IAN BUTTERWORTH MSc BEng

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WORK EXPERIENCE

Massachusetts Institute of Technology, Cambridge, MA, USA — 2013 - Present
M+Visión Biomedical Research Fellow

- Created and led project to improve hydration management, through improved physiological hydration assessment, targeting elderly care settings.
- Participated in the research and development of three biomedical projects, focusing on non-invasive measurement and monitoring.
- Designed and developed 3 novel prototypes, and built software control systems for each.
- Undertook a thorough design review process to validate proof of concept of novel approaches within each project.
- Collaborated internationally with clinicians and scientists to support the development and testing of prototypes.
- Co-authored successful grants totalling ~$650k from sources including Point-of-Care Technology Research Network (POCTRN) Center in Primary Care, Center for Future Technologies in Cancer Care at Boston University, Coulter Foundation, Michael J. Fox Foundation.
- Co-authored 11 approved human study protocols through MIT and collaborating institutions.
- Participated in the winning of a total of $130k in scientific and business plan competition prizes.

National Physical Laboratory, Teddington, UK — 2008 - 2013
Higher Research Scientist/Research Scientist – Acoustics

- Conducted a range of acoustic metrology research projects spanning audio acoustics, industrial ultrasonics, and medical ultrasonics
- Conceived of and won internal funding for numerous exploratory ideas.
- Participating in research to advance international measurement standards.
- Active in scientific outreach events and presentations, having built a range of interactive acoustic exhibits
- Undertaken measurement consultancy, interacting with industrial customers using exploratory measurement approaches

Hann Tucker Associates, Woking, UK. — Sept. 2007 Mar. 2008
Assistant Acoustic Consultant (Full-time vacation work)

- Conducted environmental and structural acoustic surveying, interacting with customers throughout the city of London
- Analysis of results and production of certified testing reports

Grapevine Recording Studios, Solihull, UK. — 2006 2008
Production Assistant/Engineer

University of Warwick Students' Union Bars, UK — 2004 - 2007
Team leader (Part-time)

EDUCATION

MSc Audio Acoustics The University of Salford, UK — 2007 - 2009
Merit. Accredited by the Institute of Acoustics.
MSc Dissertation "The variation of auditory perception across listening states; In relation to the modern urban soundscape", I Butterworth, W Davies

BEng Electronic Engineering The University of Warwick, UK — 2004 - 2007
2ii with Honors

SELECT PROJECTS

Team Hydration

2013 - Present

A hydration monitor that aims to abate the massive problem of dehydration in the elderly and later the wider population, by directly monitoring core physiological hydration reliably, non-invasively, and comfortably, to catch day-to-day dehydration early and inform hydration management. (Patent pending)

- Project lead, having initiated the exploration of the need, and led the invention, modelling, and prototyping of potential solutions.
- Prototypes developed and tested in range of different technical domains, including low GHz range near-field RF and optical spectroscopy.
- Development of complex hardware and software platforms for the operation of measurements, and the analysis of results.
- Management of a range of students at MIT, participating in the technical research and development.
- Designed and conducted dehydration studies on dialysis patients in Madrid with prototype devices.
- Collaborated with Boston Children's Hospital for an upcoming pediatric rehydration study with prototype devices.
- Secured funding through the Point-of-Care Technology Research Network (POCTRN) Center in Primary Care, CIMIT

Team Leuko

2013-Present

A home-based non-invasive in-vivo immune system monitoring for chemotherapy optimization, through automated microscopy of finger capillaries to image passing leukocytes. (Patents pending)

- Co-creator, developing novel approaches for automated imaging systems based on enhanced nailfold capillaroscopy.
- Hardware prototyping for both high-end optical bench top prototyping, and miniaturized phone-based systems.
- Software development for measurement capture and analysis of measurement quality.
- Secured a total of $300k of funding through the Center for Future Technologies in Cancer Care and Coulter Foundation
- Won "Innovation of the year" award from MIT Technology Review Spain, 2015
- Won Innovation award at the Rice Business Plan Competition, 2016

neuroQWERTY

2013-Present

Exploiting daily finger interactions with personal electronics to generate a novel biometric signal capable of identifying subtle changes in motor performance, working towards earlier and more accurate detection of Parkinson's Disease. (Patent pending)

