Engineering Recovery with Moving Materials and Thinking Structures

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C.V. Highlights

Education

2012 - 2017 Master and Bachelor of Science in Robotics and Autonomous Systems / Micro-engineering
Advisor : Prof. Gregoire Courtine
Swiss Federal Institute of Technology Lausanne (EPFL)

2016 - 2017 Master Research Thesis
Advisor : Prof. Etienne Burdet
Imperial College London, UK

2017 - 2022 Ph.D. in Robotics, Control and Intelligent Systems
Advisor : Prof. Yves Perriard
Swiss Federal Institute of Technology Lausanne (EPFL)

2022 - 2025 Postdoctoral Scholar (Innovation Fellows Program)
Advisor : Prof. Jonas Rubenson, Prof. Xiaogang Hu
The Pennsylvania State University

2025 - Postdoctoral Scholar
Advisor : Prof. Tyler Clites
University Of California, Los Angeles (UCLA)

Key Publications

[1] **S. Thomas**, P. Germano, T. Martinez, and Y. Perriard, "An untethered mechanically-intelligent inchworm robot powered by a shape memory alloy oscillator," *Sensors and Actuators A: Physical*, Dec. 2021

[2] **S. Thomas**, G. Maquignaz, A. Thabuis, and Y. Perriard, "A self-biasing shape memory alloy gripper for lightweight applications," in *2021 IEEE/RSJ international conference on intelligent robots and systems (IROS)*, IEEE, Sep. 2021.

[3] M. Ghorbani, **S. Thomas**, G. Lang, T. Martinez, and Y. Perriard, "Fabrication and characterization of the kirigami-inspired SMA-powered actuator," *IEEE Transactions on Industry Applications*, Jul. 2023

[4] **S. Thomas** *et al.*, "An implantable variable length actuator for modulating in vivo musculo-tendon force in a bipedal animal model," in *2023 IEEE/RSJ international conference on intelligent robots and systems (IROS)*, IEEE, Oct. 2023.

[5] **S. Thomas**, A. Thabuis, T. Martinez, P. Germano, and Y. Perriard, "Designing compliant mechanisms composed of shape memory alloy and actuated by induction heating," *Smart Materials and Structures*, Aug. 2021

[6] P. Peralta, **S. Thomas**, and Y. Perriard, "Characterization and verification of eddy-current position sensing for magnetic levitation," IEEE Transactions on Industry Applications, Nov. 2021

[7] **S. Thomas** *et al.*, European Patent "EP4026659 - microgripper device." 2021.

Teaching and Mentorship

2018 - 2022 Undergraduate Teaching Assistant - Intro to Electrical Engineering

2018 - 2022 Undergraduate Teaching Assistant - Electromechanics Conversion

2018 - 2019 Graduate Teaching Assistant - Embedded Motor Control

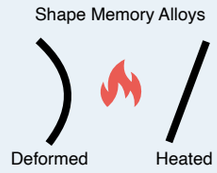
2018 - 2022 Graduate Thesis Mentor - Robotics Masters Students

Research Contributions

Robotics

Background

Smart Materials - Materials that produce work in response to a stimulus



They are power-dense, lightweight, mimic muscle-like behaviour and can act as both sensors and actuators

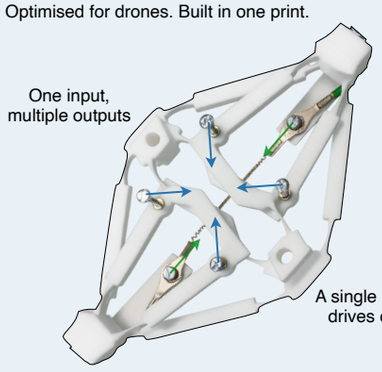
Mechanical Intelligence in Motion

A robot that crawls without a brain

Inspired by the inchworm, weighs less than a tablespoon of water, yet crawls untethered.

Design by Optimisation, Performance by Design

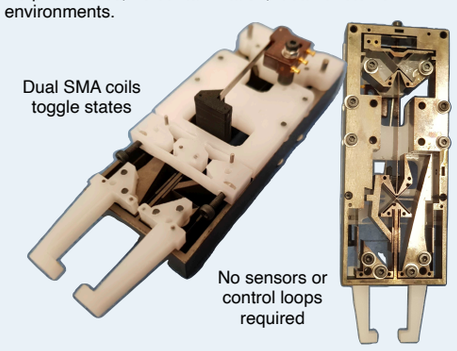
Optimised for drones. Built in one print.



