Stuart Walker PhD MEng MIMechE

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PhD qualified Chartered Mechanical Engineer with post-doctoral and commercial experience.
Strong interest in renewable energy and the environment, and a real passion for engineering.

Key skills in:

- **Circular Economy:** Life Cycle Assessment, Material analysis and selection. Considering impact beyond CO_2.
- **Communication:** National & international conferences, large public engagement events, school presentations, public speaking to paying audiences.
- **Publications:** Peer reviewed journal papers in a range of subjects, national newspaper articles, radio interviews, commercial reports.
- **Funding:** EPSRC Fellowship and multiple small grants. Experience in development of large multi-disciplinary/agency/country bids. Familiar with success and failure.
- **Supervision & Teaching:** Two current PhD supervisions, two current (two previous) MEng supervisions. Experience developing teaching material for UG and public programmes.

Research Experience

August 2019 to present:

Post-Doctoral Research Associate
Grantham Centre for Sustainable Futures, University of Sheffield

The *Plastics: Redefining Single Use* project is funded by a grant from the EPSRC Plastics Research and Innovation Fund (PRIF). Genuinely multidisciplinary, with academics and researchers from four faculties and 15 departments, the project aims to address the current plastic crisis by understanding when plastic can be removed, when it can be replaced (and by what), and when it should remain.

Much of my work is on Life Cycle Assessment (LCA) of plastic and potential alternatives, across three key areas: Reuse of packaging, Plastic in agriculture, and Plastic in medicine. This involves a diverse research field, from understanding the environmental impact of Soybean hulls in cattle feed, to the adoption of latex gloves in dentistry and the impact this has on patient confidence, to the development of a small-scale industrial composting system for bio-based plastic tubs at a small ice cream parlour.

Role specifics:

- Developing and publishing (see pages 5-6) new techniques in Life Cycle Assessment
- Working closely with industry, from a small local dairy to Coca Cola and Marks & Spencer
- Developing and promoting high quality LCA work through the network of PRIF-funded institutions
- Acting as an academic representative to the UK Plastics Pact, a traditionally closed group of plastic packaging producers and major users
- Investigating the true impacts of alternative materials and gathering unbiased data (for example on Bioplastics, which is a current focus)
- Using my renewable energy experience to develop future projections on the interaction of grid defossilisation, plastic production, and environmental impact
- Supervising two MEng student projects and two PhD supervisions
- Producing articles for public engagement, including work recently published in The Times
- Co-ordinating and contributing to responses to government consultations
- Reviewing journal and conference submissions
- Organising a conference for early career researchers from all PRIF-funded projects
- Working with colleagues to develop bids for further funding, including a large project on the impact of plastic waste in low and middle income countries

In January 2020 I will travel to the Gambia to work with academia, government and NGOs to develop a single-use plastic reduction strategy.

Having received further funding from the MaRINet2 programme, I have also continued experimental Tidal Turbine research with partners in the UK and Italy, and recently presented work on the impact of waves on the performance and structural deflection on a tidal stream turbine at a European conference (see page 6). Further work on the development of turbine designs for breakwaters and the potential for a combined energy capture and marine litter removal device were also studied, and I hope to continue this work. Publications on these studies are either in press or to be submitted early in 2020.

September 2018 to August 2020:

Researcher in Low Carbon Product Design and Development

Institute for Innovation in Sustainable Engineering, University of Derby

Multi-skilled low carbon consultant on the ERDF-funded D2EE project, aiming to reduce the carbon emissions of Small and Medium sized enterprises in the Derbyshire region. Involved in a diverse range of projects utilising many skills, including as examples:

- Development of a machine learning system (coded in Python) to identify and classify infrastructure features in images from UAV (drone) photography
- Mathematical (power output and optimal efficiency calculations) and computational (fluid dynamics) modelling of an in-stream hydroelectric generator
- Research and development of a range of low U-value windows and doors suitable for PassivHaus use with full product life cycle assessment and resource accountability
- Design and testing of a prototype small-scale cavitation energy capture system
- Building process monitoring and sensor development to identify and reuse waste process energy

These projects required a combination of academic rigour, commercial awareness, delivering to tight deadlines and the ability determine and present work at the appropriate level. I was also involved in work to raise the profile of the institute and secure its future, including:

