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, UK**)**
Master and Bachelor of Physics (MPhys) with honours   **2011 – 2015**

ENGINEERING EXPERIENCE

Vanderbilt University (Nashville, TN) – 'R1' private university founded in 1873.
Research Associate   **2019 – 2024**
Investigating the application of end-to-end machine learning pipelines and statistics to sensor data to enhance performance of medical diagnostic tests.

- Devised approach to reduce sensor response time by a factor > 5, using ensembles of LSTM deep neural networks (Tensorflow, Python) for time series forecasting, uncertainty estimation, and transfer learning with a simulated dataset, enabling rapid medical diagnostic tests.
- 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 low cost, robust and scalable sensors for point-of-care medical diagnostics.
- Developed Morlet wavelet phase signal processing method (Matlab) to improve detection limits by 10x for thin film sensors, using Morlet wavelet band pass filtering to remove noise, and created open source app.
- Built software (Python) and hardware (stepper motor, laser cut plexiglass) 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 safety-critical, production-ready gas detector firmware (C), analogue and digital electronics for communications and running sensors, driving the companies push towards IoT capability, accelerating beyond competitors.
- Solved design flaws in existing products after troubleshooting customer problems under pressure and finding the root cause (ESD susceptibility, temperature drift), rescuing a $70,000 order of 150 units.
- 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, ran, and analysed experiments to test software and hardware of a gas detecting camera and designed electronics in intelligent junction box, collaborated 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 communicating findings to company stakeholders at GE.
- Probed molecular behaviour of surfactants using dual polarization interferometry, providing valuable insights Procter and Gamble product development, 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, 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 embark 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 with the R&D department, resulting in one apprentice taking a permanent position in the team.

AWARDS AND HONORS

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

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 spectrum of difficulties, requiring specialized care.

St Aldates Church Volunteer (Oxford, UK) **2016 – 2018**
- Prepared and served meals to the homeless population of Oxford.