SIMON WOLFGANG FUNKE

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PERSONAL INFORMATION

Name: Funke, Simon Wolfgang

Date of birth: 17.10.1983

Sex: Male

Nationality: German

POSITIONS

2016 - today   **Research Scientist, Simula Research Laboratory, Oslo, Norway**.

2016 - today   **MC Member, COST Action TD1307 (European Model Reduction Network)**.

2015 - today   **Adjoint Associate Professor, University of Oslo, Norway**.

2014 - today   **Technical advisor (CTO in 2014), IMERSO AS, Oslo, Norway**.

2013 - 2015   **Postdoctoral Fellow, Simula Research Laboratory, Oslo, Norway**.
In addition, a 20% adjoint PostDoc position in 2014 at Imperial College London, UK.

2014 - 2015   **Consultant, Kalkulo AS, Oslo, Norway**.

2013 - 2014   **Consultant, E.ON AG, Düsseldorf, Germany**.

EDUCATION

2009 - 2013   **PhD, Computational science, Imperial College London, UK**.
- Thesis title: *The automation of PDE-constrained optimisation and its applications*.
- Department of Earth Science and Engineering.
- Supervisors: M.D. Piggott, P.E. Farrell, P.A. Allison, G.J. Gorman.
- Date of approved disputation: 01.03.2013.

2007   **Erasmus, École normale supérieure de Lyon, France**.

2004 - 2009   **Diplom, Mathematics, Technische Universität München, Germany**.
- Passed with high distinction (1.0).
- Thesis title: *Fast solvers for the Navier-Stokes equations on high Reynold numbers*.
- Department of Mathematics.
- The German Diplom is equivalent to a Master degree.
- Supervisor: M. Ulbrich.

AWARDS AND PRIZES

- **Wilkinson Prize for Numerical Software**, 2015
  The Wilkinson prize for Numerical Software is a prestigous prize in scientific computing, awarded every four years to the authors of an outstanding piece of numerical software. In 2015, the prize was awarded to Funke and his co-authors P.E. Farrell, D.A. Ham and M.E. Rognes for the high-level AD tool dolfin-adjoint.

- Best Poster Award, CSE 2015

- Imperial College Startup Venture Catalyst Award, 2013

- Imperial College Excellence Award, 2010

- Google Interactivism Award, 2011

- Grantham Institute for Climate Change and Fujitsu CASE Studentship, 2009

- Hurwitz-Association Award for an excellence diploma thesis, 2009

FUNDING

- PI on NOK 7M FRIPRO Young Research Talent "Simulation-based optimisation with dynamic domains", (#251237/F20), 2016

- EU Horizon 2020 SME instrument, IMERSO AS, 2015

MOBILITY

Studied and worked in research institutions in **Germany, France, UK and Norway** (> 6 months).

Shorter research visits:
- Heidelberg Laureate Forum, Germany (2016)
- Texas A&M University, USA (2015)
- Humboldt University of Berlin, Germany (2013)
- Simula Research Laboratory, Norway (2012)
- Isaac Newton Institute, Cambridge, UK (2012)
- Institut of Atmospheric Physics, Beijing, China (2011).

SUPERVISION

PostDocs: August Johannsson (Simula).

PhD students: Jorgen Dokken (Simula), David Culley (Imperial College, co-superviser).

TEACHING ACTIVITIES

2015 - today   **Lecturer,** INF3331/INF4331 Higher-level programming, University of Oslo, Norway.

2017 - today   **Python Workshop** NTNU Trondheim (2017, 2 days).

2014 - today   **FEniCS/dolfin-adjoint Workshop** UNISA Johannesburg (2016, 1 day), Technical University of Munich (2016, 5 days), SUURPH workshop, Simula (2016, 1 day), Simula (2016, 2 days), Simula (2014, 1 day), Zhejiang University (2014, 5 days).

2010 - 2012   **Teaching assistant** for courses on computational science, programming and mathematics. Department of Earth Science and Engineering, Imperial College London, UK.

