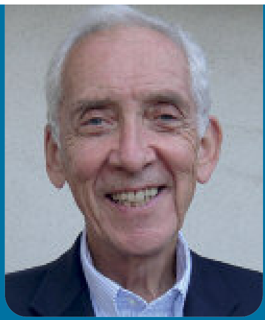
SENSORS AND DATA ACQUISITION AND ANALYSIS SOFTWARE

EDITORIAL BY ANGELOS N. FINDIKAKIS & RUI ALEIXO



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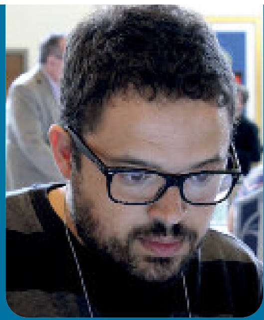

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Sensors, instrumentation, and data acquisition and processing software are essential tools in basic research, as well as in searching for solutions to engineering and environmental problems. Hydraulics and hydro-environment research and engineering have benefitted greatly from advances in sensors and electronics. As an example, laser and acoustic based instrumentation, which make possible the rapid acquisition of accurate high-resolution data in the laboratory, have made it possible to study many flows over a broad range of time and spatial scales. In many cases, using multiple sensors sampling at high rates produces large amounts of data, which require efficient software tools to manage, filter, process, and reduce them to the point that they can be used to improve the understanding of the physical processes being monitored and validate numerical models for their simulation.

Recognizing the importance of sensors, instrumentation and software for processing and modelling in hydraulics and hydro-environment research and practice, IAHR through its Experimental Methods and Instrumentation (EMI) committee has organized over the years several technical events on these subjects. The latest of these events is the International Symposium and Exhibition on Hydro-Environment Sensors and Software, Hydrosensoft 2017, in Madrid, which aims at bringing together a diverse group of researchers, engineers and developers of instrumentation for data acquisition and supporting software. The publication of the current issue of Hydrolink coincides with the opening of Hydrosensoft 2017, and includes articles by some of the participants in this meeting, who provide examples of different new tools for use in field data collection, in the coordination of data from multiple sources and in hydraulic laboratory studies.

An example of the challenges encountered in using multiple sensors to obtain high-accuracy synchronized water level data in harsh environments is given in the article by Bousmar, Savary, Swartenbroekx and Zorzan that discusses data acquisition in navigation locks for use in optimizing performance.

The article by Sánchez-González, Gutiérrez-Serret, and Martín-Soldevilla describes use of digital imagery in laboratory studies of coastal hydrodynamics and morphodynamics at the Centre for Harbor and Coastal Studies of CEDEX in Madrid. The same article discusses also the measurements made in wave overtopping studies for breakwaters in harbors performed in the same laboratory.

Using large data sets efficiently is challenging, especially when real time decisions must be made as the data come in. Extracting timely and actionable information may require the use of artificial intelligence, machine learning and real-time predictive analytics. The article by Moya discusses the use of advances in these fields to develop a water network management system that helps water utilities making operational and maintenance decisions, and describes how this system is used by the utility that serves the city of Karlsruhe in Germany.

Another example of efficient use of large volumes of data is the Copernicus Emergency Management Service system described in the article by Natschke. This system, which was designed to support flood preparedness and forest fighting and prevention efforts, collects and validates meteorological observations across Europe, and uses them to produce maps of essential variables on a 6-hour basis, made available for downstream usage as input to flood and forest fire hazard forecast systems.

The development of new instruments helps not only provide new insights into the physics of different phenomena, but it also contributes to overcoming current limitations of existing instruments. It improves measurement reliability, but it also can create new challenges. For example, continuously recording data, including digital images, often requires very large storage capacity and long processing times. The article by Aleixo, Mendes, Antico and Ferreira presents an innovative way for bypassing this problem in hydraulic laboratory experiments for sediment transport studies by using pressure signals to count bedload particles instead of capturing and processing digital images. This reduces significantly the volume of data collected, stored and analyzed and offers the possibility of assessing test results in real time.

Collecting and processing data to extract essential information on different physical processes, and developing models to simulate and possibly control some of these processes are standard parts of the scientific method. However, as demonstrated in the articles of this issue, scientists and engineers do not work in a vacuum. In many instances their work serves specific communities whose trust is essential for the successful completion of their projects. Technical rigor is not enough by itself to establish such trust. In addition to transparency about the technical approach to the solution of specific problems, it is necessary to raise public awareness about their broader context and some of the major challenges in water resources planning and management such as climate change, pollution, sustainability and water security among others. Education and community outreach actions are essential in efforts to increase public participation in the decision-making process for water projects. Two of the articles in this issue discuss the use of serious gaming, as one of the tools used for this purpose.

Serious gaming has been used in education and community engagement and now is making its way into hydraulics and water project applications. A serious game is a game whose main objective is not entertainment, but training different players in how to operate in a set of diverse situations. A classic example of serious gaming is the use of flight simulators, where pilots train in a controlled and yet realistic environment and practice different strategies of flying a plane without being in any danger. Two articles in this issue describe the use of serious gaming in water resources planning and management. The article by Muste, Demir, Smith and Carson illustrates how serious gaming can be used to test different strategies for reducing drought and flood risks and for improving water quality by engaging different stakeholders and community actors in an effort to create strategies to address these problems. Similarly, the article by Chew and Lloyd describes a serious gaming initiative, called Aqua Republica, which includes the development of online games dealing with sustainability and water allocation issues, and their use in government strategy workshops, national competitions and stakeholder engagement workshops in different countries.

The articles published in this issue illustrate how quickly the hydraulics community can adopt and use advances in other fields ranging from sophisticated sensors, electronic instrumentation, and big data management and processing to artificial intelligence, machine learning and new approaches for stakeholder and community engagement such as serious gaming.

"Measure what is measurable, and make measurable what is not so."
Attributed to Galileo Galilei (1564-1642)