- Development of software platforms for passive capture of keystroke timing on consumer electronic devices.
- Participation in the Mass Challenge summer accelerator, exploring routes for commercialization.
- Secured $200k of funding through the

Team Lumbar

2013-2015

A non-invasive ultrasound diagnostic for infant meningitis reducing the need for lumbar puncture, with huge potential for the developing world. (Patent pending)

- Ultrasonic design, testing, and phantom design.

Taste Defense

2013-2014

A small project looking at developing solutions for reducing the discomfort and dietary impact of taste loss during chemotherapy.

- Won the best hack award at the Center for Future Technologies in Cancer Care Hackathon, 2013

Audio Acousto-Optic Imaging

2010-2013

- Leading work on a novel acousto-optic imaging technique, based on scanned laser interferometry, which has proven successful for a range of airborne and underwater applications. Presented work for various international audiences including TEDx, Institute of Physics, and Audio Engineering Society invited lectures. Managing the coverage of the work in various modern science and technology websites and magazines, leading commercial exploitation of the technique.

Ultrasonic Metrology 2010-2013

- Won internal awards for explorative work on a novel dual-sensor approach for the determination of ultrasonic cavitation in-vitro. The collaborative work with the Institute of Cancer Research built on the NPL Cavitation Sensor, developing and conducting trials on the monitoring of HIFU-induced cavitation within tissue mimicking materials, for therapeutic and imaging applications of medical ultrasound.
- Conceived a novel technique for the measurement of bulk ultrasonic absorption coefficients of geometrically complex test objects, such as tissue samples for validation of ultrasonic imaging phantoms. Won internal funding to explore this, and designed the hardware, software, and protocol for testing. Successfully managed a student worker who conducted the bulk of the testing.
- Discovery and development of a novel simplified Schlieren imaging technique for visualization of High Intensity Focused Ultrasound fields, leading to well-received presentations at international conferences, resulting in the trialing of the technique by a number of international laboratories.
- The development and trialing of a novel bench-top thermochromic absorber tile, to provide a reliable, practical, and affordable quality assurance tool for physiotherapy ultrasound end users.
- Software and hardware development of a prototype reference cavitation vessel, towards the aim for a cavitation standard. Written in LabView, the system includes 3-D scanning, integrated acquisition hardware and the ability to rapidly frequency mode-track, to ensure the stability of the system through temperature changes.

Audio Acoustics 2008-2013

- Highly regarded for conceiving, winning and completing an exploratory research project shortly after joining NPL. The project trialed a novel mechanism for hearing protection, and the funding was gained through an internal research funding competition in which the application ranked 1st out of ~30 company-wide submissions. Leading the inter-departmental project through liaising with senior NPL staff, and presenting the work internally. Work continued into the exploration of possible intellectual property exploitation routes.
- An interdepartmental study on the redefinition of the standard pinna, resulting in a strong good news story leading to interviews for 'New Scientist' and 'The Engineer' magazines.
- The innovative development of a Google maps-based noisemapping website and back-end server for DREAMSys, a project to develop a new measurement-based approach to environmental noise monitoring and mapping using novel MEMS sensors. Requiring extensive programming in php/MySQL, VB6, Java and working with various Google APIs.

Scientific Outreach 2009-2013

- Designed, built, and represented the major parts of a Royal Society stand on NPL's 'bubble science', aimed at everyone from prestigious scientists to children, in which a Bubble Organ was the center-piece. This resulted in a well-received BBC Radio interview, and NPL/Serco awards.
- Participation in a number of science ambassador activities at, and away from NPL, including presenting to Royalty, teaching primary children the basics of acoustics through a BBC Radio 4 program, helping run water rockets activities both at NPL and at the Tower of London, and numerous presentations.

