Flight Dynamics and Control 2

Lecture 1 - Introduction

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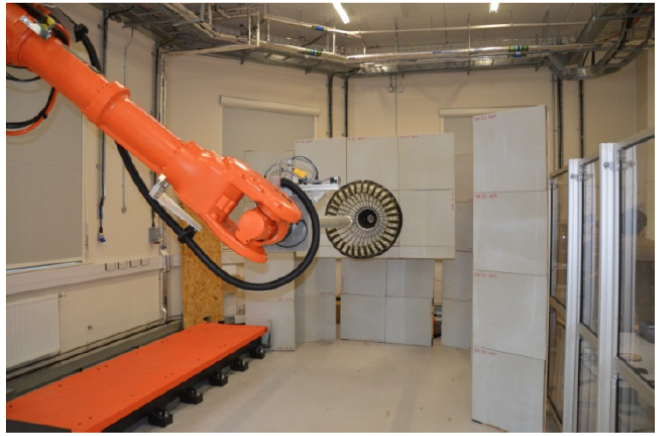
1903 Wright Flyer
Smithsonian *National Air and Space Museum*

Dr Tom Richardson - Microlight

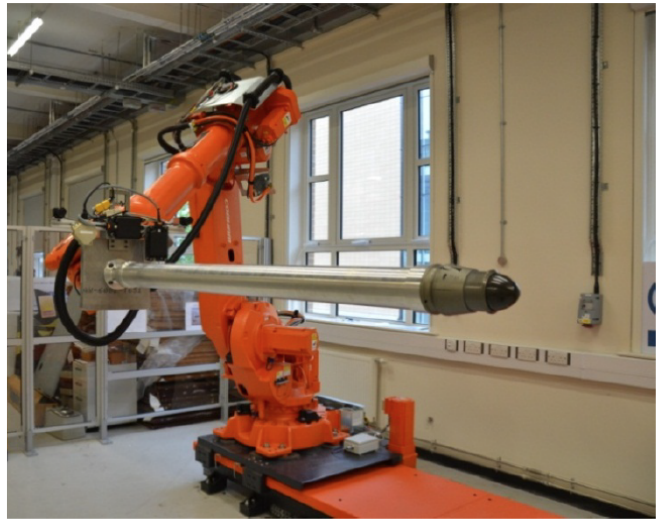
COBHAM

Dr Tom Richardson



ASTRAEA

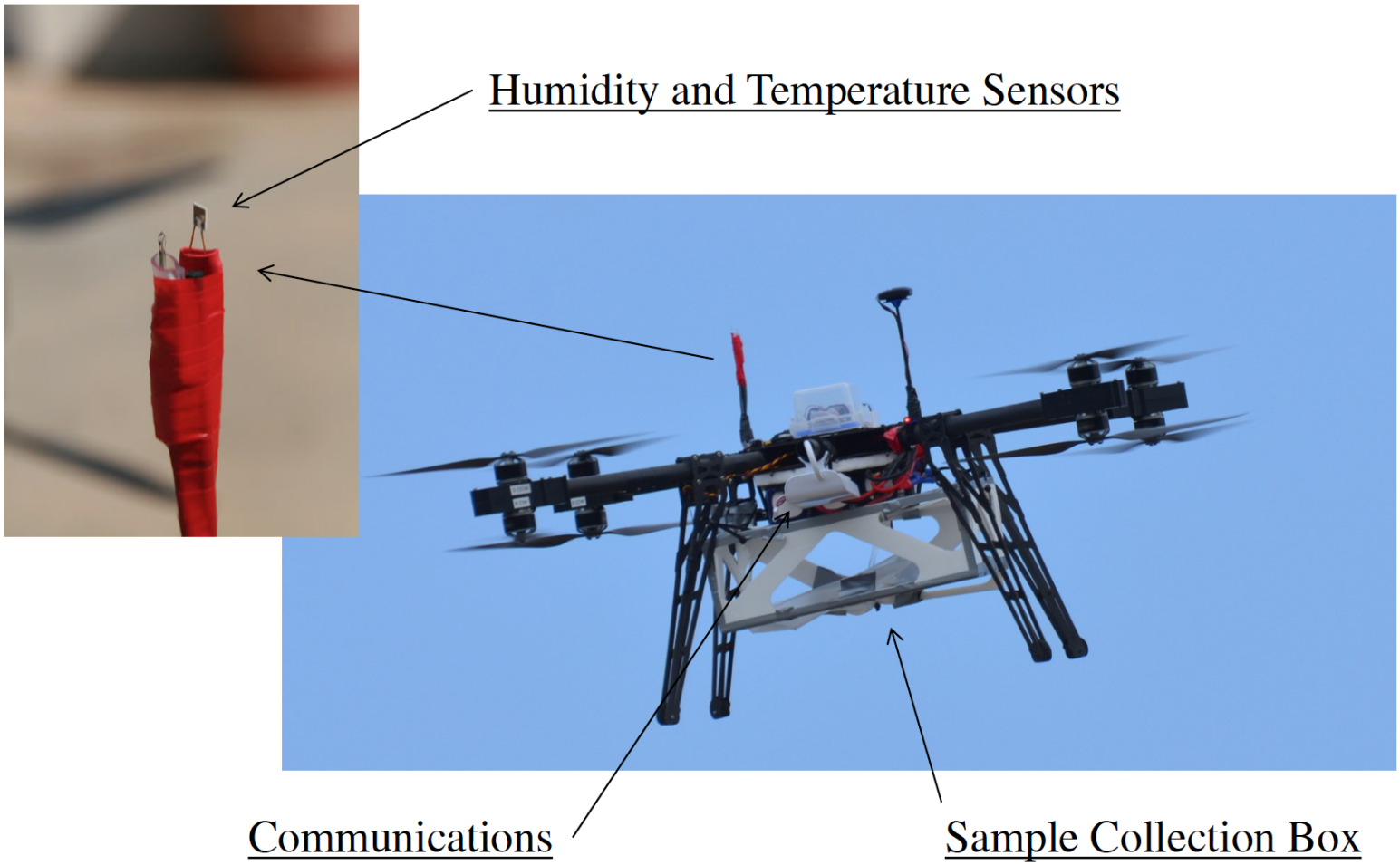
- Sensors in the loop
- Air-to-air refuelling
- Real-time operation
- Full nonlinear simulation environment



