

Visit of Northrop Grumman

Systems Engineering/ Engineering Design

12/5/16

Jim Scanlan

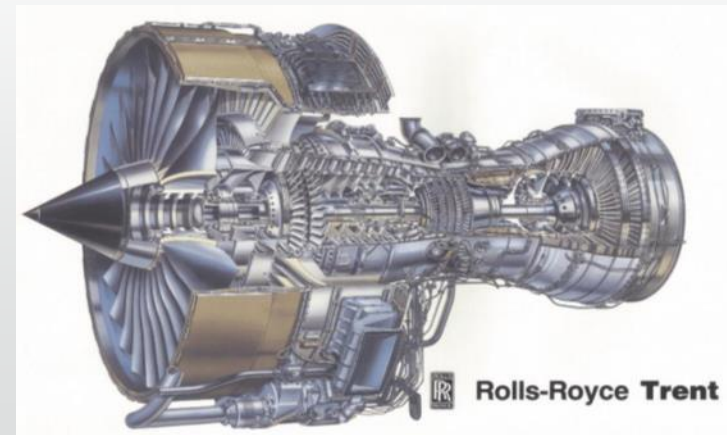


Southampton

- Has eight University Technology Centres;
four aerospace related;
 - Rolls-Royce UTC in design
 - Rolls-Royce UTC in engine noise
 - Airbus UTC in airframe noise
 - Microsoft Institute for High Performance Computing