PUBLICATIONS, WORKS, AND PRESENTATIONS

ISI JOURNAL PUBLICATIONS

- Jimenez X, Shukla S, Ortega I, Illana F, Castro-González C, Marti-Fuster B, **Butterworth I**, Arroyo M, Anthony B, Elvira L (2016) "Quantification of Very Low Concentrations of Leukocyte Suspensions In Vitro by High-Frequency Ultrasound." Ultrasound in Medicine & Biology
- L Giancardo, A Sanchez-Ferro, **I Butterworth**, C Sanchez-Mendoza and J M Hooker, "Psychomotor Impairment Detection via Finger Interactions with a Computer Keyboard", Nature Scientific Reports, 2015.
- **Butterworth I**, Barrie J, Zeqiri B, Žauhar G, Parisot B. "Exploiting thermochromic materials for the rapid quality assurance of physiotherapy ultrasound treatment heads." Ultrasound in Medicine and Biology, 2012
- T Arroyo-Gallego, A Sanchez-Ferro, C Sanchez-Mendoza, **I Butterworth** and L Giancardo "A Natural Mobile-Phone-Based Approach for Characterizing Parkinsonian Motor Features ", IEEE Biomedical Engineering

REFEREED CONFERENCE PAPERS

- **I Butterworth**, J Seralles, C Sanchez Mendoza, L Giancardo, L Daniel. "A wearable physiological hydration monitoring wristband through multi-path non-contact dielectric spectroscopy in the microwave range." RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-BIO), 2015 IEEE MTT-S, 2015

- J Lee, J Jimenez, **I Butterworth**, C Castro-Gonzalez, S Shukla, B Marti-Fuster, L Elvira, D Boning, B Anthony "Measurement of very low concentration of microparticles in fluid by single particle detection using acoustic radiation force induced particle motion." Ultrasonics Symposium (IUS), IEEE International, 2015
- B Piper, T Koukoulas, **I Butterworth**. "Illuminating Sound: a review of how sound can be measured using light." Proceedings of the Institute of Acoustics 40th Anniversary Conference, 2014
- L Wang, G Memoli, **I Butterworth**, M Hodnett, Zeqiri B. "Characterisation of a multi-frequency cavitation vessel." IOP Conference Series: Materials Science and Engineering, 2012
- **I Butterworth**, Shaw A. "Realtime acousto-optical QA methods for high intensity fields." Ultrasonic Industry Association Symposium (UIA), 2010 39th Annual, 2010

ISI JOURNAL PUBLICATIONS IN PROCESS

- L Giancardo, T Arroyo-Gallego, C Sanchez-Mendoza, **I Butterworth** and A Sanchez-Ferro "Interaction with a computer keyboard may be an early indicator of Parkinson's disease", Proceedings of the National Academy of Science, Nature Scientific Reports (submitted)
- A Sanchez-Ferro, C Sanchez-Mendoza, **I Butterworth**, M Matarazzo, P Montero, R Trincado, T Arroyo Gallego, V Puertas-Martín, M José Catalán, J Antonio Molina, F Bermejo-Pareja and L Giancardo, "neuroQWERTY: characterizing parkinsonian motor features via the routine user's interaction with consumer electronics", Parkinsonism & Related Disorders, PLOS ONE (submitted)
- C Castro-Gonzalez, A Bourquard, **I Butterworth**, D Jimenez-Carretero, N Montesdeoca, J Lopez Herraiz and L Giancardo "Mobile-Phone-Based Snoring Detection for Obstructive-Sleep-Apnea Screening", PLOS ONE (submitted)

