

Harry Redgrave Smith

ROTARY AERODYNAMICIST · TEST ENGINEER · SCIENCE COMMUNICATOR

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Enthusiastic aerospace engineer with thirteen years of experience working at levels from individual contributor, through to technical manager. Proficient in design, simulation, testing, and data analysis - skills honed through research and industrial work in experimental, and multi-fidelity numerical aerodynamics of flight vehicles and subsystems. Specialist in reduced order modelling of aerodynamic phenomena, safety analysis, control surface design, stability and control estimation, wind-tunnel testing, and data analysis.

Key Skills

Flight Dynamics	WT and FT Determination of Stability Derivatives, Linear and Nonlinear Simulation , Fixed and Rotary Wing
Technical Leadership	Led technical design of >£1m rotor rig, managing multiple engineers.
Detailed Design	Designed novel high-lift flapperon system that <i>reduces</i> cruise drag, high aileron effectiveness, and $C_{l_{max}} \simeq 2.4$.
CFD	Proficient in 2D multi-element RANS CFD (NSU2D) for detailed design.
Rotary Aerodynamics	BEMT, vortex models, coupled FE-CFD, unsteady models (Theodorsen, Leishmann-Beddoes, GDW)
Experimental Work	Planning/estimation, Wind tunnel corrections, Model Deformation Measurement (MDM)
Complex Systems	Technical Authority for Rotary Testing at ARA. Focal for aircraft controls on overactuated eVTOL aircraft.
Presentation	Award-winning Professor . Competition Winner (Science Slam, Pint of Science). SME on BBC Evening News.)
Risk Management	Experienced with ISO 31000 Risk Management Strategies - apply principles in work and daily life!
Python	Taught Python for Engineers : data analysis, signal/image processing, machine learning, big data, nonlinear simulation
Technical Software	LabVIEW, ParaView, Tecplot, \LaTeX , CAMRAD, Fusion 360, XFOIL, AVL, XFLR5, NSU2D, STAR-CCM+

Experience

Senior Aerodynamicist

Aurora Flight Sciences, a Boeing Company

FULL TIME REMOTE ROLE

Sept 2021 to Present

S&C and Performance Senior Engineer on www.wisk.aero:

- Successfully developed methodology to quantify safety differences between competing control surface designs for eVTOL aircraft.
- Designed control surface geometry - reduces separation vs. clean wing due to throughflow.
- Demonstrated aircraft design meets MIL-STD-8785C or MIL-STD-1797B criteria for manoeuvrability
- Created workflow to get clean foils/control surfaces into wing loft - maintaining curvature continuity and eliminating manual smoothing by lofters.

S&C Lead on Virgin Galactic Mothership venture:

- Demonstrated deficiencies in existing control system and led small modifications to improve agility by 50%.
- Led team of Aurora engineers in night-shift working to quantify uncertainties in actual aircraft geometry (crawling around the inside of VMS Eve).

Others:

- Wrote `scToolbox.py` - a module to gain estimates of flying/handling qualities at preliminary design stage.
- Raised safety concerns on aircraft program that led to Chief Engineer intervention.

Industry Assistant Professor

Illinois Institute of Technology, Chicago IL

TIER II FACULTY ROLE

March 2020 to Aug 2021

- Created research programme with industrial partners - AIAA Journal Paper Submitted, second being written.
- Developed fully-online teaching methodologies in response to Covid-19 - moved to HQ video lectures - see youtu.be/ZxYc9ORAGtw

Aerospace Lecturer

FACULTY ROLE TEACHING AND SUPERVISING UNDERGRADUATE STUDENTS.

August 2018 to March 2020

- MMAE 410 Flight Mechanics - wrote new syllabus, and accompanying website in lieu of textbook - aircraftflightmechanics.com.
- MMAE 315 Aerospace Laboratory - taught fundamentals of experimental methods, drawing from own industrial experience
- MMAE 304 Mechanics of Aerostuctures, developed a new syllabus; all lectures [available online](#).

Senior Aerodynamics Engineer

Aircraft Research Association (ARA), Bedford UK

SENIOR ROLE WITHIN AERODYNAMICS AND TEST TECHNIQUES GROUP

December 2016 to June 2018

Technical Authority for Rotary Testing:

- Developed Pressure-Sensitive Paint (PSP) and Blade Deformation Measurement systems for use on 3ft diameter propeller at 6000RPM.
- Wrote data reduction scripts for live Fourier analysis of rotating-frame data for conversion into inertially-fixed forces.
- Lead in the investigation of, and mitigation against electromagnetic interference issues encountered during previous testing.

Created *DynAMoS* - 'DYnamic Analysis of MOdel Stresses' for safe wind-tunnel testing involving dynamic behaviour:

- Live feedback system to monitor dynamic stresses in aircraft model components, separating dynamic and steady-state loads.

Successfully implemented, trialled and sold Model Deformation Measurement (MDM) system to a major US Civil Airframer:

- Fully-mapped data back to aircraft global reference system for production of modified CAD surfaces to implement in CFD.

Technical lead for balance data reduction:

- Created tools for conversion between NLR and ARA wind tunnel balance matrices.
- Technical point of contact between ARA and Triumph (Calspan), and Aerophysics Research Instruments.