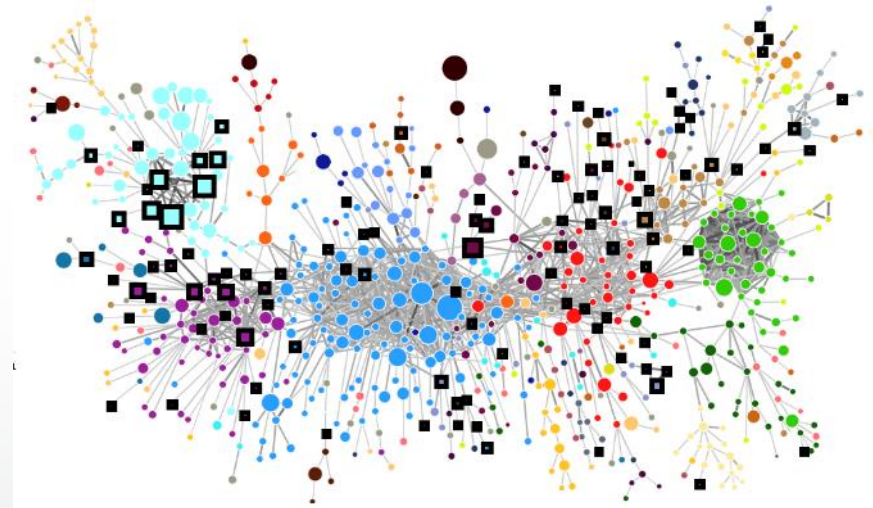


Rolls-Royce

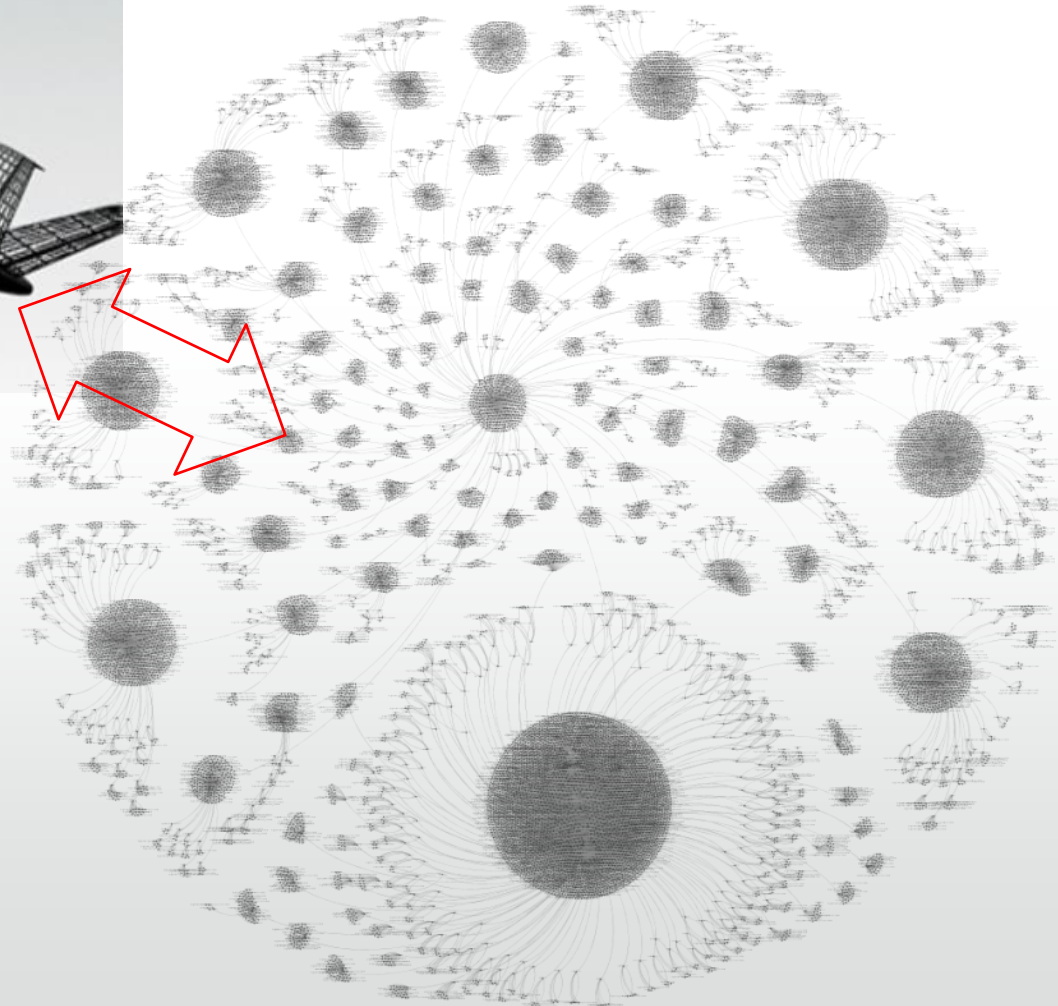


Rolls-Royce UTC in design

- How to **systematically** design...
 - “better” **solutions**
 - more **quickly**
 - with greater **certainty**
-
- Two areas of particular focus.....