COMMISSIONS OF TRUST

2019   **Organiser Committee** ECCOMAS, Young Investigators Conference.

2013 - today   **Reviewer** for SIAM Journal on Scientific Computing (SIAM), Computer Physics Communications (Elsevier), Energies (MDPI) and European Wave and Tidal Energy Conference Series and Geoscientific Model Development (GMD), Applied Energy.

2015-today   **Examiner** for 2 Master projects.

2015   **Organiser** of a Workshop on Advanced Techniques in Biomedical Computing, *Center for Biomedical Computing*.

2015   **Organiser** of a Mini-symposium on Efficient Solvers for PDE-constrained Optimization, *SIAM CSE15*.

RESEARCH INTEREST/RESEARCH PROFILE

Funke's research interests center around optimisation problems governed by partial differential equations, with a focus on their numerical solution. In particular, he is interested in the automated derivation of adjoint and tangent linear models and their use in optimal control, data inversion and design optimisation. He is a founder of the dolfin-adjoint project, a software which automatically derives adjoint models from complex computer models solving partial differential equations based on a high-level symbolic problem specification language that mimics mathematical notation.

Funke applies these advances to applications in a wide variety of different domains including renewable energy and bioengineering. For the renewable energy sector, he developed OpenTidalFarm, an open-source software for optimising of tidal turbine farms, such as the optimal position of turbines within the farm. In bioengineering, he developes data assimilation techniques for blood flow simulations, with the aim to tune high-fidelity numerical blood flow models to match with MRI measurements.

Journal publications

1. *SD Parkinson, SW Funke, J Hill, MD Piggott, PA Allison.* Application of the adjoint approach to optimise the initial conditions of a turbidity current (AdjointTurbidity 1.0), *Geoscientific Model Development (GMD)*, doi:10.5194/gmd-10-1051-2017, 2017.

2. *SW Funke, SC Kramer, MD Piggott.* Design optimisation and resource assessment for tidal-stream renewable energy farms using a new continuous turbine approach, *Renewable Energy*, doi:10.1016/j.renene.2016.07.039, 2016.

3. *DM Culley, SW Funke, SC Kramer, MD Piggott.* Integration of cost modelling within the micro-siting design optimisation of tidal turbine arrays, *Renewable Energy*, doi:10.1016/j.renene.2015.06.013, 2016.

4. *S Rao , H Xue, M Bao, SW Funke.* Determining tidal turbine farm efficiency in the Western Passage using the disc actuator theory, *Ocean Dynamics*, doi:10.1007/s10236-015-0906-y, 2015

5. *PE Farrell, A Birkisson, SW Funke.* Deflation techniques for finding distinct solutions of nonlinear partial differential equations, *SIAM Journal on Scientific Computing*, doi:10.1137/140984798, 2015.

6. *R Venell, SW Funke, S Draper, C Stevens.* Designing Large Arrays of Tidal Turbines: a synthesis and review, *Renewable & Sustainable Energy Reviews*, doi:10.1016/j.rser.2014.08.022, 2015.

7. *SW Funke, PE Farrell, MD Piggott.* Tidal turbine array optimisation using the adjoint approach, *Renewable Energy*, doi:10.1016/j.renene.2013.09.031, 2014.

8. *PE Farrell, CJ Cotter, SW Funke.* A framework for the automation of generalised stability theory. *SIAM Journal on Scientific Computing*, doi:10.1137/12090074, 2014.

9. *PE Farrell, DA Ham, SW Funke, ME Rognes.* Automated derivation of the adjoint of high-level transient finite element programs, *SIAM Journal on Scientific Computing*, doi:10.1137/120873558, 2013.

10. *SW Funke, CC Pain, SC Kramer, MD Piggott.* A wetting and drying algorithm with a combined pressure/free-surface formulation for non-hydrostatic models, *Advances in Water Resources*, doi:10.1016/j.advwatres 2011.

