Editorial

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Reading the papers in this issue took me back to my undergraduate hydraulics course. We spent hours at the computer writing a program to calculate the location of a hydraulic jump and our mastery of this topic was tested with an exam question, which gave full marks for the exact location and zero marks for any partial or incorrect answers. Rumours flew that one student had just guessed a number and received full marks. I never found out if those rumours were true, but at the time it seemed like a fun mathematical puzzle to be solved rather than an important question for the real world. I had certainly never seen a real weir, sluice gate or stilling basin at that point in my life.

However, these types of hydraulics problems do exist in the real world and remain complex and difficult to solve. One study found that 50% of the world's population live within 3 km of freshwater but 10% live at least 10 km away (Kummu *et al.*, 2011). This distance means that conveyance of water to where we live, work and play is a critical function in today's world. And the hydraulic equipment that makes it all happen comprises canals, weirs, dams, sluice gates, stilling basins, pumps and pipes – to name a few.

This issue begins with an analysis of rectangular weirs by Bijankhan *et al.* (2018) that develops generalised stage–discharge relationships that can be applied to a large range of weir width to channel width ratios, rather than time-intensive development of individual stage–discharge curves. Such weirs are common in irrigation, raw water conveyance and drainage systems. Also on the topic of weirs, Jalili Ghazizadeh *et al.* (2018) explore side weirs, which are typically used for flow control and diversion. Flow over side weirs is still considered a complex topic and the difficulty in predicting hydraulic behaviour increases when a hydraulic jump forms within the weir section. The authors present a model that was validated against experimental data as a first step in solving this complex problem.

Hydraulic jumps also feature in the paper by Shokrian Hajibehzad and Shafai Bejestan (2018), who examine this hydraulic behaviour within a river-bed rock chute. Rock chutes

and stilling basins perform important roles in erosion control and energy dissipation for water conveyance infrastructure and this paper furthers understanding about a little-understood type of hydraulic jump. Energy dissipation is important to the proper functioning and longevity of water conveyance infrastructure. Jafari *et al.* (2018) examine vibration in sluice gates, which can have direct impact on the structural strength, and find that vibrational energy can be associated with horizontal or vertical vibrations.

Another complex and real-world hydraulic problem is the design of water distribution systems. Jabbary *et al.* (2018) introduce an optimisation methodology to solve multi-objective distribution system problems, in this case the question of minimising pipe cost while maximising reliability. The methodology incorporates a deterministic evolutionary algorithm for optimisation and a fuzzy ranking method to select the best compromise solution from among the optimal Pareto set.

Finally in this issue, Swan *et al.* (2018) tackle the practical problem facing many parts of the world where hand-operated pumps break down and remain out of service, potentially leaving a community without a safe water supply. A novel monitoring system was developed to track usage at each pump and relay this data to a central monitoring system using SMS text messages, resulting in faster repair response and shorter down times.

All of these papers collectively paint a picture of the depth and complexity of the business of moving water around, whether through simple structures like weirs or complicated pipe networks. This complexity makes it an interesting field of work and study – we are not going to run out of problems anytime soon. In case you were wondering, my hard work in hydraulics class resulted in a computer program that successfully solved the hydraulic jump problem for full marks, with no guessing required. And while I probably didn't realise it at the time, this experience probably also set me along the path of trying to understand hydraulics for many years to come. If you can't get enough of hydraulics problems either, there are always new

papers available on the *Water Management* webpage in the Ahead of Print section.

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