UNIVERSITY OF ABERDEEN

Postdoctoral Research Fellow

School of Engineering

Closing date:	04 November 2020
Interview date:	To Be Confirmed
Reference number:	ENG158R

The Times Good University Guide 2019 Scottish University of the Year

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Introduction

A majority of engineering and environmental flows occur over surfaces that are heterogeneous, i.e., they contain spatial variations in roughness and/or topography at a wide range of scales. When a turbulent flow evolves over such surfaces, it may exhibit unusual physical properties, depending on the relationship between the dominant length-scales of the surface and that of the flow. Often, this surface heterogeneity leads to the emergence of secondary currents (SCs) that may extend up to the entire depth of the flow and manifest as "time-averaged" streamwise vortices accompanied by low- and high-speed regions. The presence of SCs invalidates some of the fundamental concepts of turbulent wall-bounded flows that have been originally developed for flows over homogeneous surfaces. As a result, current predictive tools that rely on these concepts can neither predict nor offer insights into the flows that contain wall-induced SCs. The effects of surface-induced SCs have been recently recognised in at least two major engineering areas: (1) Performance of engineering systems such as in-service turbine blades, bio-fouled ship hulls and textured surfaces for flow control; and (2) Understanding of environmental implications of river flows with applications in flood management, sediment transport, and mixing of contaminants. Given the growing interest in this topic, it is timely to explore the synergies in these areas to develop new understanding of turbulent flows in the presence of surface-induced SCs. A recently funded EPSRC project 'Secondary currents in turbulent flows over rough walls' will address this matter and will combine the expertise, domain knowledge and infrastructure of four leading research groups at the Universities of Aberdeen, Glasgow, Southampton, and University College London. A comprehensive series of physical experiments (at Southampton & Aberdeen) and complementary numerical simulations (at Glasgow & UCL) will be performed to generate unprecedented data on surface-induced SCs. This will allow, for the first time, to systematically compare and contrast the behaviour of SCs across key canonical wall-bounded flows: *boundary layers, open-channels, pipes and closed-channels*. The obtained data will underpin identification and validation of potential universalities (and differences) in drag mechanisms and momentum/energy transfer in these flows in the presence of surface-induced SCs. Synthesising the insights obtained from the data, a new framework leading to physics-informed semi-empirical and numerical models will be developed to predict and optimise the influence of surface-induced SCs on turbulent wall-bounded flows. The contribution of the Aberdeen group will relate to *open-channel flows* and will be based on high-precision laboratory experiments involving the Aberdeen Open Channel Facility (AOCF) and a custom-made robotic multi-camera Particle-Image Velocimetry (PIV) system. The Postdoctoral Fellow, to be appointed, will be based in Aberdeen and will actively collaborate with researchers from all four Universities involved in this project.

Job description

Main purpose of the role:

The central goal of the proposed study is to advance fundamental understanding of the genesis of surface-induced secondary currents in all major types of wall-bounded flows (*boundary layers, open-channels, pipes and closed-channels*) and, based on this, to develop a comprehensive unifying framework for their identification, prediction and control. The study will explore a variety of surface heterogeneities relevant to applications and will establish the roles of SCs in momentum and energy transfer. To achieve this goal, the project will be split into three interlinked specific objectives:

1. Conduct high-precision laboratory experiments (Aberdeen, Southampton) and numerical simulations (Glasgow, UCL) for a comprehensive set of flow scenarios covering *boundary layers, open-channels, pipes and closed-channels* with similar surface conditions representing spatially heterogeneous walls/beds.
2. Using the experimental and simulation data, (i) quantify momentum and energy budgets in space-scale domain and assess modulation effects of SCs on turbulence structure; and (ii) identify key similarities/differences in secondary currents across the studied flow types.
3. Develop new models for prediction of drag and its constituents (surface-induced dispersive and turbulent stresses) based on surface topography/roughness information.

These objectives will be pursued through a 4-year programme with three work packages (WPs), with each WP addressing a specific objective. Four post-doctoral researchers (one in each institution) will carry out a significant part of the work. Aberdeen-based postdoc will focus on the turbulence and secondary currents in open-channel flows. The selected candidate will be responsible for design, preparations, and execution of laboratory experiments, development of numerical codes and data analysis, interactions with practitioners and members of the advisory board, preparation of data reports and research publications.

Applications are invited from individuals with civil, environmental, or mechanical engineering background, including a PhD in open-channel hydraulics. The ideal candidate will be familiar with modern turbulence theories and concepts, double-averaging methodology and its applications, have extensive experience in laboratory experimentation in hydraulic flumes (especially with advanced modes of PIV/PTV and acoustic velocimetry), data analysis, and computer programming. The post is for 46 months, with the expected starting date on March 1, 2021.

