# RESEARCH TO REVOLUTIONISE FLOOD DEFENCES

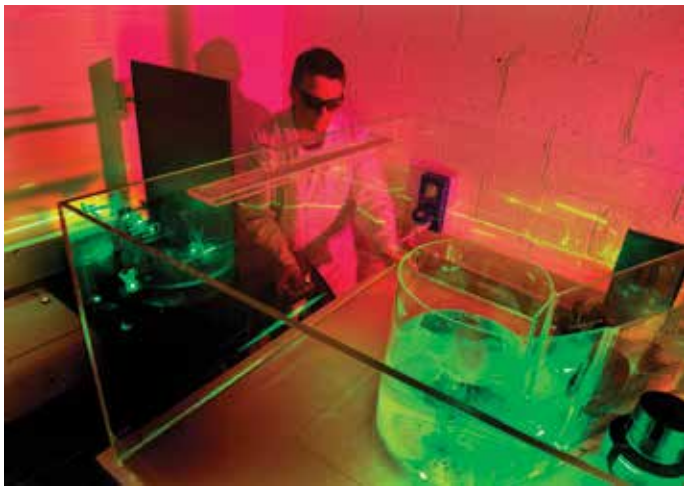
**Whirlpool research at IT Sligo is set to change the way rail, flood and sewerage systems are built in the future, following the findings of a new study by researchers from IT Sligo and one of Switzerland's leading universities, shedding new light on the flow patterns of whirlpools.**

Already, the findings are being used to inform a number of major European projects that include mega-sewer tunnels to help deal with growing waste water problems in large cities.

Vortex technology is also becoming an important form of small-scale hydroelectric power generation to provide cheap electricity in poor and isolated communities in developing countries, where access to a large-scale power grid might be impossible.

Members of the research team have travelled to Nepal where rural communities in the Himalayas are turning to vortex technologies to supply electricity to their communities.

There has been renewed interest in the study of whirlpools — or free-surface vortices — in recent years due to their relevance to diverse fields but a complete description of the turbulent three-dimensional structure of strong vortex flows has remained elusive, until now.



*Dr Sean Mulligan, pictured in IT Sligo's Hydraulics Research Lab, measures the speed of water flows within the vortex (the 'glass box') by placing different inserts in the middle of the model, using a technique called particle imaging velocimetry (PIV).*

## IRISH-SWISS COLLABORATION

The collaboration between the IT Sligo team and researchers from the Laboratoire de Constructions Hydrauliques (LCH) at the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland is working to change the situation.

The group's findings, which broaden the understanding of a classic fluid mechanics problem, were recently published in the international scientific journal 'Nature Scientific Reports'.

The current approach to these problems is to generate computer models of the flows. However, even using today's high-end supercomputers, the results for vortex flows can be significantly inaccurate.

The IT Sligo team, which has since been joined by NUIG to further explore the ramifications of the findings, comprises of Dr Sean Mulligan, Mr John Casserly and Dr Richard Sherlock.

"This newly discovered analogy has the potential to be a significant step forward in our understanding of turbulent flows in free-surface vortices and to provide insights into diverse areas of study. These range from civil engineering hydraulic structures to weather systems in the atmosphere and even extending to the details of how galaxies rotate around the black holes at their centres," according to Dr Sherlock, Physics Lecturer at IT Sligo.

Last year, Dr Giovanni De Cesare, deputy director of LCH, brought a suite of sensors called 2D ultrasonic Doppler velocity profilers (UDP) to Sligo and mounted them on a free-surface vortex test rig in the Hydraulics Research Laboratory in IT Sligo. This was the first time these sensors had been used to monitor whirlpools and it enabled very detailed measurements of the complex flow patterns of a whirlpool to be noted.

## BRIDGING THE GAP

Vortex flows are also central to many flood defence systems. Dr Sean Mulligan, who is currently a postdoctoral researcher leading an Enterprise Ireland commercialisation project at NUIG, and Dr De Cesare recently completed another collaborative study.

This aim of this study on innovative groundwater transfer system (which has been developed for the Swiss firm BG Consulting Engineers for the CEVA rail project in Geneva), was to find an alternative solution to traditional energy intensive pumping and consisted of putting in place a series of vortex siphons.

"We are involved in bridging the gap between the university and industry by developing diverse applications of vortex flows ranging from mega-sewer infrastructure projects to energy applications which can potentially help boost exports and employment here in Ireland," Dr Mulligan noted.