SIMON WARD

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Simon Ward Vanderbilt

EDUCATION

Vanderbilt University (Nashville TN, US) **2019 – 2024 (Feb)**
PhD in Electrical and Computer Engineering

Durham University (Durham, United Kingdom)
Master and Bachelor of Physics (MPhys) with honours **2011 – 2015**

ENGINEERING EXPERIENCE

Vanderbilt University (Nashville, TN)
Research Associate **2019 – 2024**
Investigating the application of machine learning, AI and statistics to enhance performance and accessibility of medical diagnostic tests.

- Devised approach to reduce sensor response time by a factor > 5, using ensembles of LSTM deep neural networks (Python) for time series forecasting, uncertainty estimation, adversarial training, and transfer learning with a large-scale simulated dataset, enabling rapid testing of harmful molecules.
- Designed a capture agent-free biosensor using machine learning, applying dimensionality reduction for data visualization and classification (Python) to data from biosensor arrays, a step towards unprecedented robust, scalable, and low-cost biosensors.
- Invented algorithm using Morlet wavelet band pass filtering and Fourier analysis (Matlab), which improved detection limits of thin film sensors by 10x, and released easy-to-use open-source app.
- Built software (Python) and hardware to automate biosensor data collection, improving accuracy by 48% and increasing experimental throughput by 100x.

Crowcon Detection Instruments Ltd. (Abingdon, UK) – $47mil revenue company designing and manufacturing gas detection solutions for a wide range of industries.
Electronic Engineer **2015 – 2019**

- Developed and deployed safety-critical, production-ready gas detector firmware (C) and analogue and digital electronics for communications and running sensors, driving the companies push towards IoT capability and expansion into a previously untapped market.
- Solved design flaws in existing products after troubleshooting customer problems under pressure and finding the root cause (ESD susceptibility, temperature drift), rescuing large orders ($70,000+).
- Created test procedures for new products, designed software (Python), electronics, and mechanics for automated test jigs and audited test house, improving quality and increasing production yields by 5%.

Research and Development Intern *(two summer internships)* **2014 and 2015**

- Designed, implemented, and analyzed experiments to test software and hardware of a gas detecting camera and designed intelligent junction box, collaborating with a multi-functional global team.

Durham University (Durham, UK) – Elite public university in the north of England, founded in 1832.
Research Associate **2012 – 2015**

- Engineered eddy current pipeline defect testing solution and data analytics (Python), potentially reducing operating costs by >20%, and communicated findings to partners and stakeholders at GE.
- Probed molecular behaviour of surfactants using dual polarization interferometry, providing valuable insights Procter and Gamble product development, and presented to P&G stakeholders.
- Modelled physics of sending a rocket to the moon (Python), adding novel functionality.

Oxford Instruments (Abingdon, UK) – $440mil revenue company manufacturing imaging and low temperature systems for research and industry.
Research and Development Intern *(summer internship)* **2011**

- Quantified vibration in cryogen-free superconducting magnet system with laser Doppler measurements.

SKILLS AND TOOLS

Python (NumPy, Pandas, Scikit-learn, Keras, TensorFlow, Matplotlib), MySQL, Git, C, Linux, Matlab, SPSS, SAS, Microsoft Office, Microsoft Windows, Mac OS X, Dimensionality reduction (LDA, PCA), Classification (Linear/Logistic Regression, Random Forest, SVM, KNN, ANN), Time series forecasting (RNN, GRU, LSTM), Digital Signal Processing (Fourier Analysis, Wavelet Denoising)

LEADERSHIP

Vanderbilt University (Nashville, TN)

Research Mentor **2019 – 2024**

- Led interdisciplinary team of undergraduate and graduate students working on projects I curated. The 5 undergraduate mentees over 4 years went on to be co-authors on publications, presenters at national conferences, and graduate students embarking on PhD degrees of their own.

Teaching Associate **2019 – 2020**

- Instructed undergraduate course focused on Python and electronics, creating 30% of lab content.