At a glance

Salary:

£33,797 - £35,844 per annum

Hours of work:

Full time

Contract type:

Available until December 2024

Key responsibilities:

Postdoctoral Research Fellow

- Organise, prepare and conduct laboratory experiments
- Develop and test specific PIV modes and set-ups
- Develop and test data analysis routines involving advanced methods of random functions and fields

- Conduct data analyses and contribute to physical interpretations
- Liaise with end-users dealing with potential applications
- Contribute to conference and journal papers
- Contribute to the development of the project's Webpage and its maintenance
- Undertake administrative responsibilities associated with the project as required
- Assist with the supervision of PhD student(s)
- Assist with the supervision of undergraduate project students as required
- Undertake teaching/demonstration duties for up to 6 hours per week

Candidate background

Applications are invited from individuals with civil, environmental, or mechanical engineering background, including a PhD in open-channel hydraulics. The ideal candidate will be familiar with modern turbulence theories and concepts, double-averaging methodology and its applications, have extensive experience in laboratory experimentation in hydraulic flumes (especially with advanced modes of PIV/PTV and acoustic velocimetry), data analysis, and computer programming.

Knowledge

- Advanced turbulence theories and associated methods of analyses
- Double-averaging methodology for rough-bed environmental flows
- Advanced theoretical background of PIV/PTV methodologies
- Advanced theoretical background of acoustic velocimetry
- Advanced statistics and probability theory, particularly related to random functions and fields
- Advanced uncertainties theory and error analysis with the focus on PIV applications

Skills

- Problem solving and analysis skills
- Acoustic Doppler velocimetry operations
- PIV calibration, set-up, operation
- Programming skills using Matlab, C++ and/or other computing languages
- General mathematical skills (advanced calculus, probability theory)
- Excellent written and oral communication skills
- Time management skills

Experience

- Extensive experience in design, planning and execution of laboratory experiments in hydraulic flumes
- Application of acoustic Doppler velocimeters in hydraulic experiments
- Multi-mode multi-camera PIV/PTV applications including 2d2c, 2d3c, 3d3c
- Proven computer code development
- High-quality writing of research reports/publications
- Application of advanced statistical tools (spectra, correlations, POD, EMD, etc)

Terms of appointment

Salary will be at the appropriate point on the Grade 6 salary scale (£33,797 - £35,844 per annum) and negotiable with placement according to qualifications and experience.
As this position is funded by EPSRC it is available until December 2024.

Any appointment will be made subject to satisfactory references and a 12 month probation period.

For further information on various staff benefits and policies please visit www.abdn.ac.uk/staffnet/working-here

Should you require a visa to undertake paid employment in the UK you will be required to fulfil the minimum points criteria to be granted a Global Talent Visa. As appropriate, at the time an offer of appointment is made you will be asked to demonstrate that you fulfil the criteria in respect of financial maintenance and competency in English. Please do not hesitate to contact Heather Clark, HR Adviser on h.m.clark@abdn.ac.uk for further information.

Person specification

	Essential	*Desirable*
Education/Qualifications	• *PhD in civil, environmental, or mechanical engineering in the field of open-channel hydraulics, awarded or pending.*	• *Honours degree in civil/environmental engineering, or equivalent.*
Work and Other relevant experience (including training)	• *Consuming interest in experimental, theoretical, and computational hydraulics/fluid mechanics research. Familiarity with modern turbulence theories/concepts, double-averaging methodology, and research tools of experimental hydrodynamics. Experience in laboratory experimentation (especially with advanced PIV/PTV), hydraulic flumes, data analysis, and computer programming. Potential to create a strong track record of research publications of high quality in refereed journals.*	• *Theoretical knowledge and experience in optical and acoustic hydraulic instrumentation.*
Personal qualities and abilities	• *Ability and willingness to work on own or within a team. Good written and oral communication skills. Proactive attitude in solving research and practical problems.*	
Other	• *Capability to perform laboratory experiments outside normal working hours (to reduce effects of background noise in PIV experiments).*	

The University

Founded in 1495, Aberdeen is Scotland's third oldest University and the fifth oldest in the UK. Ranked within the world top 160 in the Times Higher Education Rankings 2019 and named Scottish University of the Year in the Times and Sunday Times Good University Guide 2019. Aberdeen is 'open to all and dedicated to the pursuit of truth in the service of others'.

Aberdeen is a broad based, research intensive University, which puts students at the head of everything it does. It has significant academic strengths and potential across a wide variety of disciplines. Outstanding in a wide range of discipline areas, Aberdeen has also been credited for its international reach and its commercialisation of research ideas into spin out companies.

The University has over 14,000 matriculated students and 3,600 staff representing 130 nationalities. We encourage bold thinking, creativity and innovation and we nurture ambition with many opportunities for professional and personal development in an inclusive learning environment which challenges, inspires and helps every individual to reach their full potential.

