

Callen Fisher

PHD CANDIDATE · ELECTRICAL ENGINEERING

✉ FSHCAL001@myuct.ac.za | 🏠 www.mechatronics.uct.ac.za/people-callen-fisher | 📱 Callen-Fisher | 🌐 Callen Fisher

The University of Cape Town

October 19, 2018

RONDEBOSCH
CAPE TOWN
7700

Job Application for Lecturer or Assistant Lecturer

Dear Members of the Search Committee.,

I am writing to apply for the position of Lecturer with emphasis in Mechatronics in the Electrical Engineering department. I am currently a third year PhD candidate in the Mechatronics laboratory (Electrical Engineering) at the University of Cape Town and fully expect to complete my PhD degree requirements by August 2019. I am extremely interested in obtaining a faculty position at the University of Cape Town, where I can contribute to its focus on electrical engineering education, continue my research on rapid manoeuvrability in legged robots and assist in the running of the department.

My BSc in Mechatronics in the department of Electrical Engineering was completed in 2013 with First Class Honours. In 2014 I started my MSc in Electrical engineering at the University of Cape Town and graduated in 2015 with a distinction. The focus of my MSc was the state estimation of a cheetah's spine and tail during rapid manoeuvres. During this time I published a paper on my undergraduate research (a lizard inspired stunt robot that performed a barrel roll when launched into the air) as well as mentored a number of final year students resulting in another publication (aerial pitch righting of a robotic spider using a dragline).

In 2016 I started my PhD in Electrical Engineering at the University of Cape Town under the supervision of Dr. Patel and investigated the effects of spine morphology on rapid acceleration in quadruped robots. Simulation results have shown that a novel active prismatic spine has benefits in terms of rapid acceleration in quadrupeds. A new template for acceleration manoeuvres has also been identified and is in the process of being published. This work involves an international collaboration with A/Prof. Christian Hubicki at Florida State University. The final stage of my PhD is to experimentally validate my controller on a robotic platform, which I expect to occur early in 2019.

During my postgraduate career I had the amazing opportunity to work as a Teaching Assistant for over three years, which involved managing the tutors along with the course administration, as well as lecture a course on programming (EEE3070S) to third year Electro-Mechanical students in 2017. I am currently lecturing another third year course (EEE3099S) to Mechatronics and Electro-Mechanical students. The course is focused on designing and building a wheeled robot that must compete in a line following race. This year I have also been given the opportunity to supervise four final year projects. These have been amazing experiences and have built my confidence and interest in teaching and I look forward to the opportunity to not only teach existing courses, but also work to develop new ones.

I believe that robotics is an excellent vehicle to inspire the pursuit of STEM. This is particularly important for previously disadvantaged learners and can enable transformation. As such, I have plans to embark on a robotics club initiative at Livingstone High School (in collaboration with Dr. Amir Patel).

I would enjoy discussing this position with the search committee in the weeks to come. I have enclosed my curriculum vitae along with a teaching statement and my research interests. If you require any additional material or information, I am happy to supply it. Thank you very much for your time and consideration.

Sincerely,

Callen Fisher

Personal Details

Full name Callen Fisher
Identity number
Date of Birth
Gender Male
Race White

Education

PhD candidate, Electrical Engineering

THE UNIVERSITY OF CAPE TOWN

- Third year student.

Rondebosch, Cape Town

2016 - PRESENT

MSc, Electrical Engineering

THE UNIVERSITY OF CAPE TOWN

- Awarded with distinction.

Rondebosch, Cape Town

2014 - 2015

BSc, Mechatronics Engineering

THE UNIVERSITY OF CAPE TOWN

- First class honours.

Rondebosch, Cape Town

2010 - 2013

Matric Certificate

WYNBERG BOYS' JUNIOR & HIGH SCHOOL

Wynberg, Cape Town

1998 - 2009

Skills

Programming Python, C/C++, GAMS, Matlab

Hardware STM32F0, STM32F3, STM32F4

Knowledge Areas State Estimation, Mathematical Modelling, Trajectory Optimisation, Optimal Control, Sensor Fusion, Sensor Networks

Experience

Part time lecturer for EEE3099s

THE UNIVERSITY OF CAPE TOWN

- Lecturing a class of 112 students.
- Setting of and marking project.
- Course management.

Rondebosch, Cape Town

Aug. 2018 - PRESENT

Part time lecturer for EEE3070s

THE UNIVERSITY OF CAPE TOWN

- Lecturing a class of 34 students.
- Setting of and marking class tests, assignments and exams.
- Course management.

Rondebosch, Cape Town

Aug. 2017 - Nov. 2017

Part time lecturer for EEE3061W

THE UNIVERSITY OF CAPE TOWN

- Run the course while Dr. Patel was on paternity leave.
- Lecture the course.
- Attend all tutorial/practical sessions.

