

# RICHARD B. WOODWARD PhD, CEng

## Postdoctoral Fellow

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Chicago, USA

## ACADEMIC EXPERIENCE

### Postdoctoral Fellow

#### Shirley Ryan AbilityLab & Northwestern University

Oct 2015 – Present

Chicago, USA

- Applying machine learning and pattern recognition techniques in advancing myoelectric prostheses.
- Improving human-machine interfaces using novel training regimes, including virtual reality and serious gaming.

Advisor: Levi Hargrove, PhD

### Research Assistant/Associate

#### Imperial College London

Sep 2014 – Sep 2015

London, UK

- Project one: Applying motion tracking and acoustic technologies to monitor foetal health in expecting mothers.
- Project two: Using piezoelectric elements to detect loosening of knee implants through non-destructive testing.

Advisors: Ravi Vaidyanathan, PhD

Niamh Nowlan, PhD

## INDUSTRIAL EXPERIENCE

### Quality Assurance Engineer

#### Rovi Corporation

June 2010 – Oct 2010

Maidenhead, UK

- Testing the content protection on physical media and their players using quality assurance techniques in order to combat piracy.

### Software Developer

#### Sony Corporation

Sep 2009 – May 2010

Basingstoke, UK

- Project one: Development of a web service for HDXchange; a media editor and storage environment.
- Project two: Development of a media importer which automatically downloaded content into the HDXchange API when media cards were present.

### Quality Assurance Engineer

#### Sony Corporation

Summer 2008 & Summer 2009

Basingstoke, UK

- Discovering and correcting software bugs, limitations, or unexpected results in the media editor software HDXchange before release to the customer.

## VOLUNTARY EXPERIENCE

### Support Volunteer

#### Royal Brompton Hospital

May 2011 – Aug 2015

London, UK

- I volunteered three hours per week to my local hospital, providing assistance in their respiratory ward.

## TEACHING EXPERIENCE

### Graduate Teaching Assistant

#### Imperial College London

Term time 2011 – 2015

London, UK

- "Embedded C for Microcontrollers". Undergraduate course (years 3 & 4).

## EDUCATION

### PhD in Biomechanics

#### Imperial College London

Oct 2011 – June 2015

London, UK

Thesis: Pervasive Motion Tracking and Physiological Monitoring.

Advisors: Ravi Vaidyanathan, PhD

Sandra Shefelbine, PhD

### MSc in Biomedical Engineering and Neurotechnology

#### Imperial College London

Sept 2010 – Sept 2011

London, UK

Dissertation: Compatible Instrumented Pacifier for Magnetic Resonance Imaging with Neonates. Completed with Merit.

Advisor: Etienne Burdet, PhD

### BSc (Hons) in Cybernetics and Control Engineering

#### University of Reading

Sept 2006 – July 2009

Reading, UK

Dissertation: Solar Powered Autonomous Robotic Life-form.

Completed with a two-one (2:1) honours degree.

Advisor: Kevin Warwick, PhD

### BTEC National Diploma in Electrical and Electronic Engineering

#### Chichester College

Sept 2004 – July 2006

Chichester, UK

## COMPANIES

### Managing Director

#### Woodward Technologies Limited

Aug 2009 – Sep 2015

London, UK

Woodward Technologies LTD was formed in order to contract my software development and quality assurance services (company number 06998882).

## PROFESSIONAL ASSOCIATION

### Chartered Engineer (CEng)

#### Engineering Council

Since 2016

### Member

#### Institute of Electrical and Electronics Engineers (IEEE)

Since 2014

### Member

#### Institute of Engineering and Technology (IET)

Since 2004

## PUBLICATIONS

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### Journal Articles

- J. Lai, R. B. Woodward, Y. Alexandrov, Q. a. Munnee, C. C. Lees, R. Vaidyanathan, and N. C. Nowlan, "Performance of a Wearable Acoustic System for Fetal Movement Discrimination," *PLOS One*, [In Review], 2018.
- R. B. Woodward, M. Stokes, S. J. Shefelbine, and R. Vaidyanathan, "Monitoring Muscle Response in Pervasive Environments Using Mechanomyography and Inertial Measurement Units," *Journal of NeuroEngineering and Rehabilitation*, [In Progress], 2018.
- R. B. Woodward, S. J. Shefelbine, and R. Vaidyanathan, "Pervasive Monitoring of Motion and Muscle Activation: Inertial and Mechanomyography Fusion," *IEEE/ASME Transactions on Mechatronics*, volume 22, number 5, pages 2022–2033, 2017.

