MATTHEW ANDERSON

Extreme Environment Field Roboticist, System Integrator, UAS Development and Deployment

Nationality: Australian

Languages: English

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EMPLOYMENT

PostDoc / Lecturer   [2019 – Current]
Aerospace Robotics and Control Laboratory (ARCL) – Caltech

- Developer and Lecturer for Experimental Robotics (ME/CS/EE 129)
    - ⇒ Introduced students to the field of robotics, bridging the gap between theory and field deployment of robotic systems (with a focus on experiential learning)
    - ⇒ Catered to students from a wide variety of backgrounds (Mechanical Engineering, Electrical Engineering, and Computer Science) and year levels (3rd – Masters)
    - ⇒ Syllabus included System Architecture, Sensors, Embedded Programming (Arduino and Raspberry Pis), ROS, Git, Mechanical Design, Safety and Designing Test Campaigns.
- Lead Researcher and Contributor to several projects across many fields including
    - ⇒ Remote sampling of volcanic fumaroles using an in-house developed UAV and sample capture system (SciTech 2021)
    - ⇒ ARCL's Autonomous Flying Ambulance, a testbed demonstrator for many of ARCL's non-linear control and machine learning technologies (SciTech2021)
    - ⇒ UAS operations for Multistatic SAR research (in collaboration with JPL for the Distributed Aperture Radar Tomographic Sensors (DARTS) project)

PostDoc / Hardware Integrator   [2018 – 2019]
DARPA Subterranean Challenge – Jet Propulsion Laboratory

- Team Lead / Team Member for Hardware design (and supporting electronics), sensor integration and operation for a diverse range of ground vehicles both on custom builds and COTS systems.
- Embedded low-level software development, including interfacing with high-level systems such as ROS, development of redundant, highly reliable robot safety systems.
- Developed safety procedures and protocols for both field and flight operations, including for operations in challenging underground environments.
- On-lab and remote field test planning, co-ordination, and execution (both as Field Lead and Safety Lead) for teams with varying sizes and levels of experience

Researcher / UAV GCS Operator   [2013 – 2018]
The University of Sydney – Aeronautics Department and The Australian Centre for Field Robotics

- Aircraft Designer for the University's Phase 1 submission for the Wasp AE replacement for the Australian Army of 2020, funded by the Defence Innovation Hub.
- Worked on several projects designing, building and operating UAVs for many novel applications.
- Support for anything in the UAV Lab, typically for undergrad theses and PhD work.

UAV GCS Operator / Support Crew   [2017 – 2018]
Private Contracting

- GCS operator, technical and general support for UAV operations including multi-vehicle operations and UAS-detection field trials.
- Technical consultant for UAV development including airframe and component selection, autopilot configuration and operational procedures

Casual Lecturing and Tutoring   *[2010 – 2018]*
The University of Sydney

- Guest Lecturing for Professional Engineering 2 (Workplace Health & Safety and Sustainability) and UAV Operations (low-level hardware design, aircraft design, UAV piloting).

- Tutoring including Safety Systems, Mechanical Design, Professional Engineering 1 and 2, Aircraft Design, Aircraft Construction, System Dynamics and Control, Workshop skills

EDUCATION

Ph.D   *[2011-2018]*
A Methodology for Aerodynamic Parameter Estimation of Tail-Sitting Multirotors
The University of Sydney, Australia & Université Libre Bruxelles, Belgium

- Developed a method for accurately identifying and modelling the dynamic behaviour of a tail-sitting multirotor using wind tunnel tests and a freely-rotating gimballed model. The methodology developed was verified to work for un-stalled flight and was extended to encompass the post-stall, pre-hover flight regime tail-sitters are expected to routinely operate in.

Bachelor of Engineering (Aeronautical) Hons I   *[2008–2010]*
Honour Thesis - Autonomous Take Off and Landing of an Unmanned Aerial Vehicle
The University of Sydney, Australia. Exchange student at The Royal Institute of Technology (KTH), Sweden

- Competed in the UAV Outback Challenge 2010 as part of control software development within a larger aircraft wide team of ten thesis students

TECHNICAL SKILLS

Robotic Hardware Integration and Testing

- System Architecture Design of complex systems with consideration to hardware constraints, sensors placement and bandwidth, power constraints, serviceability, and field survivability

- Integration of many different COTS and in-house systems, both from an initial build and as retro fits into existing systems

- Development of interfacing solutions to enable components to communicate with each other and extra sensing capabilities

Aircraft Design and Operations

- Design including sizing optimisation, performance modelling, airframe construction, system identification of unconventional airframes, CAD design

- Operations including flight testing (APM, Mission Planner, qgroundcontrol), operations safety, RC test pilot, wind tunnel testing, flow visualisation, and software development.

Software

- Technical packages including MATLAB, Inventor, SolidWorks, Arduino, Excel, C/C++, LaTeX, AVL, python, ROS, git

- Operating Systems Microsoft Windows and Linux routinely used

Certifications

- Gold Wings (Fixed-Wing), Model Aircraft Association of Australia
- First Aid / CPR

OTHER

Interests
- Rock climbing, kayaking and adventure
- Radio control aircraft (pylon racing) and autonomous control

Awards & Positions Held
- Earth Science & Technology Directorate Team Bonus Award (SubT, JPL), 2019
- Best Written Paper (Propulsion) and Best Over Congress Paper – AIAC 2017, 2017
- Thesis Seminar Award (Aeronautical), 2010

REFEREES AND REFERENCES

- Available upon Request

PUBLICATIONS

Published

- *Development and Deployment of an Autonomous UAV-Borne Gas and Particulate Sample Capture System for Fumarole Sampling,* AIAA SciTech Forum 2021 (SciTech2021), 2021, (1st Author)
- *Design of the Next-Generation Autonomous Flying Ambulance,* AIAA SciTech Forum 2021 (SciTech2021), 2021, (3rd Author)
- *Design and Autonomous Stabilization of a ballistically Launched Multirotor*, IEEE International Conference on Robotics and Automation (ICRA 2020), 2020, (3rd Author)
    - $\Rightarrow$ Best Paper Award on Unmanned Aerial Vehicles
- *Modelling Small Electric Brushless Motors and Propellers*, 17th Australian International Aerospace Congress (AIAC 2017), 2017. (1st Author)
    - $\Rightarrow$ Best Written Paper (Propulsion)
    - $\Rightarrow$ Best Overall Congress Paper
- *Flight Experimentation Towards Enhanced UAV Capabilities – The Multi-Rotor Air-Crane*, 17th Australian International Aerospace Congress (AIAC 2017), 2017. (1st Author)
- *Modelling Propeller in FINE/Open using OpenLabs*, Fourth Australasian Unmanned Systems Conference, 2014. (1st Author)
- *Propeller Location Optimisation for Annular Wing Design*, International Micro Air Vehicle Conference and Flight Competition, 2013. (1st Author)

Preprint

- *NeBula: Quest for Robotic Autonomy in Challenging Environments; TEAM CoSTAR at the DARPA Subterranean Challenge* - https://arxiv.org/abs/2103.11470 (13th Author)
- *Neural Tree Expansion for Multi-Robot Planning in Non-Cooperative Environments* - https://arxiv.org/abs/2104.09705 (3rd Author)