Rondebosch, Cape Town

Jun. 2016

Teaching Assistant (TA)

THE UNIVERSITY OF CAPE TOWN

- TA for EEE3074W (embedded systems) in 2014.
- TA for EEE3061W (mechatronics design) in 2015 to June 2017.
- Class admin and maintaining Vula cite.
- Assist with running of the course.
- Attend all tutorial/practical sessions.

Rondebosch, Cape Town

Feb. 2014 - Jun. 2017

Extracurricular Activity

Volunteer Wildlife Services (VWS)

VOLUNTEER WILDLIFE FIREFIGHTER (IN TRAINING)

- In training until next fire season.

Cape Town

Mar. 2018 - PRESENT

Honors & Awards

2015 **Distinction**, MSc, Electrical Engineering

The University of
Cape Town

2013 **First Class Honours**, BSc, Mechatronics Engineering

The University of
Cape Town

2012 **Deans Merit List (third year)**, BSc, Mechatronics Engineering

The University of
Cape Town

2011 **Deans Merit List (second year)**, BSc, Mechatronics Engineering

The University of
Cape Town

2010 **Deans Merit List (first year)**, BSc, Mechatronics Engineering

The University of
Cape Town

2010 **Golden Key International Honour Society**, BSc, Mechatronics Engineering

The University of
Cape Town

Publications

JOURNALS

Quasi-Steady State Aerodynamics of the Cheetah Tail

DOI: 10.1242/bio.018457

BIOLOGY OPEN

2016

- A. Patel, E. Boje, C. Fisher, L. Louis, E. Lane, "Quasi-Steady State Aerodynamics of the Cheetah Tail," *Biology Open*, DOI: 10.1242/bio.018457.

Tracking the Cheetah Tail using Animal-Borne Cameras, GPS and an IMU

DOI: 10.1109/LSENS.2017.2716618

IEEE SENSORS LETTERS

2017

- A. Patel, B. Stocks, C. Fisher, F. Nicolls, E. Boje, "Tracking the Cheetah Tail using Animal-Borne Cameras, GPS and an IMU," *IEEE sensors letters*, ver. 1, no 4, 2017.

CONFERENCES

FlipBot: A Lizard Inspired Stunt Robot

Cape Town, South Africa

INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL (IFAC)

2014

- C. Fisher, A. Patel "FlipBot: A lizard Inspired Stunt Robot," 19th *World Congress of the International Federation of Automatic Control* (IFAC), Cape Town, South Africa, 24-29 August 2014.

A spider-inspired dragline enables aerial pitch righting in a mobile robot

Hamburg, Germany

INTERNATIONAL CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS (IROS)

2015

- S. Shield, C. Fisher, A. Patel "A spider-inspired dragline enables aerial pitch righting in a mobile robot," *IEEE/RSJ International Conference on Intelligent Robots and Systems* (IROS), Hamburg, Germany, IEEE, 2015.

The Effect of Spine Morphology on Rapid Acceleration in Quadruped Robots

Vancouver, Canada

INTERNATIONAL CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS (IROS)

2017

- C. Fisher, S. Shield, A. Patel, "The Effect of Spine Morphology on Rapid Acceleration in Quadruped Robots," *IEEE/RSJ International Conference on Intelligent Robots and Systems* (IROS), Vancouver, Canada, IEEE, 2017.

Grants

NRF scarce skills funding for PhD Research 2016 to PRESENT

IEEE/RSJ travel grant to attend IROS 2017

IEEE/RSJ travel grant to attend IROS 2015

NRF scarce skills funding for MSc Research 2014 to 2015

Research Statement

My passion for research started in 2013 where, for my final year project for my BSc in Mechatronics (at the University of Cape Town, under the supervision of Dr. Patel), I was tasked to design, build and control a lizard inspired stunt robot that utilised an inertial tail to perform a barrel roll when launched into the air. This research resulted in my first publication [1] in IFAC (International Federation of Automatic Control), where I presented this research in 2014.

In 2014 I started my MSc in Electrical Engineering at the University of Cape Town, under the supervision of Dr. Patel and Prof. Boje. As part of this research I investigated the effect of the cheetah's spine and tail on its manoeuvrability. This involved the development of a wireless sensor network, state estimation algorithm to track the spine and tail motion and aerodynamic experiments on cheetah fur that resulted in my second publication [2]. Unfortunately the sensor network and state estimation algorithms were only validated on a test rig and not on an actual animal (this research is currently being extended by an MSc student in the Mechatronics lab that I am working closely with). I was later involved in using animal borne cameras along with IMU (Inertial Measurement Unit) and GPS (Global Positioning System) sensors to track the movement of the spine and tail, resulting in a journal publication [3].

During my first year of my MSc, I worked closely with an undergraduate student in the development of a spider inspired mobile robot that utilises a dragline for aerial pitch righting. This research resulted in a publication [4] at IROS (International Conference on Intelligent Robots and Systems) in 2015.

