and e-mail if predefined limits are exceeded. Additionally, the logger regularly transmits the acquired data to the SOMMER data cloud, which pushes alert messages to social media platforms such as Twitter or Telegram. The MRL data logger also collects and transmits images shot by a connected camera, visualizing the situation at the measurement site. Thus, the local authorities are continuously updated and have the tools at hand to inform the public in case of an approaching flood.

A 3-unit RQ-30d site in Nepal with one primary and two secondary devices. As the river is bending, a multi-sensor setup had to be selected to acquire accurate discharge values. A one-sensor setup would not be appropriate to handle the flow inhomogeneity.

A monitoring station with an RQ at a canal with high water. No part of the station is submerged or in contact with the water, thus avoiding damage and providing maintenance-free operation.

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