### Conference Proceedings

- R. B. Woodward and L. J. Hargrove, "Adapting Myoelectric Pattern Recognition in a Virtual Environment," in *22nd Congress of the International Society of Electrophysiology and Kinesiology*, Dublin, Ireland, 2018, [Pending].
- R. B. Woodward and L. J. Hargrove, "Robust Pattern Recognition Myoelectric Training for Improved Online Control within a 3D Virtual Environment," in *40th International Conference of the IEEE Engineering in Medicine and Biology Society*, Honolulu, HI, 2018, [Pending].
- R. B. Woodward and L. J. Hargrove, "Virtual Training Environment to Improve Myoelectric Pattern Recognition in Transradial amputees," in *2nd International Symposium on Innovations in Amputation Surgery and Prosthetic Technologies*, Vienna, Austria, 2018.
- C. A. Rábago, R. B. Woodward, J. M. Cancio, R. Fisher, L. J. Hargrove, D. Siewiorek, and A. Smailagic, "Development of a Virtual Coach for Upper-Extremity Myoelectric Prosthetic Rehabilitation," in *Military Health System Research Symposium*, Kissimmee, FL, 2017, pages 1–2.
- R. B. Woodward, J. M. Cancio, R. Fisher, L. J. Hargrove, C. A. Rábago, D. Siewiorek, and A. Smailagic, "A Virtual Coach for Upper-Extremity Myoelectric Prosthetic Rehabilitation," in *International Conference on Virtual Rehabilitation, ICVR*, Montreal, QC, 2017, pages 1–2.
- R. B. Woodward, J. A. Spanias, and L. J. Hargrove, "User Intent Prediction with a Scaled Conjugate Gradient Trained Artificial Neural Network for Lower Limb Amputees Using a Powered Prosthesis," in *38th International Conference of the IEEE Engineering in Medicine and Biology Society*, Orlando, FL, 2016, pages 6405–6408.
- E. Hallett, R. Woodward, S. Schultz, and R. Vaidyanathan, "Rapid bicycle gear switching based on physiological cues," in *IEEE International Conference on Automation Science and Engineering*, Gothenburg, Sweden, 2015, pages 377–382.
- R. Woodward, S. Shefelbine, and R. Vaidyanathan, "Integrated grip switching and grasp control for prosthetic hands using fused inertial and mechanomyography measurement," in *2015 Swarm/Human Blended Intelligence Workshop*, Cleveland, OH, 2015, pages 1–8.
- M. Gardner, R. Woodward, R. Vaidyanathan, and E. Burdet, "An Unobtrusive Vision System to Reduce the Cognitive Burden of Hand Prosthesis Control," in *ICARCV International Conference on Automation, Robotics, Control and Vision*, Singapore, 2014, pages 1279–1284.
- R. Woodward, S. Shefelbine, and R. Vaidyanathan, "Pervasive Motion Tracking and Muscle Activity Monitor," in *2014 IEEE 27th International Symposium on Computer-Based Medical Systems*, New York City, NY: IEEE, 2014, pages 421–426.
- R. Woodward, M. Gardner, P. Angeles, S. Shefelbine, and R. Vaidyanathan, "A Novel Acoustic Interface for Bionic Hand Control," in *Towards Autonomous Robotic Systems*, volume 8069, Oxford, UK, 2014, pages 296–297.

### Patents

- L. Hargrove and R. Woodward, *Prosthetic Virtual Reality Training Interface and Related Methods*, U.S. Provisional Patent App. No. 62/485,885, (filed 4/14/2017) (Assignee: Shirley Ryan AbilityLab).
- R. Vaidyanathan, R. Woodward, N. Nowlan, and S. Shefelbine, *Biomechanical Activity Monitoring*, Patent PCT/GB2014/053276, May 5, 2014.

### In Press

- "The armband that controls an artificial hand," BBC, 2017.
- "Man with no limbs controls robotic hand using muscle whispers," New Scientist, 2015.
- "Star Wars-style robotic hand controlled by muscle vibrations," Imperial College News and Events, 2015.

## GRANTS

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Research Investigator

UK National Institute of Health Research

Mechanical Muscle Activity with Real-Time Kinematics (M-MARK): A Novel Combination and Application of Existing Technology Designed to Improve Arm Recovery Following Stroke

 2015

 £872,000

## AWARDS

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IEEE 27<sup>th</sup> Computer-Based Medical Systems - Best Student Paper Finalist

 2014

Imperial Medal of Outstanding Achievement

 2013

James Dyson Foundation Scholarship Recipient

 2011

## PROGRAMMING

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Python   MATLAB   Java   C, C++, C#  
HTML   CSS   Assembly   MySQL

## SOFTWARE

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Vicon   LabVIEW   Solidworks   Eclipse  
Visual Studio   Unity   MPLAB   LaTeX  
Microsoft Office   SVN/Git  
Windows/Linux/Mac

## ENGINEERING

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Computer Aided Design (CAD)   3D Printing  
Turning   Drilling   Milling   Fabrication