Machine Learning - Dr Tom Richardson


Ascension Island, Ascension, Saint Helena
Ascension Island, Saint Helena
Terrain · Search nearby
Western Sahara
Mauritania
Mali
Niger
Chad
Nouakchott
Dakar
Senegal
The Gambia
Bamako
Niamey
Burkina Faso
Guinea-Bissau
Conakry
Guinea
Benin
Nigeria
Sierra Leone
Togo
Côte d'Ivoire
Ghana
Lagos
Liberia
Abidjan
Lome
Cameroon
Central African Republic
Yaounde
Gulf of Guinea
Equatorial Guinea
Maracaibo
Bogota
Colombia
STATE OF ACRE
Nuestra Señora de La Paz
Paraguay
Asuncion
STATE OF SÃO PAULO
STATE OF RIO DE JANEIRO
STATE OF PARANÁ
Chile
STATE OF RIO GRANDE DO SUL
Uruguay
Buenos Aires
Montevideo
Argentina
Earth
South Atlantic Ocean
Ascension Island
Google

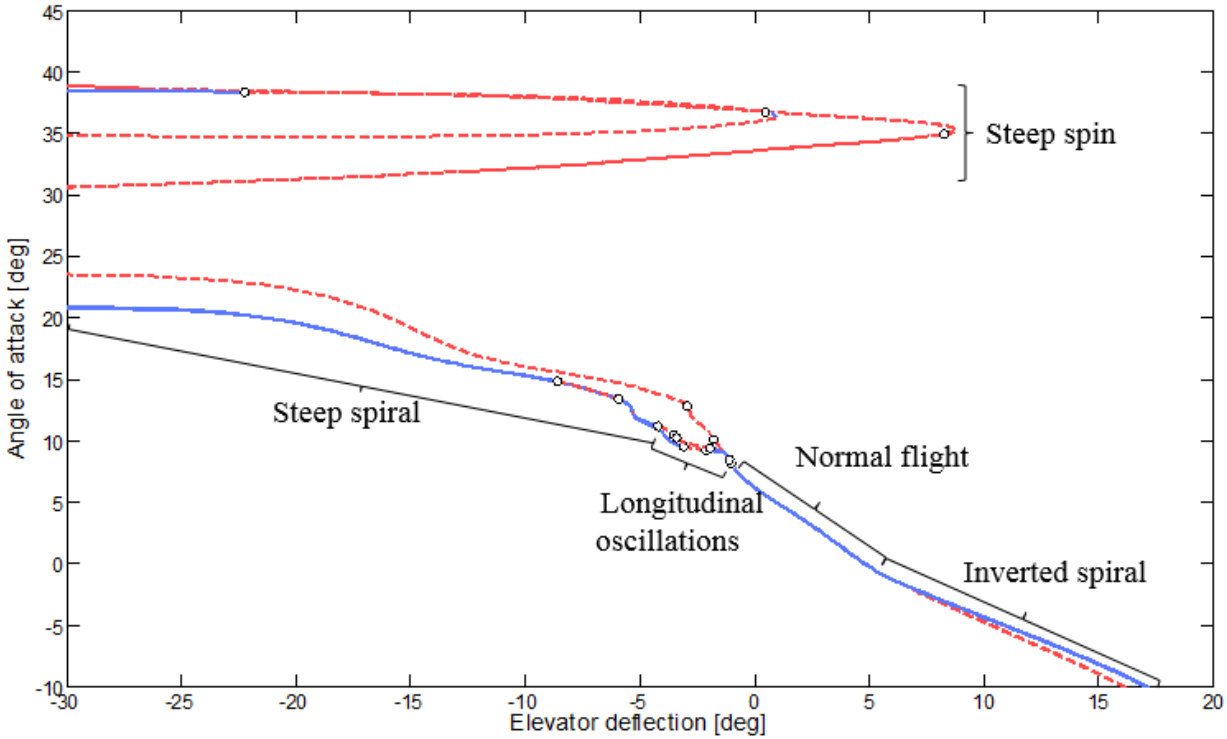
Final Flight Vehicle




TURTLE GRILL
Ascension Island 2014-2015

Mark Lowenberg: airliner loss-of-control studies

NASA Generic Transport Aircraft (GTM) model



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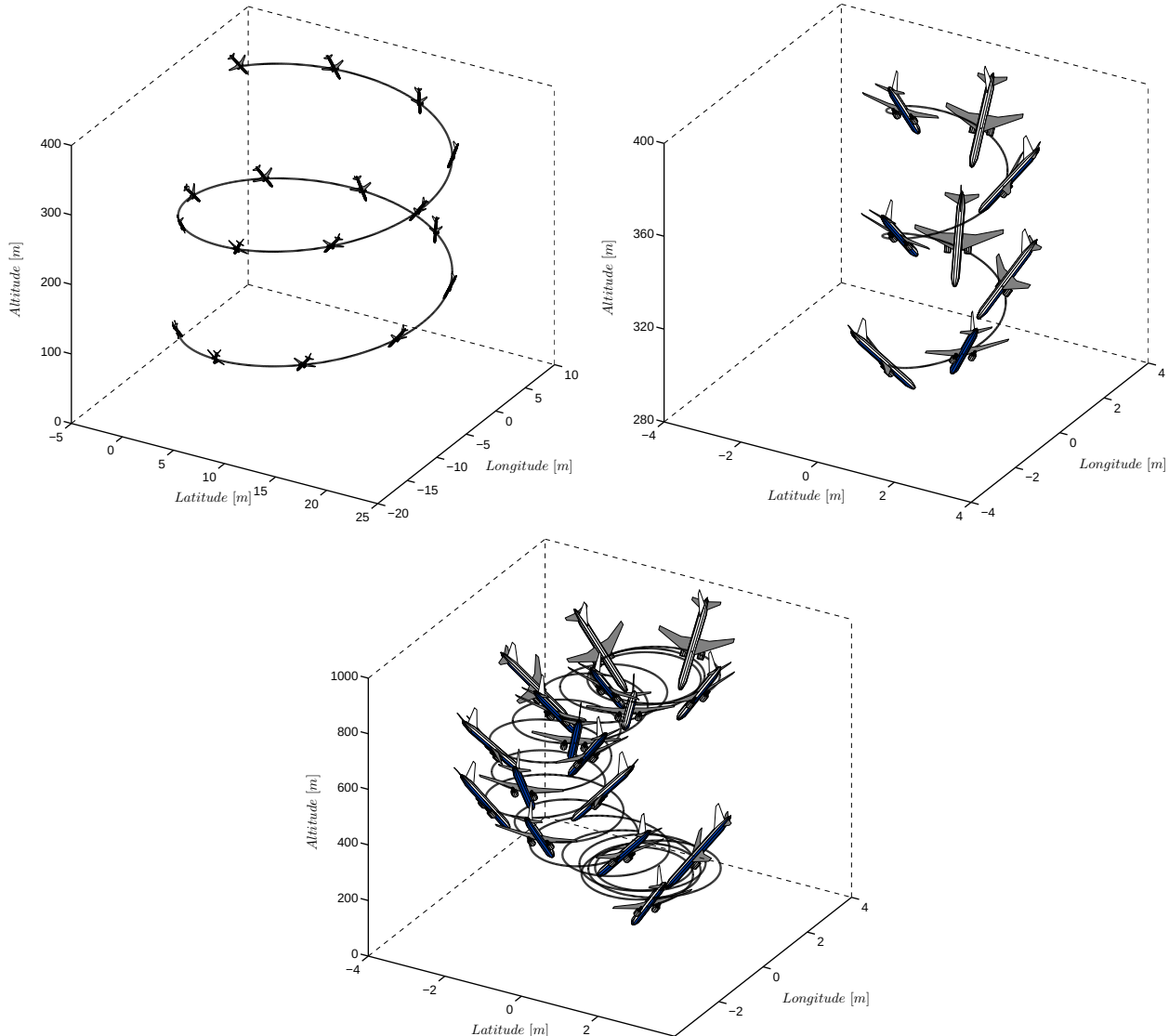
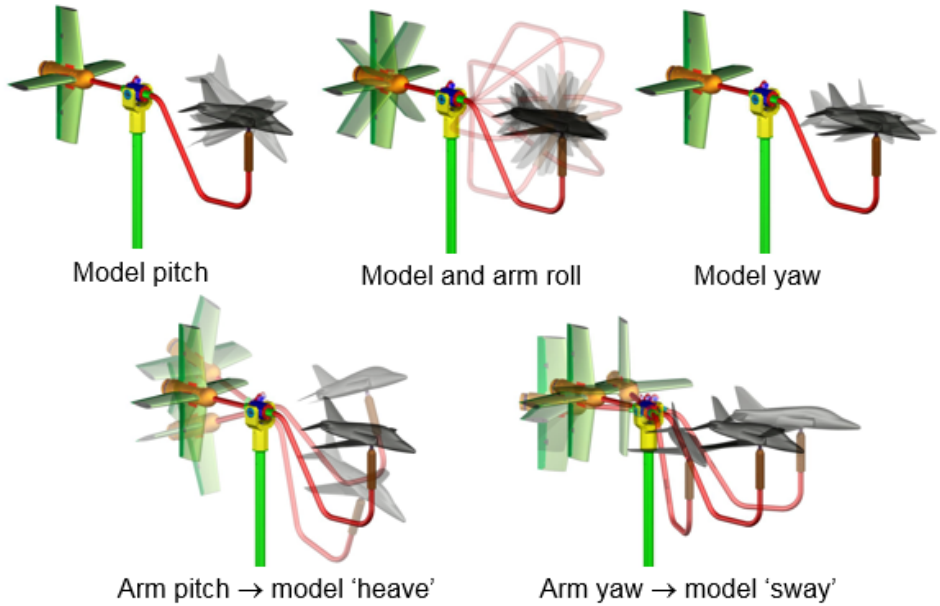