- I was one of four main contributors to a multi-million pound bid for continued funding
- Acting as co-supervisor for two PhD students supported via Rolls Royce
- Part of staff interview panels for new research positions
- Representing the institution at regional events (e.g. Low Carbon Business Network)
- Holding the institute to account and questioning greenwash

In addition to this work, I remained involved in the marine energy industry, and was awarded funding via the MaRINet2 program to test an instrumented turbine at the University of Florence. The focus of this work was the lifetime fatigue effect on performance. This work was subsequently presented at a European conference in 2019 and will be published in 2020. I also continued Life Cycle Assessment projects, wrote journal articles and acted as a reviewer for conferences and journals.

During this role I was nominated for a *Positive Impact* staff excellence award, for working to return the D2EE project from being significantly behind schedule when I joined the institution.

January 2017 to August 2018:

Post-Doctoral Research Associate in Structural Dynamics

Dynamics Research Group, University of Sheffield

As part of the renowned University of Sheffield Dynamics Research Group, I was the lead experimental researcher on the S^3 – *Disease Surveillance for Systems and Structures* project, under Prof. Keith Worden.

Experimental and computational work, including:

- Design, setup, instrument management, calibration and repair of equipment including scanning laser vibrometer
- Experimental testing using laser vibrometry, accelerometers, force transducers and impact testing

- Signal processing and data analysis (MatLab, Python)
- Development of machine learning algorithms for structural response prediction using Extreme Function Theory
- Finite element modelling and model updating using experimental data
- Preparation of conference and journal papers and presentations

Management of the group and lab, including:
- Supervising and supporting undergraduate and postgraduate student projects, including experimental design, equipment recommendation, teaching and day-to-day assistance
- Responsibility for the use allocation, training and user safety of Scanning Laser Doppler Vibrometer
- Responsible for lab safety, risk assessments, inductions and security

December 2014 to December 2015:

EPSRC Doctoral Prize Fellowship Researcher

Department of Mechanical Engineering, University of Sheffield

Following my PhD I was awarded 12 months' EPSRC funding to continue tidal turbine research. This was undertaken in two sections, at the University of Florence and the University of Sheffield.

Experimental testing of scale models (University of Florence). Major achievements:
- Developed project plan, budget and experimental strategy (during application process)
- Designed and constructed scale model turbines and instrumentation to measure speed and power
- Characterised large water channel to understand boundary layer and turbulence levels
- Recorded flow data using Ultrasonic, Laser and Acoustic Doppler systems
- Analysed large flow data sets using MatLab, e.g. Fourier Transforms and spectral analysis

Computational Fluid Dynamics (CFD) work at the University of Sheffield, including:
- Model construction in CAD and ANSYS CFX software
- Parametric analysis using models of increasing complexity to balance performance and resource
- Comparison of CFD model performance data with experimental results
- Study of turbulence results using Q criterion and vorticity
- Presentation of data and results, writing of formal reports

This work was presented at two European conferences in 2015, and is the subject of a journal article published in 2017. During this project I also helped other researchers and PhD students with experimental water channel work, CFD, and journal article and thesis writing.

September 2010 to December 2014:

PhD Candidate: Hydrodynamic interactions of a Tidal Stream Turbine and Support Structure

Department of Mechanical Engineering, University of Sheffield

Part of the University of Sheffield E-Futures Doctoral Training Program, PhD included a taught first year:
- Current, historical and forecast UK and global energy and resource (inc. water) use and demand
- Detailed study of fossil fuel, nuclear and renewable energy sources
- Projects on Hydrogen burning, Life Cycle Assessment and psychology (resulting in two journal articles)

PhD project major achievements:
- Conducted extensive review of literature on tidal power (resource, technology, economics), hydrodynamics and turbulence, water channel research and instrumentation
- Initiated discussions with commercial partner, resulting in support and access to privileged data
- Constructed instrumented turbines, developing theoretical and practical understanding of sensors
- Used numerous flow measurement methods, e.g. Dye injection, Doppler systems and Particle Image Velocimetry, developing skills in system construction, use, repair and safety issues
- Gained experience in MatLab signal and image processing (e.g. Proper Orthogonal Decomposition of turbulence data) and programming scripts and functions
- Awarded funding via the MaRINet transnational access program (EU FP7 "Capacities" Programme)