The University combines a distinguished heritage with a forward looking attitude. In the past few years, the University has encouraged creativity in its academic staff, broken new ground with an innovative curriculum, and developed state-of-the-art facilities including the new Sir Duncan Rice Library and the Aberdeen Sports Village and Aquatics Centre. In looking to the future, the University seeks to enhance its reputation as one of the world's leading Universities by moving forward with ever more ground breaking research; ensuring students have an intellectual and social experience second to none; and capitalising upon the dual role as one of the major institutions of the north and as a cornerstone of regional economic and cultural life.

Aberdeen

From its position high on the east coast of Scotland, Aberdeen has exerted its influence right around the planet. Our long and proud tradition of invention and discovery – from subsea technology and the discover of insulin, to treatments for Cystic Fibrosis and even the first MRI scanner – demonstrated a fundamental element of our region's DNA, to blaze new trails and shape the future for all of humankind. We're open to the world.

We may be known as Europe's oil and gas capital, but we are so much more. Our impact is felt all around the globe. We are at the forefront of a global energy transition to a lower carbon world. We are recognised as an important centre for life sciences. Our health research is world-leading. And we are home to food and drink brands that are enjoyed right across the planet.

Ours is not just an illustrious history of global influence and, more recently, leadership in the oil and gas sector. Aberdeen has moved seamlessly into scientific, engineering, digital and low carbon specialisms. The city has one of the largest concentrations of life scientists in Europe and the largest biologics cluster in the UK after Cambridge.

Perhaps there's something in Aberdeen's culture that has always made it a magnet for global innovators – the city boasts no fewer than five Nobel Prize winners. It was back in 1922 that one of these winners, biochemist John MacLeod, helped to discover insulin. And Aberdeenshire-born physician Patrick Manson made the momentous discovery that malaria is spread by mosquitoes, credited as one of the most important medical breakthroughs of its time.

That drive and dynamism continues apace, and today we have Europe's largest single-site health
campus, where ground breaking research into cures for contemporary diseases is being carried out.

Aberdeen faces forward. It's a place that gets on with it. Ours is a small European city region with a big personality, punching well above its weight. We don't wait to see what others are doing and how they're doing it; we drive on with the business of innovation and don't stop when we hit the coast.

Supporting Facts:

Aberdeen has one of the largest concentrations of life scientists in Europe.

Aberdeenshire is a global centre for subsea technologies and expertise. In fact, 75% of the world's subsea engineering capability is based here.

Aberdeen is the centre of a UK industry that has, over 50 years, invested almost £500 billion in extracting oil and gas from the North Sea. Our skills and expertise have played a vital part in recovering the 20 billion barrels remaining in the UK Continental Shelf.

Breakthrough research in Alzheimer's, Cystic Fibrosis and Irritable Bowel Syndrome is taking place here in Aberdeen.

With regular connections to over 40 international and domestic destinations, Aberdeen International Airport looks after more than three million passengers each year, travelling right across the world.

Robert Thomson, from Stonehaven, was the acknowledged inventor of the fountain pen and original inventor of the pneumatic tyre.

The first written evidence of a game where the ball is passed from player to player to score goals appears in a book from Aberdeen dated 1633.

George Paget Thomson was professor of natural philosophy in Aberdeen when he discovered the electron, for which he was awarded the Nobel Prize in physics in 1937.

The role of mosquitos in spreading malaria was discovered by Aberdeenshire physician Sir Patrick Manson, known as the 'Father of tropical medicine'.

Aberdonian inventor and energy pioneer Robert Davidson built the world's first known electric locomotive here in 1837.

Sir Thomas Sutherland, the founder of the Hong Kong and Shanghai Banking Corporation, now known as HSBC, was born in Aberdeen and studied at the University of Aberdeen.

Aberdeen has UNESCO-recognised archives – the oldest and most complete collection of records of any Scottish town.

The terraces of the Houses of Parliament and the original Waterloo Bridge in London were constructed with Aberdeen granite.

How to apply

Online application forms are available at www.abdn.ac.uk/jobs

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The closing date for receipt of applications is 04 November 2020

Should you wish to make an informal enquiry please contact Professor Vladimir Nikora, Leader of the Mechanics of Fluids, Soils and Structures Research Group at the School of Engineering
01224 273830
v.nikora@abdn.ac.uk

Please do not send application forms or CVs directly to Professor Vladimir Nikora

Please quote reference number ENG158R on all correspondence

The School of Engineering welcomes a diverse working environment and recognises the benefits this can bring. The School is keen to receive applications from individuals from across all of the equality protected characteristics (race, gender, disability, gender reassignment, age, sexual orientation, religion/belief, pregnancy/maternity, marriage/civil partnership).

The University supports opportunities for flexible working for a range of reasons and has policies in place to facilitate this. The policies can be found here:

https://www.abdn.ac.uk/staffnet/working-here/flexible-working--5607.php

The University's commitment to gender equality has been recognised through the achievement of an Athena SWAN Bronze award. The University is also a Stonewall Diversity Champion to further LGBT equality and a Disability Committed Employer recognising our commitment to supporting disabled staff and students.

https://www.abdn.ac.uk/staffnet/governance/equality-and-diversity-277.php