Mark Lowenberg: experimental nonlinear flight dynamics

University of Bristol Manoeuvre Rig



Controlled Atmospheric Flight

- Forces & Moments
- Stability
- Modelling & Simulation
- Control

Context within the four year Aerospace MEng course

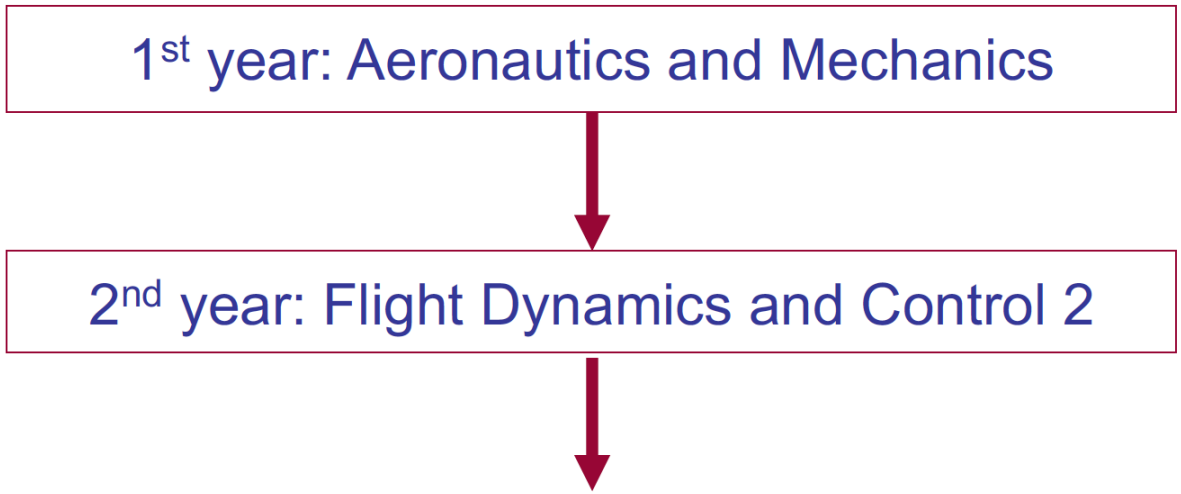
Degree Programme

1st year: Aeronautics and Mechanics

Aeronautics and Mechanics

- Introduces the concepts of static and dynamic mechanics
- Introduces basic aerodynamic principles
- Characteristics and performance of aircraft in flight
- Introduces some other aspects of aviation through specialised lectures