“Intelligent” geometry



System

Assembly

Part

Feature

Dimension

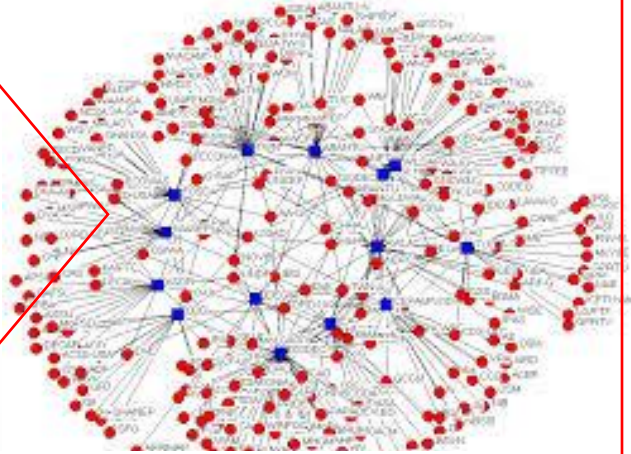
Tolerance

Automated search



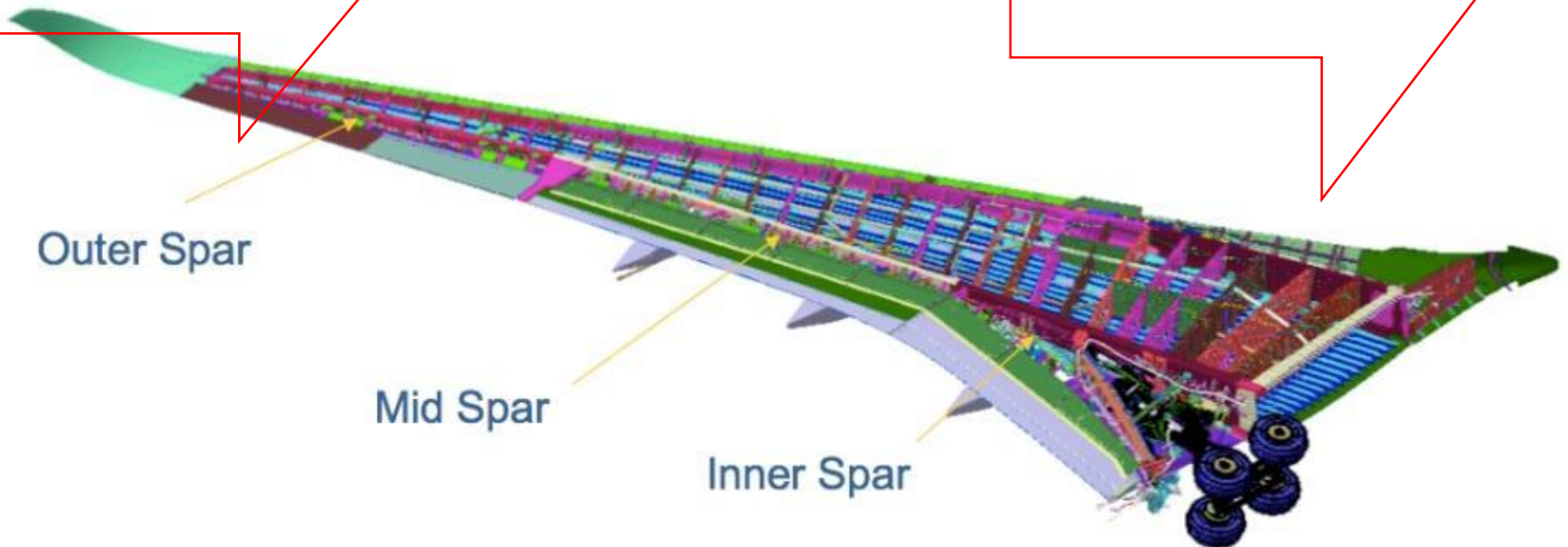
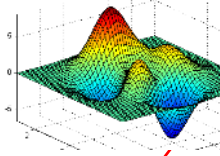
Input Variables

Span
t/c ratio
AR
Skin thickness
Sweep
Taper ratio
....
....



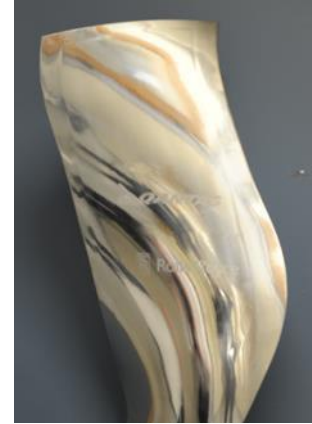
Output Variables

Weight
Stiffness
L/D
Stall behaviour
Critical mach No
Flutter
...