Compliant mechanisms amplify the incredible energy density of smart materials. Grip, return and motion amplification, all through geometry.

Harnessing Bistability for Rapid, Reliable Gripping

No pneumatics, no contamination, ideal for sterile environments.



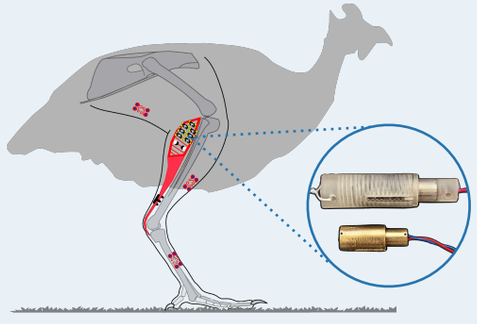
Flexures and buckled beams enable instantaneous motion, solving SMA's biggest weakness: speed

Rehabilitation

Implantable Artificial Muscles

When assistive tech feels like a burden, it gets left behind

Works like a built-in tendon spring, engages only when needed, staying passive the rest of the time

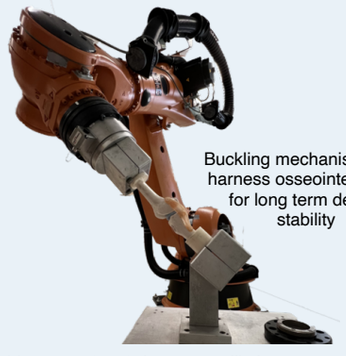


A small implantable device replaces part of the calf muscle to assist movement from inside the leg

Osseointegrated Mechanisms

A seatbelt for your knee - ACL injury prevention

An extra-articular implant for ACL injury prevention



Female athletes are 2 to 8 times more likely to tear. Prevention reduces need for costly surgeries and avoids future issues like early-onset osteoarthritis

Research Vision

Synergise Materials and Mechanisms for Assistive Robotics

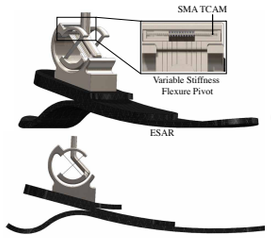
Movement from design. Motors are optional when structures are smart.

My research combines shape-changing materials and architected structures to develop intuitive, assistive robotic technologies for real-world clinical impact.

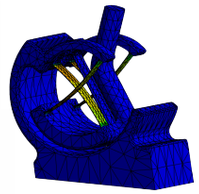
Project 1

Smart Ankle with Twisted and Coiled Actuation

One stiffness doesn't fit all: amputees face fatigue, falls, and frustration without adaptive ankle prostheses.



Innovative flexure design paired with energy-dense twisted and coiled artificial muscles



Flexures naturally match the needs of smart materials

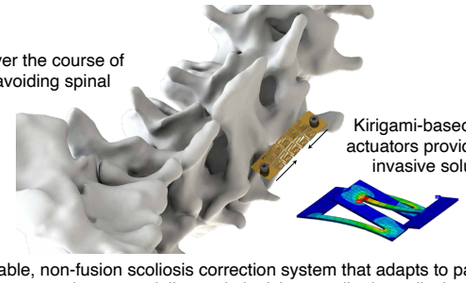
Even lighter than a fixed-stiffness ankle

Project 2

Kirigami-Inspired Vertebral Body Tethering

Current scoliosis treatments rely heavily on spinal fusion which limits spinal growth and mobility.

Relaxes over the course of treatment avoiding spinal fusion



Kirigami-based Nitinol actuators provide a less invasive solution.

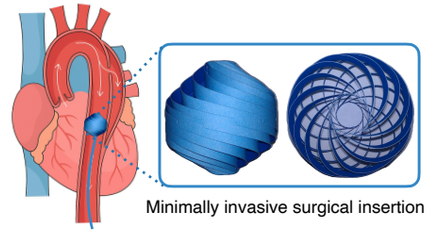
A fully implantable, non-fusion scoliosis correction system that adapts to patient growth without reoperation, potentially revolutionising paediatric scoliosis care.

Project 3

Origami Intra-Aortic Pump

When mechanical assistance of the heart is required, balloon pumps are often inserted using a catheter to help. However, the restricted blood flow can lead to ischemia.

Spiral origami pump - Shape Memory Polymers



Blood flow without restriction

Minimally invasive surgical insertion