Degree Programme

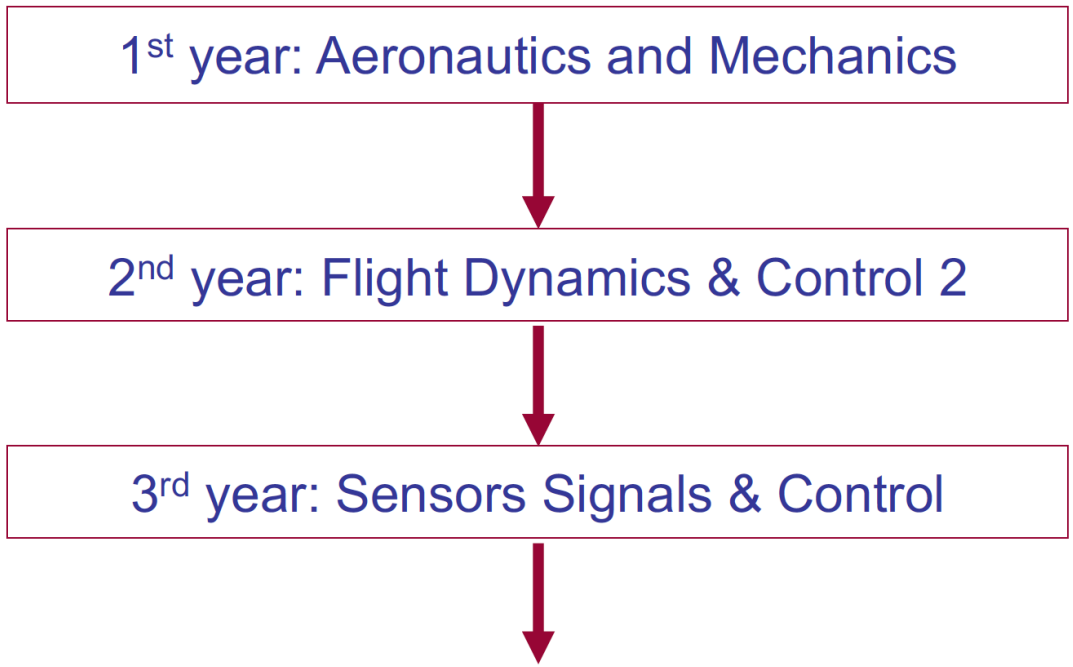



BRITISH AIRWAYS

Flight Dynamics and Control 2

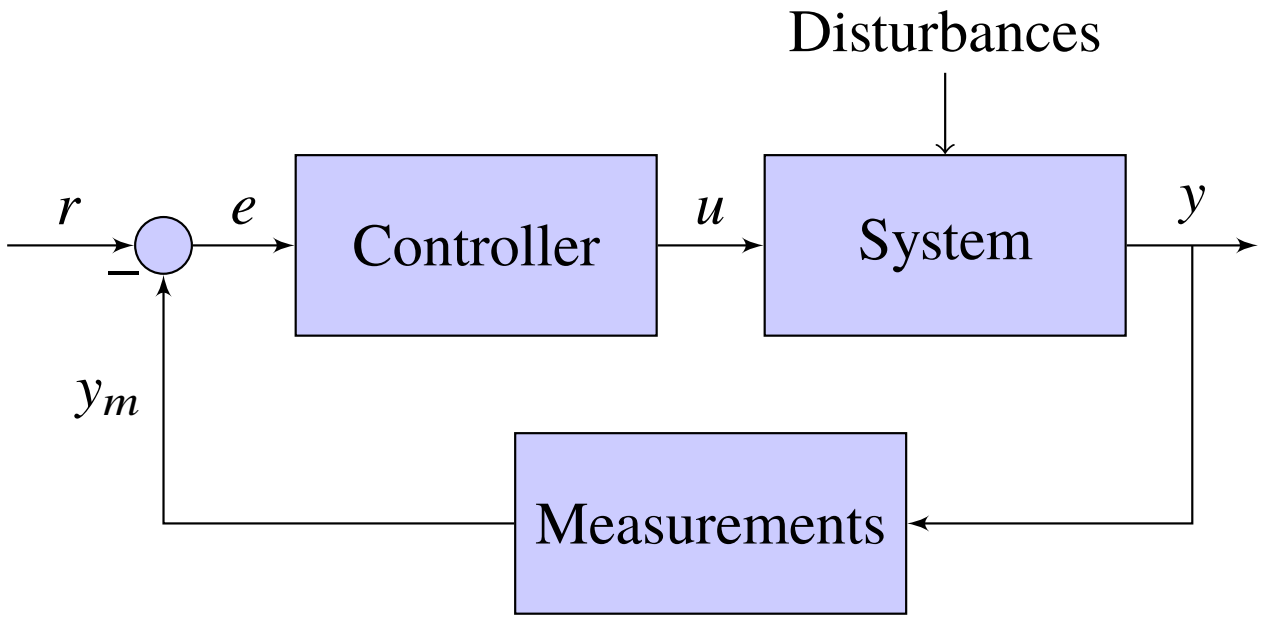
- Multi-degree of freedom systems - i.e. Aircraft
- Methods for predicting principle forces acting on the whole aircraft - e.g. strip theory
- Static flight balance and aircraft stability