Crowcon Detection Instruments Ltd. (Abingdon, UK)

Apprentice Advisor **2018**

- Mentored 3 junior employees during 3-month rotations within the R&D department, resulting in one apprentice taking a permanent position on the team.

AWARDS AND HONORS

- SPIE Optics and Photonics Education Scholarship 2022 ($3000)
- C.F. Chen 2022 Graduate Student Paper Award for "Best Paper in Electrical Engineering" ($5000)
- Vanderbilt Graduate Leadership Institute Fall 2022 Dissertation Enhancement Grant ($2000)

SELECTED PUBLICATIONS AND PRESENTATIONS

Refereed Journal Articles:

1. **Ward, S. J.**, et al. (2024). Sensor Response-Time Reduction using Long-Short Term Memory Network Forecasting. *Manuscript in Preparation*
2. **Ward, S. J.**, et al. (2023). Protein Identification and Quantification Using Porous Silicon Arrays, Optical Measurements, and Machine Learning. *biosensors* 13(9), 879, 1–12. doi: 10.3390/bios13090879
3. **Ward, S. J.**, et al. (2021). Morlet Wavelet Filtering and Phase Analysis to Reduce the Limit of Detection for Thin Film Optical Biosensors. *ACS Sensors*, *6*(8), 2967–2978. doi: 10.1021/acssensors.1c00787
4. Arshavsky-Graham, S., **Ward, S. J.**, et al. (2021). Porous Silicon-Based Aptasensors: Toward Cancer Protein Biomarker Detection. *ACS Measurement Science Au*, *1*(2), 82–94. doi: 10.1021/acsmeasuresciau.1c00019

Conference Proceedings:

1. **Ward, S. J.**, et al. (2023). Reduction in sensor response time using long short-term memory network forecasting. *Proc. SPIE*, 12675(126750E). doi: 10.1117/12.2676836
2. **Ward, S. J.**, et al. (2022). Analysis of machine learning techniques for capture agent free biosensing with porous silicon arrays. *Proc. SPIE*, 11979(1197907). doi: 10.1117/12.2614697
3. **Ward, S. J.**, et al. (2021). Reducing detection limits of porous silicon thin film optical sensors using signal processing. *Proc. SPIE*, *11662*(116620J). doi: 10.1117/12.2579361

Conference Presentations:

1. "Reduction in sensor response time using long short-term memory network forecasting" **Ward, S. J.**, et al. SPIE Optics and Photonics, San Diego, CA, Aug. 2023.
2. "Using Machine Learning with Porous Silicon to Determine IgG Concentrations in Human Serum" Paier, G., **Ward, S. J.**, et al. BMES, San Antonio, TX, Oct. 2022.
3. "Reducing Detection Limits of Porous Silicon Thin Film Sensors using Signal Processing" **Ward, S. J.**, et al. PSST, Lido di Camaiore, Italy, March. 2022.
4. "Analysis of Machine Learning Techniques for Capture Agent Free Biosensing with Porous Silicon Arrays" **Ward, S. J.**, et al. SPIE Photonics West, San Francisco, CA, Jan. 2022.
5. "Reducing Detection Limits of Optical Thin Film Sensors using Signal Processing" **Ward, S. J.**, et al. SPIE Photonics West, Online, March. 2021.

COMMUNITY SERVICE

Vanderbilt University Engineering School Ambassador (Nashville, TN) **2019 – 2023**

- Represented Vanderbilt School of Engineering to external stakeholders in public online information sessions and several in-person events, sharing research and experiences at Vanderbilt.
- Ran 3 outreach events for summer academy high school students to encourage STEM participation.

Foster Caretaker/Mentor (Abingdon, UK) **2015 – 2019**

- Cared for disadvantaged foster children from newborn to twelve years old, aiding my parents who are full-time caregivers. These children faced a range of difficulties, requiring specialized care.

St Aldates Church Volunteer (Oxford, UK) **2016 – 2018**

- Prepared and served meals to the homeless population of Oxford.