

Ashley Stewart

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Personal Statement

I am a driven and highly creative person. I have a wide range of experience which I can pull unique knowledge and ideas from. I am always eager to learn more. I work well with others in either a leadership position or as part of a team, and I always bring a bit of fun to any environment. I have recently completed my PhD with the Mechanical Engineering Department at the University of Canterbury.

Education and Qualifications

PhD Mechanical Engineering, University of Canterbury, graduated April 2019.

Bachelor of Electrical Engineering (2nd class Honors 1st division), University of Canterbury, graduated February 2013.

First Aid Certificate, valid until – July 2021

Description of PhD

Overview

My PhD project involved the development of a novel sensing and control platform for use in a hybrid upper-limb assist-as-needed exoskeleton. This is for rehabilitation of the elbow (bicep/triceps muscles) of stroke patients. This exoskeleton combines an electromechanical actuator with Functional Electrical Stimulation (FES) with a focus on rebuilding muscle strength with a reduction in FES-induced muscle fatigue.

Scope of Work

- Design, construction, and testing of a voltage-controlled Functional Electrical Stimulator (FES)(included soldering of SMT components and boost converter design).
- Investigation, design, construction, and testing of e-textiles for use with the FES device.
- Physical design and construction of the upper limb exoskeleton.
- Development and testing of a generalised model for control of FES-induced movement (on healthy human subjects).
- Implementation and interpretation of sensors and sensor data.
- Development of an adaptive control scheme which can balance FES support with electric motor support in response to the user's ability and past performance with a reduction in FES-induced muscle fatigue. This included model based control as well as PID control.
- Implementation of the control scheme and system analysis using C programming on the Arduino Microcontroller (for control), and Matlab (for analysis). This included low level embedded programming of the Atmega onboard the Arduino for improved flexibility of PWM signals.
- Investigation into design and use of EMG (electromyography) sensors for muscle force estimation.

Publications

Stewart, A. M., Pretty, C. G., & Chen, X. (2016, August). Design and testing of a novel, low-cost, low-voltage, functional electrical stimulator. In *Mechatronic and Embedded Systems and Applications (MESA), 2016 12th IEEE/ASME International Conference on* (pp. 1-6). IEEE.

Stewart, A. M., Pretty, C. G., & Chen, X. (2017, October). An Evaluation of the Effect of Stimulation Parameters and Electrode Type on Bicep Muscle Response for a Voltage-controlled Functional

Electrical Stimulator. *In the 20th World Congress of the International Federation of Automatic Control, 9-14 July 2017 (IFAC).*

Stewart, A. M., Pretty, C. G., Adams, M., & Chen, X. (2017, October). Review of Upper Limb Hybrid Exoskeletons. *In the 20th World Congress of the International Federation of Automatic Control, 9-14 July 2017 (IFAC).*

Stewart, A. M. (2017 December). Hybrid Exoskeletons for Upper Limb Stroke Rehabilitation. In Habib, M., & Habib, M.(Eds.) *Handbook of Research on Biomimetics and Biomedical Robotics.*

Stewart, A. M., Pretty, C. G., & Chen, X. (2019). An investigation into the effect of electrode type and stimulation parameters on FES-induced dynamic movement in the presence of muscle fatigue for a voltage-controlled stimulator. *IFAC Journal of Systems and Control*, 100043.

Work History

Residential Assistant (RA) for the University of Canterbury WiECAN program (2019)

- Involved leading a team of 6 students (year 12) during daytime and evening activities for the week of the WiECAN program. This included staying in the halls on overnight call duty, and acting as the first point of call for WiECAN attendees if any issues arose.

Teaching Assistant (TA) for the University of Canterbury in the following subjects (2015 - 2018):

- ENGR 101 – First year introduction to engineering design course. TA tasks involved running 1-2 two hour workshops per week as well as marking of assignments and exams.
- ENEL 270 – Second year Principles of Electronics and Devices course. TA tasks involved answering any student questions during 2 three hour labs each week and marking lab sheets.
- ENCE 260 – Second year computer systems course. TA task involved exam marking.
- ENME 313 – Third year electro technology for mechanical engineers course. TA tasks involved answering any student questions during 1 three hour lab each week and marking lab sheets.
- ENMT 482 – Forth year robotics course. TA task involved supervising students as they tested their code on the UR5 robot arm.
- I also travelled to Geraldine early 2018 with another postgrad student for the Geraldine high school careers day and took my exoskeleton along for a demonstration and I have done school visits on behalf of Futureintech.org in 2013 and 2014.

School Camp Guide for Big Rock Canyons (2017)

- Involved two days of guiding year 7/8 students abseiling down a small canyon (4 groups of about 8-10 people per group each day).

21 Day Challenge

- In 2015 I travelled to the Philippines with other students (from a wide range of disciplines) from the University of Canterbury as part of the 21 Day Challenge, to help a Filipino community in San Dionisio. During our week there we built a permaculture garden and rainwater collection system for a local school with the help of the school's students.

Graduate Engineer (2013) and Network Integration Engineer (2014) at Unison Networks Limited

- Power systems modeling.
- Project scoping and cost estimations.
- Asset data representation using excel, HTML, JavaScript, and CSS

I also have barista experience (pre-2009). I am conversationally fluent in French. I took courses using Java, VHDL, and Solidworks, during my undergraduate degree. I have some experience with Arm

microcontrollers and extensive experience with Atmegas. I have some experience with Python and I am currently teaching myself C# in my spare time. An example of my C# code can be found here: <https://github.com/Indipi/CaptureThePot>.

Personal Interests and Club Activities

Canyoning

- Founder and current President of the University of Canterbury Canyoning Club (UCanCan).
- I regularly run canyoning trips for members of the club and have extensive rope management, rigging, and people organising skills.
- In the past year, I have completed three first descents of previously unexplored New Zealand canyons as part of a team.

Wine Tasting

- Secretary of the University of Canterbury Wine Club from 2015-2019. This includes hosting wine tastings and teaching people about wine.
- Reserve member on the New Zealand Blind Wine Tasting Team. I achieved 4th in the NZ National Blind Wine Tasting Competition and travelled with the team to France in October 2017 where the team competed in the World Blind Wine Tasting Competition against 23 other countries; NZ came 4th.
- Amateur gardener, winemaker, and pumpkin carver. I have made pumpkin wine from homegrown Giant Atlantic pumpkins and I recently came 3rd in the pumpkin carving competition at the Pumpkin Festival 2019.

Rock-climbing

- Regular rock climber. Committee member of the University of Canterbury Rock-climbing Club (2010-2012).

Writing

- Two short stories selected for publication in the Literary Taxidermy Short Story Competition (2018) and Whimsically Dark Anthology (2018).
- In Semester 1, 2018 I took an English paper in creative writing (ENGL 118) as part of the Vice Chancellor's Excellence Award.
- I am also working on a novel (fiction) in my spare time which is currently approximately 100,000 words.

Referees

Professor XiaoQi Chen – (Supervisor of PhD project)

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Dr Chris Pretty – (Co-supervisor of PhD project)

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Professor Phil Bones – (Professor/lecturer for my Undergraduate Degree Courses and Employer for ENEL 270 and ENCE 260 TA work)

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Michelle Lyes – (HR Advisor at Unison in 2013 and 2014)

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