- Developed understanding of Big Data and interrogation techniques
- Regularly helped other students: PhD, MSc, and undergraduates (laboratory demonstration)

September 2010 to December 2015 (concurrent with PhD & Fellowship):

Collaborator on Life Cycle Assessment project

LCA Expert Group, TATA Steel

After collaboration during the first year of my PhD have continued this work alongside my main research. Major aspects of the project:

- Study of embodied energy of Tidal energy devices, both using commercial software (GaBi) and self-developed linked spreadsheet tool using Visual Basic
- Analysis of the impact of Circular Economy principals to part design and reuse
- Development of collaborations and access to TATA Steel data on embodied energy and CO_2
- Published in three peer reviewed articles and at international Life Cycle Management conference
- Presentations and meetings with all levels of TATA Steel research staff

Industry Experience

September 2007 to September 2010:

Graduate Consultant

AECOM Advanced Design Group

Member of a specialist team within the AECOM Buildings Division. Main responsibilities:

- Energy demand modelling and energy planning at building scale
- Working as part of masterplan design teams on energy, water and transport layout
- Development of energy strategy for large project bids (e.g. Qatar 2022 World Cup bid)
- Computational modelling for building regulation compliance using dynamic thermal modelling
- Specialising in CFD analysis for external wind assessment and internal airflow analysis (managing projects from inception to completion, including all bid work and presentation of findings)

In this role I regularly delivered presentations and prepared reports for clients, building design teams, and planning authorities. I also managed two members of staff when project workload required.

May 2004 to September 2004:

Manufacturing Engineer

Labman Automation

- Assisted in the design and construction of robotic systems for commercial and academic applications
- This role cemented my interest in engineering, aided my practical workshop skills, and introduced me to CAD and computational modelling

May to September 2002 and 2003:

Design Engineer

BioGene Research

- Part of a small team working on the prototype design of DNA testing equipment
- Developed a full construction and assembly guide to allow subsequent batch manufacturing

Management Experience

December 2015 to October 2016:

Chalet Manager (Winter) & Resort Manager (Summer)

After my post-doctoral fellowship my wife and I spent a year in the French Alps. This was planned for 2016 as we both reached the end of fixed-term roles in December 2015. This role developed my management and practical skills:

- Managed a remote 25 guest chalet over the winter season
- Managed three self-catered chalets during the summer season
- Developed customer service and advanced driving skills
- Improved French and German language skills
- Managed three members of staff in a busy customer-facing environment

September 2004 to October 2005:

Ski Instructor

Sheffield Ski Village

Part-time role during undergraduate degree. Planned and delivered lessons to clients of all ages:

- Attained Snowsport England Club Instructor qualification
- Developed teaching skills for a wide range of audiences, from large groups of 3 year-olds to individual and family lessons for adults

Publications

Thesis:

Walker, S., *Hydrodynamic interactions of a tidal stream turbine and support structure*, University of Sheffield, Departments of Mechanical and Civil and Structural Engineering, December 2014.

Journal articles:

Walker, S., Rothman, R., Life Cycle Assessment of Bio-based and Fossil-based plastic: A Review, Journal of Cleaner Production, Nov. 2019, in press (review comments received Jan. 2020)

Walker, S., Hodgson, P., Coleman., N., *Evaluating the environmental dimension of material efficiency strategies relating to the circular economy*, Sustainability, March 2018, **10** (3): p. 666
http://www.mdpi.com/2071-1050/10/3/666

Walker, S., Cappietti, L., *Experimental Studies of Turbulent Intensity around a Tidal Turbine Support Structure*, Energies, April 2017, **10** (4): p. 497
http://www.mdpi.com/1996-1073/10/4/497

Walker, S., Howell, R., Hodgson, P., Griffin, A., *Tidal energy machines: A comparative life cycle assessment study*, Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment, May 2015, **229** (2): p. 124-140
http://pim.sagepub.com/content/229/2/124.abstract

Kaklamanou, D., Jones, C., Webb, T., Walker, S., *Using Public Transport Can Make Up for Flying Abroad on Holiday: Compensatory Green Beliefs and Environmentally Significant Behavior*, Environment and Behavior, February 2015, **47** (2): p. 184-204
http://eab.sagepub.com/content/47/2/184

Walker, S., *Barriers to the deployment of a 100MW tidal energy array in the UK*, International Journal of Energy Engineering, Jun. 2013, **3** (3): p. 80-92
http://www.ij-ee.org/paperInfo.aspx?PaperID=4571

Walker, S. and Howell, R., *Life Cycle comparison of a wave and tidal energy device,* Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment, November 2011, **225** (4): p. 325-337
http://pim.sagepub.com/content/225/4/325.abstract

Regular reviewer for journals including: Energies; Sustainability; Proceedings of the Institution of Mechanical Engineers; Journal of Cleaner Production.