- Equations of motion
- Methods for stability analysis
- Mathematical descriptions of aircraft motions - e.g. phugoid and short period

Degree Programme

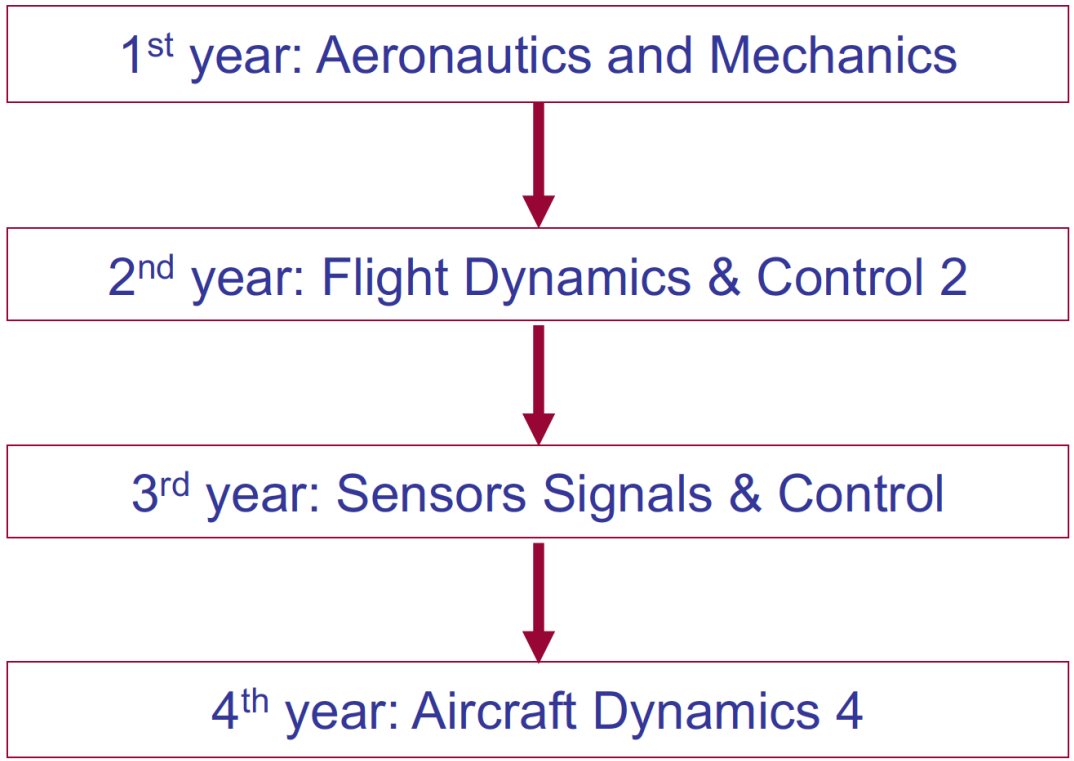


Sensors, Signals and Control

Introduces the analysis and design of control systems, with particular reference to aerospace applications.