PATENTS

- "Apparatus and method for motor function characterization." L Giancardo, A Sanchez Ferro, I Butterworth, C Sanchez Mendoza, 2015 pending.
- "RF attenuation measurement system and method" I Butterworth, C Sanchez Mendoza, L Giancardo, 2016 pending
- "Image Processing Algorithm to Extract White Blood Cell Counts From Non-invasive, In-vivo, Time-lapse Images of Nailfold Capillaries" C Castro Gonzalez, I Butterworth, A Sanchez Ferro, A Bourquard, 2016 pending
- "Method to non-invasively detect individual cells in superficial body fluids", 2016 pending

SCIENTIFIC PRESENTATIONS

- Team Leuko Coulter Foundation grant quarterly update, 2015
- "A novel dual-sensor approach for the determination of cavitation in-vitro". WIMRC 3rd International Cavitation Forum, July 2011. Session chair for the medical applications of cavitation session.
- "A novel dual-sensor approach for the determination of cavitation in-vitro". 8th meeting of the UK Therapy Ultrasound Group, May 2011
- "Visible Sound" A summary of NPL's work on the Acousto-Optic technique. Audio Engineering Society UK, Invited lecture, May 8th
- "Seeing Sound". TEDx Teddington, December 2012
- "Real-time acousto-optical QA methods for high intensity ultrasound fields." Ultrasonic Industry Association Symposium (UIA), 2010 39th Annual, Boston
- "Real-time acousto-optical QA methods for high intensity ultrasound fields." International Society for Therapeutic Ultrasound (ISTU), 2009 9th Annual, Aix-en-Provence
- "Novel technologies for non-linear hearing protection." NPL Exploratory Research Seminar, April 2010

EDUCATIONAL PRESENTATIONS

- "Introduction to Biomedical Imaging: Acoustics" Massachusetts Institute of Technology, IAP, 2015

AWARDS

- Best student paper award. 2015 IEEE MTT-S International Microwave Workshop Series on RF and Wireless Technologies for Biomedical and Healthcare Applications (IMWS-Bio 2015), Taiwan, Taipei
- IDEO design process award for the Hydration project at IEEE Healthcare Innovation Point-Of-Care Technologies (IEEE-HIPOCT) 2014 in Seattle.
- Rice Business Plan Competition Innovation Award for Team Leuko, 2016
- NPL / Serco outreach award for creation of an interactive educational exhibit at the Royal Society Summer Fair, 2013
- NPL / Serco outreach award for the work on a novel dual-transducer ultrasonic cavitation sensor, 2012

RECREATIONAL INTERESTS

Hacking/Creative Engineering

Participation in numerous international music, biomedical, and general hackathon events, where ambitious projects were completed within the 24 hours, to strong reception.

CloudChamber - A website that allows users to remotely upload their own songs, which are played and re-recorded in the NPL Reverberation Chamber, allowing people to hear the effect of real ~30 second reverb on their music. Based on the SoundCloud API, winner of the best SoundCloud hack. Music Hack Day, London 2011

Whsprs - An online version of the telephone game, utilizing SoundCloud, Facebook and Google Maps APIs. Music Hack Day, San Francisco 2012

Take Me Back - An immersive tour of your SXSW facebook event history through Google Street View. South-by-SouthWest Hackathon, 2014

Slight - A distributed sound to light visualisation through mobile devices. MIT Hacking Arts 2014

Music production and performance

Ffuries - An ongoing audio-visual project with live performances, and distributed digitally. ~400k streams

Bright Spark Destroyer - 5-piece guitar/electronic band based in London. ~300k streams

Radio at Warwick Uni - Technician and weekly DJ, participation in the design and building of a new studio.

Visual art & design

Ideas Matter Sphere - A key collaborator in a join art/science forum on Sound Light and Space, covering the connection between acoustic, optical, and dimensional science, and art.

Live music visualization - Generative visualization and re-use of archive footage, brought together through custom programmed Max/MSP/Jitter projects, performed at electronic music nights in Cambridge.

The Warwick Boar, Students' Newspaper - Graphics Editor at the Guardian Award winning Warwick University Student's Newspaper. 2005 - 2007