Selected Proceedings:

Walker, S., *A laboratory study on the effects of waves on the performance and structural deflection of a tidal stream turbine*, 13th European Wave and Tidal Energy Conference (EWTEC), September 2019, Naples.

Walker, S., Lord, C., Dervilis, N., Papatheou, E., Worden, K. *On the use of pseudo-damage to represent damage to structures in population-based Structural Health Monitoring,* ISMA International Conference on Noise and Vibration Engineering, September 2018, Leuven, Belgium.

Walker, S., *Optimising the design of a tidal stream turbine support structure for improved turbine performance*, 11th European Wave and Tidal Energy Conference (EWTEC), September 2015, Nantes.

Walker, S., *Studying tidal stream turbines in the LABIMA DICEA wave-current flume*, 7th International Short Course and Conference on Applied Coastal Research (SCACR), September 2015, Florence.

Coleman, N., Hodgson, P., Walker, S., *Life Cycle Assessment as a Tool for Understanding Material Efficiency Strategies relating to the Circular Economy*, 7th International Conference on Life Cycle Management, August 2015, Bordeaux.

Fung, C., Walker, S., Howell, R., *Effect of the velocity profile of incoming flow on the performance of a horizontal axis tidal stream turbine*, Grand Renewable Energy 2014, August 2014, Tokyo.

Selected Presentations, Posters and Talks:

2019 Article to illustrate the importance of Life Cycle Assessment published on University of Sheffield homepage and reported in local and national news media.
Rea urged to rethink his drive home for Christmas (The Times)
Driving Home for Christmas - Should Rea have taken the train? (Northern Echo)
Comment: Driving home for Christmas (University of Sheffield homepage)

2019 Talk given at meeting of the UK Plastics Pact, London.
Identifying the Right Solution

2019 Presentation given at European Wave and Tidal Energy Conference (EWTEC), Naples, Italy.
A laboratory study on the effects of waves on the performance and structural deflection of a tidal stream turbine

2019 Presented collaborative research project with industrial partner at two University of Derby Research conferences.

2018 Live interview on BBC Radio Derby regarding life cycle costs and energy generation of a range of renewable energy and energy efficiency technologies.

2018 Open talk given to University of Sheffield Dynamics Group and attendees from across the faculty.
Dynamics research in Marine Renewable Energy

2018 Poster presented at University of Sheffield Dynamics Group Showcase poster presentation.
Experimental and computational studies of nominally similar structures
Winner of best poster prize

2017 Presentation given at public engagement event in Sheffield City Centre (The Mobile University).
How Similar is Similar?

2017 Participated in conference discussion event (MaRINet2)
MaRINet2: Accessing Europe's ORE Test Facilities

2015 Talk given at Short Course on Applied Coastal Research (SCACR), Florence, Italy.
Studying Tidal Stream Turbines in the LABIMA-DICEA Wave-current Flume
Session chair and vice-chair at tidal energy sessions at SCACR

2015 Talk given at European Wave and Tidal Energy Conference (EWTEC), Nantes, France.
Optimising the Design of a Tidal Stream Turbine Support Structure for Improved Performance
Session chair and vice-chair at tidal energy sessions at EWTEC

2015 Participated in early-stage researcher's workshop (INORE)
Workshop: Does size matter in Marine Renewables? Is bigger better?