Conference publications

1. *CT Jacobs, SC Kramer, MD Piggott, SW Funke.* On the validity of tidal turbine array configurations obtained from steady-state adjoint optimisation, *ECCOMAS Congress 2016*, PDF, 2016.

2. *DM Culley, SW Funke, SC Kramer, MD Piggott.* Tidal stream resource assessment through optimisation of array design with quantification of uncertainty, *EWTEC 2015 proceedings*, PDF, 2015.

3. *T Roc, SW Funke, KM Thyng.* Standard methodology for tidal array project optimisation: An idealized study of the Minas Passage, *EWTEC 2015 proceedings*, PDF, 2015.

4. *SC Kramer, SW Funke, MD Piggott.* A continuous approach for the optimisation of tidal turbine farms, *EWTEC 2015 proceedings*, PDF, 2015.

5. *DM Culley, SW Funke, SC Kramer, MD Piggott.* A hierarchy of approaches for the optimal design of tidal turbine arrays, *Proceedings of the 5th International Conference on Ocean Energy*, PDF, 2014.

In review

1. *MM Noack, SW Funke* Hybrid Genetic Deflated Newton Method for Global Optimisation, *Computational and Applied Mathematics*, , 2017.

2. *SW Funke, PE Farrell, MD Piggott.* Reconstructing wave profiles from inundation data, *Computer Methods in Applied Mechanics and Engineering*, , 2017.

3. *T Schwedes, DA Ham, SW Funke, MD Piggott* Mesh dependence in PDE-constrained optimisation, *Springer Research Brief*, , 2016.

4. *SW Funke, M Nordaas, Ø Evju, MS Alnæs, K-A Mardal.* Variational data assimilation for transient blood flow simulations, *SISC*, 2016.

5. *DM Culley, SW Funke, SC Kramer, MD Piggott.* A surrogate-model assisted approach for optimising the size of tidal turbine arrays, *International Journal of Marine Energy*, 2016.

6. *Roan du Feu, SW Funke, SC Kramer, DM Culley, J Hill, BS Halpern, MD Piggott.* The trade off between tidal-turbine array yield and environmental impact: a multi-objective optimisation problem, *Renewable Energy*, submitted, 2016.

DISSEMINATION

Simon Funke attented various national and international conferences. The following list presents a selection of presentations:

Automatic Adjoints of Multimesh Finite Element Discretisations, *SIAM Conference on Computational Science & Engineering*, Atlanta, USA, 2017

Invited talk Introduction to FEniCS and dolfin-adjoint, *Symposium on the Application of Finite Elements in Physics and Engineering*, Johannesburg, South Africa, 2016

Designing Tidal Turbine Arrays With PDE-constrained Optimisation, *ESCO2016*, Plzeň, Czech Republic, 2016

Best poster award, dolfin-adjoint, automated adjoint models for FEniCS, *SIAM Conference on Computational Science*, Salt Lake City, USA, 2015

Tidal Farm Layout Optimisation and Resource Assessment based on PDE-constrained optimisation, *International Conference on Ocean Energy*, Halifax, Canada, 2014

Invited talk, Introduction to FEniCS and automated adjoints, *Norwegian Meteorological Institute*, Oslo, Norway, 2014

PDE-constrained optimisation in Hilbert spaces, *FEniCS'14*, Paris, France, 2014

Invited talk An introduction to libadjoint, Institut of Atmospheric Physics, Beijing, China, July 2011

OTHER PRICES

Winner of BigDataHackthon for developing a machine learning algorithm that predicts the influence of people, May 2013.

Winner of the Rewired State Hack, for novel developments for a charity that aims to improve surgical care in Africa, December 2012.

Invitation to OpenITP & Rio de Janeiro RightsCon with the goal to develop realtime censorship detection, May 2012.

Google Interactivism Award for developing a NHS health care web application that aims to improve waiting times in hospitals, 2012.

Winner of WaterHackathon London for developing a reporting platform for managing sanitation complaints in Tanzania. The project received media attention and was featured on the BBC, Africa, October 2011.