Created 'DRAFT NP' system - captures n-per-revolution harmonic data from transducers based in the rotating reference frame:

- Developed from codes written during IMPACTA testing (see overleaf) - system enables determination of inertially-fixed parameters from rotating-frame data.

Aerodynamics Engineer/Project Supervisor

ARA

EXPERIMENTAL AERODYNAMICS DEPT. AND THEN AERODYNAMIC CAPABILITY DEPT.

September 2014 to December 2016

Initially employed at ARA to bring specialist rotary aerodynamics knowledge based on PhD findings, in addition to being able to lead large wind tunnel programmes. Notable achievements include:

Designed bespoke dynamic data acquisition/reduction for IMPACTA programme (£2m wind tunnel test for GE Aviation):

- During testing, the existing NP load measurement system did not satisfy requirements and testing was halted. Took sole responsibility to measure Rotary Shaft Balance (RSB) data at 40MHz, and produced a frequency-domain data reduction suite. *Testing was continued at ARA based only on the system that I wrote.*
- ARA Representative for Vertical Lift Network (VLN) - represented the UK's leading industrial wind tunnel capability at the VLN, a group comprising rotorcraft manufacturers and academic institutions.

Business Development Manager

ARA

SUPPLEMENTARY ROLE AS INTERNATIONAL BUSINESS DEVELOPMENT REPRESENTATIVE IN THE AMERICAS

December 2016 to June 2018

In charge of business development for the Americas - >£10m tests following US visits to major aerospace suppliers including *Boeing, Northrop Grumman, Raytheon, Lockheed Martin, Textron, Triumph, Aurora Flight Sciences, Calspan, USAFRL*, and many others.

Postgraduate Flight Mechanics Engineer

AgustaWestland (now Leonardo Helicopters), Yeovil

FLIGHT MECHANICS DEPT., HELICOPTER SYSTEM DESIGN

September 2010 to May 2011

Selected by HSD Group because of knowledge in *Flight Mechanics* and *Aeroelasticity*. Role included validation of Flight Test data for AW159 Wildcat.

Created a new set of software routines to analyse transient Handling Quality Data automatically.

Systems/Aerospace Engineer

Thales Land and Joint, Bury St. Edmunds

SIX-MONTH INDUSTRIAL PLACEMENT FOR MASTER'S PROJECT

January to June 2010

Industrially-based dissertation - "*Review of Aerodynamic Load Calculation on the Vicon-18 Series Reconnaissance Pods*":

Education

Ph.D. Aerospace Engineering

University of Glasgow

DISSERTATION: 'ENGINEERING MODELS OF AIRCRAFT PROPELLERS AT INCIDENCE'

2011-2014

- A combination of commercial and security classification precluded publication of key findings.
- New validation data (UoG) has been produced in late 2020 for validation of some results, with aim to publish two journal papers in 2021-22.

M.Eng (Hons) Aeronautical Engineering

University of Glasgow

CONCENTRATIONS: ROTARY AERODYNAMICS, AEROELASTICITY, TURBOMACHINERY, CFD

2005-2010

Final Grade: 1st-class honours. **Graduated top of a class of twenty.**

Presentations and Media Appearances

Presenter

American Helicopter Society 74, Phoenix AZ

'ENGINEERING MODELS FOR INERTIALLY-FIXED FORCES ON HINGELESS RIGID ROTORS IN NON-UNIFORM INFLOW'

May 2018

Plenary speaker

Airbus DiPaRT Conference, Bristol

'THE CHALLENGES OF COMMERCIAL WIND TUNNEL TESTING IN A MODERN AGE'

April 2016

Invited Lecturer

University of Glasgow, University of Bristol, Loughborough University

'REDUCED ORDER MODELLING OF ROTARY AERODYNAMICS', 'COMMERCIAL WT TESTING'

Numerous 2015-2018

BBC Evening News

2013

SME - 'ROTORCRAFT SAFETY' AFTER THE CLUTHA HELICOPTER CRASH

Awards and Competitions

Provost's Inaugural Online Teaching Award

Illinois Institute of Technology

FULL DETAIL AT [BIT.LY/3NPPFEA](https://bit.ly/3NPPFEA)

Dec 2020

The award identifies faculty who have adapted to the circumstances of the past year due to the coronavirus pandemic, most courses have followed an online or hybrid model-and created exceptional online learning experiences in the fall 2020 semester.

Science Slam - Winner

Cambridge University

INTER-UNIVERSITY COMPETITION IN SCIENCE COMMUNICATION

2013

A competition to communicate PhD theses to the general public, in a pub. Won joint first place in a set of five entrants.

Publications

Majority of career and doctoral research has been spent on commercially-sensitive and/or classified projects - limited publications:

- Smith, H. R. (2018). *Engineering models for inertially-fixed forces caused by hingeless rigid rotors in non-uniform inflow: a problem for compound helicopters*. in VFS Forum 74 Conference Proceedings; Phoenix; Vertical Flight Society.
- Smith, H. R. (2015). *Engineering models of aircraft propellers at incidence* (Doctoral dissertation, University of Glasgow).