2014 Talk given at University of Sheffield Engineering Symposium
Improved tidal turbine performance through optimised support structure design

2014 Poster presented at University of Sheffield Engineering Symposium
Statistical Analysis in the Wake of a Tidal Stream Turbine

2014 Poster presented at Grand Renewable Energy 2014 / AWTEC, Tokyo, Japan.
Statistical Analysis in the Wake of a Tidal Stream Turbine

2014 Report published, distributed and publically available via MaRINet website
TEDSSWIP Project MaRINet Transnational Post-access activity report

2014 Talk given to University of Florence LABIMA research group, Florence, Italy.
TEDSSWIP, modelli e esperimenti

Funding Awards

MRC Unit, The Gambia - January 2020
Awarded preliminary grant to travel to the Gambia to work with academic organisations, government and NGOs to develop a single-use plastic reduction strategy. Value to be confirmed. The organisation has offered to fund a visit of up to 6 months.

MaRINet2 (EU funded) - October 2019
Awarded three weeks laboratory time and associated costs (c. £6000 total) to participate (as an expert consultant) in the development and testing of the *Blue Barriers* project, aiming to develop technology to capture litter in rivers before it reaches the ocean.

MaRINet2 (EU funded) - April 2018
Awarded funding for three weeks laboratory time and associated costs (c. £12,000 total) at University of Florence for a project (designed and proposed by myself) to develop a lifetime prediction tool for tidal stream turbine foundations, using experimental analysis and statistical modelling.

Urban Flows Observatory Sensor Design Competition - February 2018
Winner of initial stage of sensor design competition, resulting in award of c.£1000 to develop three prototype sensors for testing and development during second stage.

Engineering Researcher Society Development Opportunities fund - February 2018
Award of small grant to fund manufacture of scale model turbine blades, subject to acceptance of MaRINet2 application.

MaRINet (EU funded) - June 2015
Awarded funding for a project (designed and proposed by myself) to conduct large scale experiments on tidal turbine support structures at the University of Florence. 3 weeks of laboratory access and associated costs awarded (c. £18,000 total).

EPSRC – December 2014
Doctoral Prize Fellowship. This was a fully costed application for a 12 month fellowship, including salary, laboratory access and experimental and computational equipment. Total award value was £41,970.

Education

PhD (Tidal turbine hydrodynamics) - Dec. 14 (inc. Diploma in Professional Skills)
University of Sheffield (co-supervised by Mechanical & Civil Engineering departments)

MEng Mechanical Engineering (2:1) - July 07
University of Sheffield

Stokesley School & 6th Form College - July 03
A Levels: Design Technology Systems & Control (A) Maths (B); Physics (B);
AS Levels: General Studies (A); German (C)
GCSEs: 10 at A*-B inc. Maths (A), English (A*/ A) and Science (A*)

Public Engagement

- **STEM Ambassador:**
  - Talk to Tapton School Chemistry Club (December 2019)
  - Derby Big Bang Science Festival (July 2019)
  - St Catherine's Academy student design project (2017/2018)
- **HEA-funded student feedback project:** Appointed as student ambassador on University-wide project, and subsequently employed in data analysis role (using SPSS statistical analysis software)
- **Web Development:** Founder member and web developer, Sheffield Marine Research Forum
- **Researchers in Residence:** Delivered lessons to students at De Warenne Academy (2012)
- **National Science & Engineering Week:** Presented to large public audience (2011)
- **Festival of the Mind:** Public presentation at 2013 and 2017 'Mobile University' events
- **UCAS visit days:** Led departmental tours for prospective students and parents (2013 & 2014)

Professional Affiliations

- Chartered Mechanical Engineer (Achieved 2013)
- Member of Institute of Mechanical Engineers (MIMechE)
- Member of the Institute of Acoustics
- Member of Energy Institute (MEI)
- Member of early-stage researchers' International Network on Offshore Renewable Energies (INORE)
- STEM Ambassador & Bloodhound Project (Land speed record car) Ambassador

Interests

I enjoy practical engineering, having previously built wind turbines, an electric tricycle scooter, a campervan conversion, a remote control dustbin and a kit car. I also ran a small mountain bike manufacturing business during my undergraduate degree.

In 2016 founded the anti-litter charity *Runners against Rubbish*, which now has around 200 members and has been featured in national press. In 2018 I organised a relay around the South West Coast Path, during which 60 volunteers removed over 100 bags of rubbish from the trail.

I enjoy all outdoor sports and am a sponsored ultra-distance runner and UK Athletics qualified run leader (FLiRF). I have achieved UK race victories, and in 2013 competed at the Adventure Racing World Championships in Costa Rica. I have also raised over £7000 for charity through long distance running challenges.