Degree Programme



Aircraft Dynamics 4

Brings together elements of flight dynamics and control theory into the context of aircraft design and response.

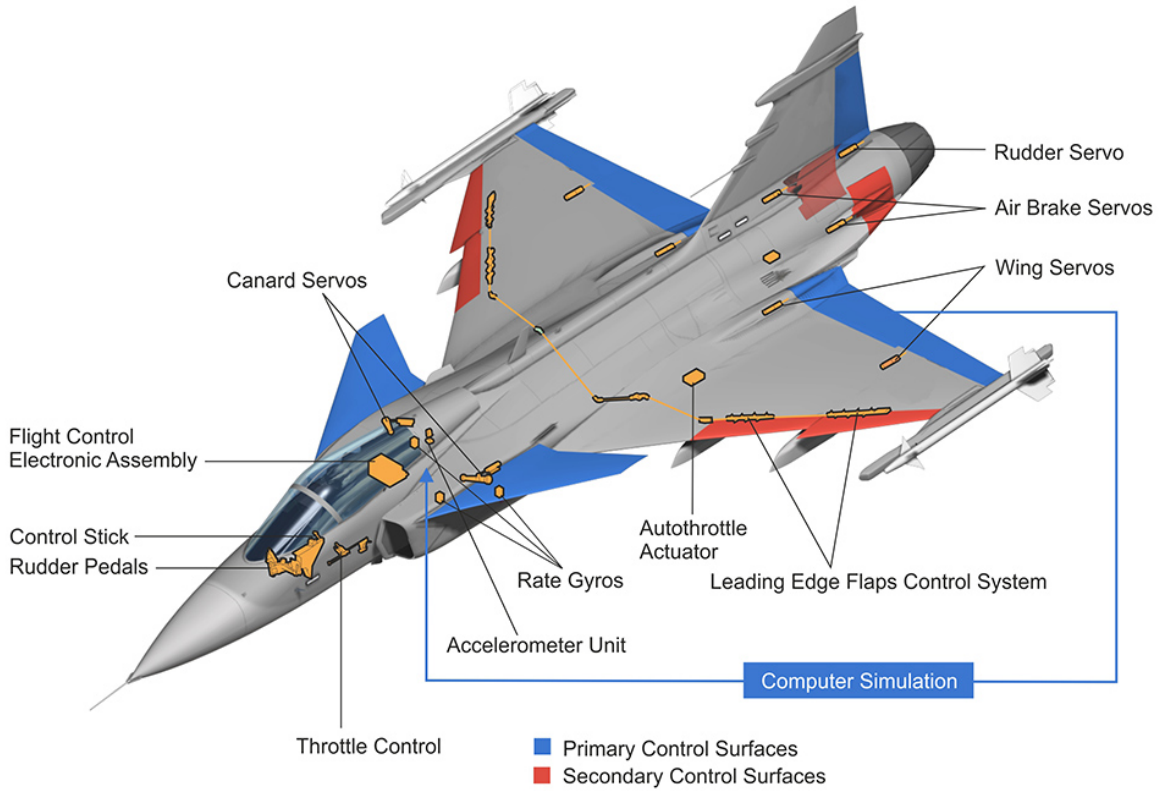


Figure: Saab Gripen - https://saabaircraftindustry.com/

Flight Dynamics and Control 2 - Assessment

- 75% - examination in May/June
- 25% - flight dynamics coursework including exercises on the flight simulators.

Flight Simulation

Flight Dynamics and Control 2 - Course Content I

- General Introduction - References
- Notation & Reference Axes - Co-ordinate axis system and sign conventions
- Control surfaces - definitions & effect
- Strip theory
- Rigid-body equations of motion - 6 DoF
- Inertial terms
- Longitudinal balance
- Elevator angle to trim

