

Bijan Dargahi

Profile & the most significant academic contributions

Profile

Presently, I am engaged as an emeritus senior researcher at the KTH- the Royal Institute of Technology at the division of river engineering, Sweden. The main activities are researching hydrodynamics with limited teaching and advisory responsibilities. My background is in hydraulics and the related fields based on the combination of extensive experimental and applied research activities over decades.

My vision of both research and teaching is geared towards gaining a fundamental understanding of the underlying physics. The aim is to better manage the growing environmental problems which stand as a significant challenge to education. The coming generations of engineers and scientists need to be equipped with a multi-disciplinary approach thus enabling a smooth transition to a more sustainable society in terms of water resources. Today, the hard facts of various complicated environmental problems are a testimony to the need.

My main present research topic is the hydrodynamics of large water bodies with the focus on new aspects not considered in previous works. I believe the flow structures in the form of Lagrangian Coherent Structures (LCS) plays a major role in the transport of nutrients, pollution such as oil spill, and even plastic which is the recent pressing environmental problems. I am also investigating the characteristics of entropy of the kinetic energy with both temporal and spatial variations. Entropy is the key to understanding the fundamental processes in nature that find their origin in the second law of thermodynamics. Commonly, the concept of entropy is applied in quantum physics and the formation of our universe. The application of entropy to large water bodies is new that can further the frontiers of research in oceans. I have worked with the foregoing ideas and topics in application to the Baltic Sea. My several recent publications on the Baltic Sea highlight some of these aspects (e.g. *Dynamics of vortical structures in the Baltic Sea*. B Dargahi *Dynamics of Atmospheres and Oceans* 2109.)

Most significant academic contributions

The main contributions are in five areas of wall-bounded boundary layer flows, local scouring and sediment transport, CFD large scale modelling, environmental aspects of hydropower, hydrodynamic of large water bodies as well as a general contribution to the field of hydraulic engineering as the associate editor for more than a decade to the Journal of Hydraulic Research. The main focus of these works has been on understanding the basic mechanism as well as the applicability of the ideas generated in the studies. The approach and the methodology have ranged from large scale experimental studies to numerical and theoretical methods. A summary of each area of contributions follows.

1. Boundary layer flows

Experiment study of boundary layer vortex generation and the related coherent structures. The study revealed several important new aspects such as the interaction of the vortices, merging and inrush events.

- *Reference: Generation of coherent structures in turbulent boundary layers. Journal of engineering mechanics, 1997*

The study on the flow field around a cylinder led to significant improvements in the understanding of three-dimensional separated flow fields that occur around all objects placed in flowing water. A wealth of important experiment data was produced that have been used in many research papers.

- *Reference: The turbulent flow field around a circular cylinder. B Dargahi - Experiments in Fluids, 1989*

2. Local scouring & sediment transport

Innovative experimental study on the mechanism of local scouring that related the three-dimensional vortex structure around a bridge pier to the scouring process. The work has been extensively cited and used in many research papers since its publication.

- *Reference: Controlling mechanism of local scouring. B Dargahi Journal of Hydraulic Engineering, 1990*

Studies of sediment transport related to river engineering problems. The focus of these works was on mitigating the various environmental problems related to the changes imposed on the river morphology.

- *Reference: Mitigation of sedimentation problems in the lower reach of the River Klarälven. B Dargahi Journal of Hydraulic Research 2008*

3. CFD modelling

Pioneering studies on the application of advanced CFD modelling combined with experiments on the physics of groundwater flow.

- *A study of turbulent flow in large-scale porous media at high Reynolds numbers. Parts I & II. F Ferdos, B Dargahi Journal of Hydraulic Research, 2016*

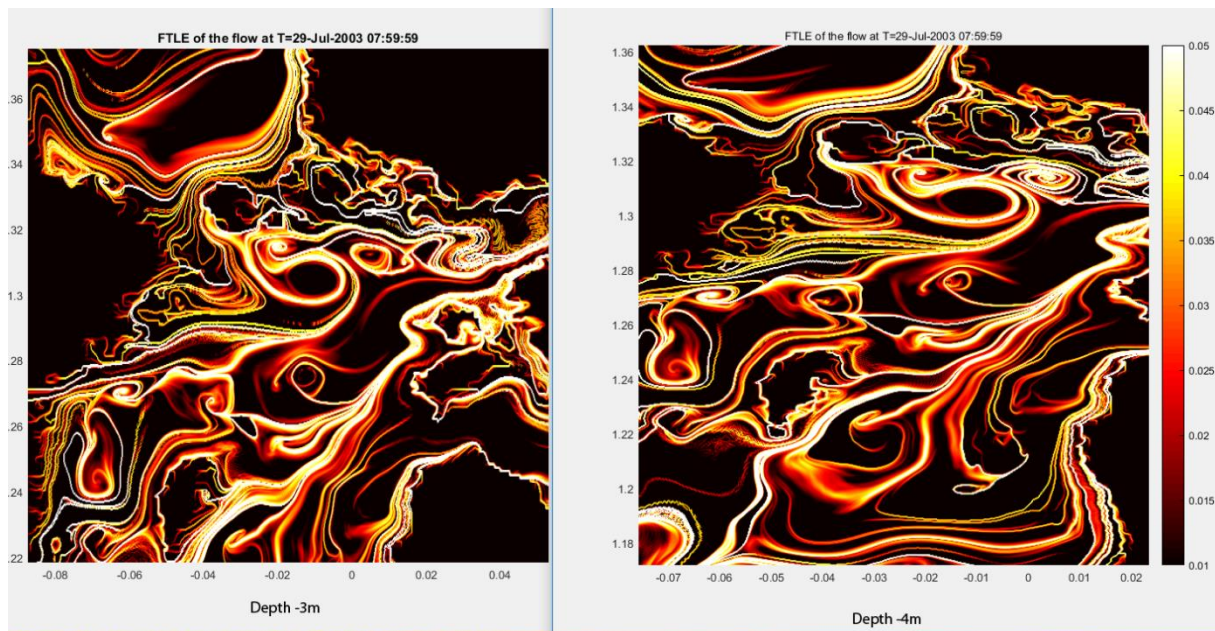
4. Environmental aspects of hydropower

- Contribution to the Encyclopaedia of lakes and reservoirs on the state of art on reservoir sedimentation.
- Innovative work on controlling the production of harmful mosquitoes employing river regulation. *Reference: Controlling Floodwater Mosquitoes by River Regulation. B Dargahi Water and Environment Journal 2109*

5. Hydrodynamics of large water bodies

The focus of the work is on understanding the new aspects of the hydrodynamics of large water bodies. Extensive innovative research is carried on the hydrodynamics of the Baltic Sea leading to many journal publications. New aspects such as the Lagrangian Coherent Structures and the entropy of the kinetic energy are addressed in great depths

Examples of Lagrangian Coherent Structures in the Baltic Sea



LCS at two different depths in the Baltic Sea, 29 July 2003. Bijan Dargahi CR