After the success of my MSc (awarded with distinction), I started my PhD in 2016. The end goal is to develop a planar quadruped with an active spine and perform rapid acceleration and deceleration manoeuvres. Currently I have investigated the effect of different spine morphologies (rigid, revolute and prismatic spine) on rapid acceleration in a two dimensional planar quadruped, which resulted in a publication [5] that was presented at IROS in 2017. I am in the process of extending this analysis for publication in a journal paper. This involved Monte Carlo Simulations utilising trajectory optimisation and optimal control.

I have also identified a new and novel template for acceleration that is consistent for a number of different robot morphologies. I am in the process finalising this research to be submitted as a conference paper (involving international collaboration with A/Prof. Christian Hubicki at Florida State University). I am working closely with an MSc student in the development of a biped robot for his research that will later be re-constructed into a planar quadruped robot for my research. We have developed all the software along with the mechanical construction of the legs and body. Over the next few months we will start making the biped hop and run.

The remainder of my PhD will involve designing novel controllers utilising the acceleration template to control the transient motion of the rigid spine quadruped robot. Following this, an active prismatic spine will be designed and built with novel control algorithms that utilise the spine to improve the manoeuvrability (rapid acceleration and deceleration) of the quadruped platform.

Upon completion of my PhD, I envision establishing a legged robots research group that focuses on employing Dr. Patel's research (bio-inspired trajectory optimisation and optimal control in simulation) on physical platforms. My goal is to improve the manoeuvrability of robots through the use of templates and control on novel legged platforms. My long term goal is to further this research to three dimensional transient motion (4 legged quadruped with a prismatic and roll spine to investigate the galloping gait) and to study rapid turning in legged platforms.

[1]C. Fisher, A. Patel "FlipBot: A lizard Inspired Stunt Robot," 19th *World Congress of the International Federation of Automatic Control* (IFAC), Cape Town, South Africa, 24-29 August 2014.

[2]A. Patel, E. Boje, C. Fisher, L. Louis, E. Lane, "Quasi-Steady State Aerodynamics of the Cheetah Tail," *Biology Open*, DOI: 10.1242/bio.018457.

[3]A. Patel, B. Stocks, C. Fisher, F. Nicolls, E. Boje, "Tracking the Cheetah Tail using Animal-Borne Cameras, GPS and an IMU," *IEEE sensors letters*, ver. 1, no 4, 2017.

[4]S. Shield, C. Fisher, A. Patel "A spider-inspired dragline enables aerial pitch righting in a mobile robot," *IEEE/RSJ International Conference on Intelligent Robots and Systems* (IROS), Hamburg, Germany, IEEE, 2015.

[5]C. Fisher, S. Shield, A. Patel, "The Effect of Spine Morphology on Rapid Acceleration in Quadruped Robots," *IEEE/RSJ International Conference on Intelligent Robots and Systems* (IROS), Vancouver, Canada, IEEE, 2017.

Teaching Philosophy and Vision

During my undergraduate studies at the University of Cape Town, the lecturers who truly inspired me were the ones who related the course content to their practical experience and filled the lessons with stories of real design challenges along with their past failures and solutions. These lectures showed the relevance of the degree I was studying and kept the class interested in the subject matter. These often involved guest lecturers from industry presenting case studies on design problems as well as bringing components that are relevant to the subject matter to pass around the class, such as gear boxes or waveguides.

I feel that engineering should be taught practically as I have observed that students lack the ability to properly debug a system that is not working (whether it be software or hardware). These problem-solving skills can be taught through hands on practicals and projects that involve applying the theory learnt to a physical system. Through the process of applying this theory and making mistakes, the students will develop the skill of problem solving and debugging.

By far the best course of my undergraduate degree was Mechatronics Design (EEE3061W). This course bridged the gap between theory and practical and really fascinated me. This course gave the students the opportunity to get some hands on experience and started preparing them for their final year project. I have had the pleasure of lecturing Mechatronics Design this year and I have implemented a new design component (students must now select and purchase components for their project) that has drastically increased the students interest and excitement for this course and project.

It is my hands on experience gained through five years of postgraduate research in robotics along with my experience as a Teaching Assistant (for Embedded Systems and Mechatronics Design) and Lecturer (for Introduction to Microcontrollers and Mechatronics Design) that I believe will aid me in contextualising engineering concepts and in so engage and captivate students. This experience enables me to lecture a wide range of course content. I will try and relate these experiences to the content being lectured in order to keep the students interest and provide real world problems and solutions. Through this I hope to inspire students to pursue postgraduate studies and potentially a future in academics.

Lastly, I feel it is the responsibility of the lecturer to engage and encourage students to strive for their best. This is achieved through interesting and relevant content delivered in a professional and easy to understand manner that ensures the learner remains interested. With my hands on experience with cutting edge robotics I am certain that I will be able to keep the lessons interesting and relevant.