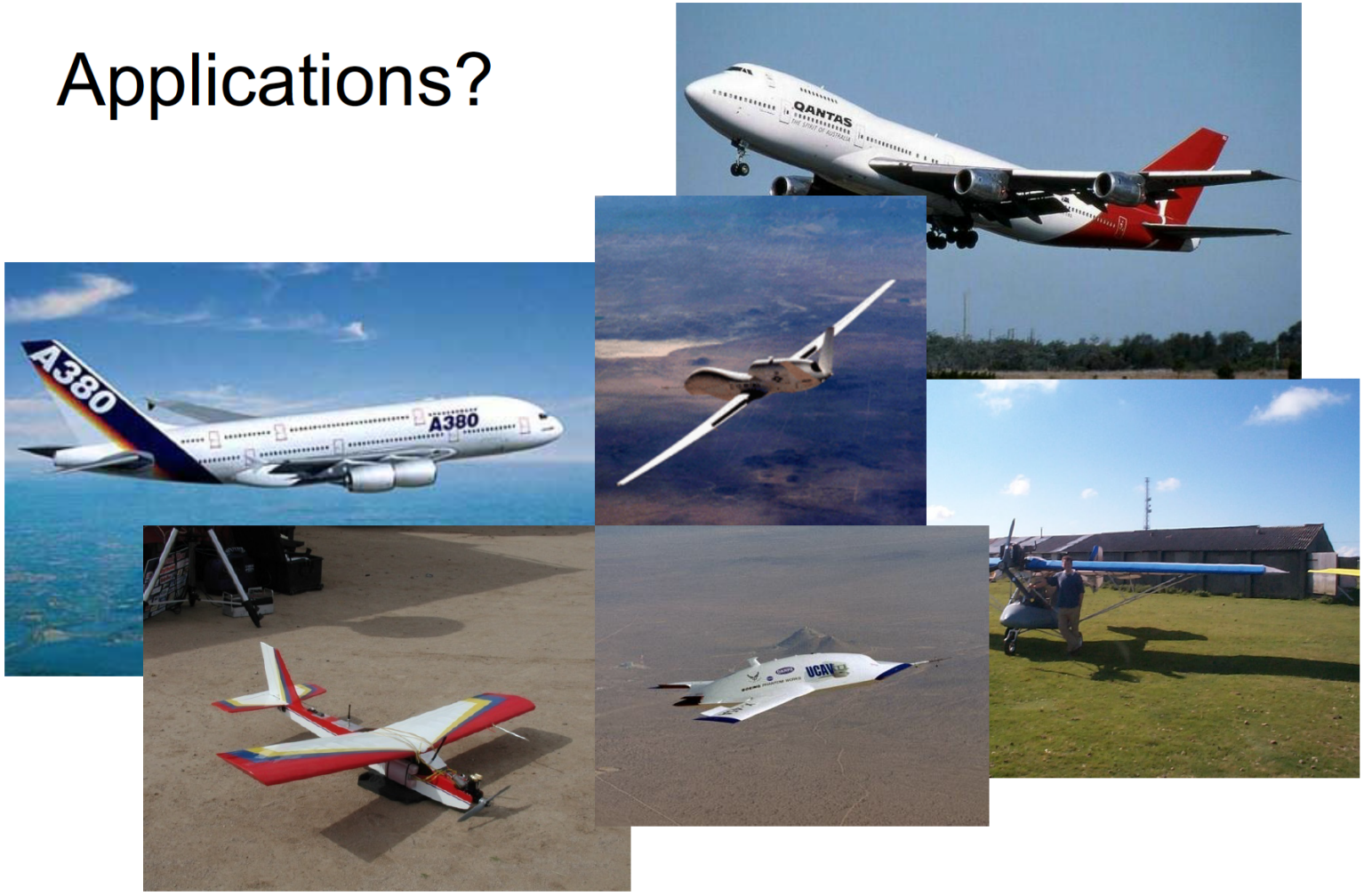
Flight Dynamics and Control 2 - Course Content II

- Static stability and static margin
- Manoeuvre margin
- Trimming & Linearisation
- Aircraft Modes
- Handling Qualities
- Matlab example & Assignment
- Introduction to closed loop control
- Revision lecture

Flight Dynamics and Control 2 - References

1. Etkin, B, Reid, L.D. *Dynamics of Flight, Stability and Control*. Wiley, New York, 2011.
2. McLean, D. *Automatic Flight Control Systems*. Prentice-Hall, Hemel Hempstead 1997.
3. Prouty, R. W. *Helicopter performance, stability, and control*. 2nd edition, Krieger Publishing Company, Florida, 2001.
4. Russell, J.B. *Performance and Stability of Aircraft*. Arnold, London,1996.
5. Cook, M.V. *Flight Dynamics Principles*. Arnold, London, 2012.

Applications?



Suggested Background Reading

Cook, M.V. *Flight Dynamics Principles*. Arnold, London, 2012.

Lecture 1 - *Introduction*

Lecture 2 - *Systems of axes and notation - Earth, Body and Euler axes*

Next Lecture

Reference Axes