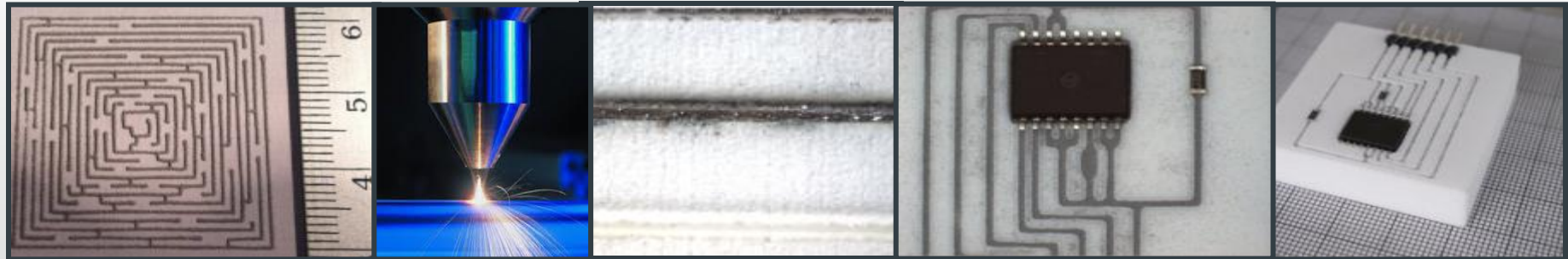
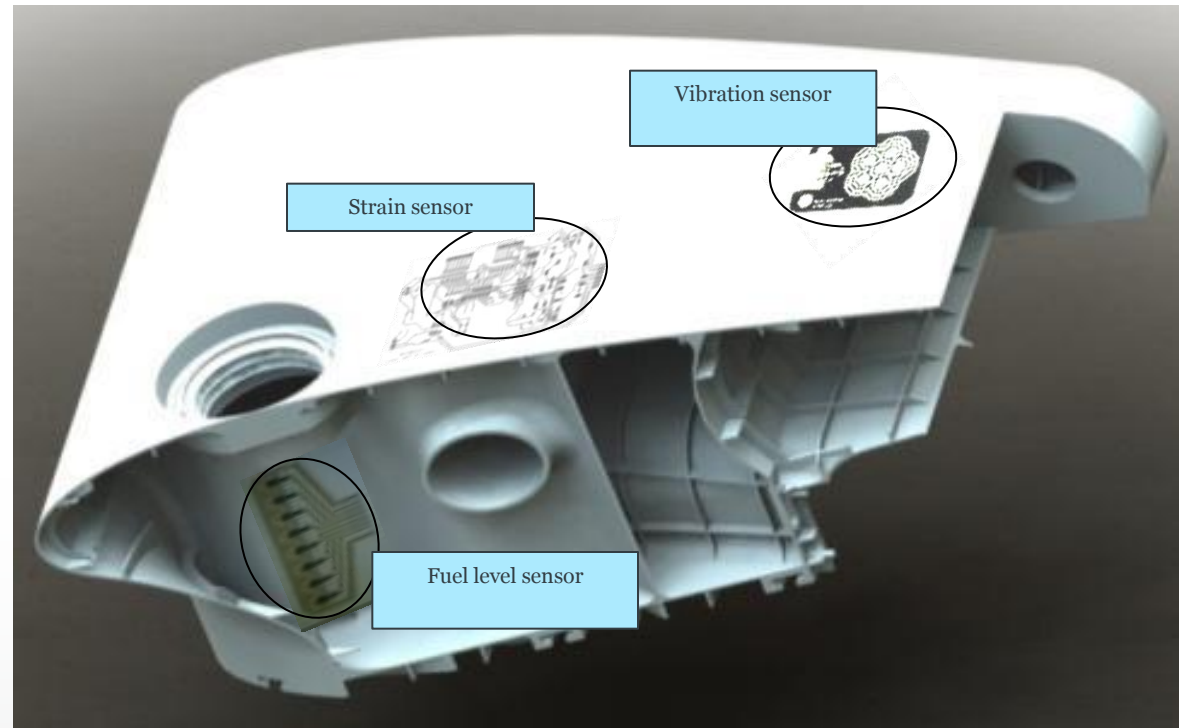
“Micro-Optimisation”

- Use of computers to automatically find the “best” solution
 - Within a time limit
 - Given a computational budget
- Automated search...
 - Manipulate geometry
 - Undertake automated analysis
 - Present results



Strucronics

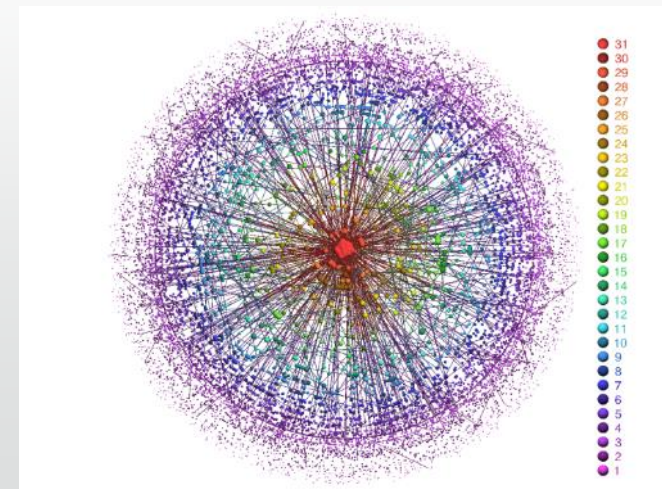
- Print “systems” not just parts
- Multi-material printing
- Structures that contain wiring



“Macro-Optimisation Evolution..

- Constraint satisfaction
- Performance optimisation
- Performance/Unit-cost trade-offs
- LCC optimisation
- Value optimisation
- Supply chain design/optimisation.....
 - BOXARR university (spin-out)

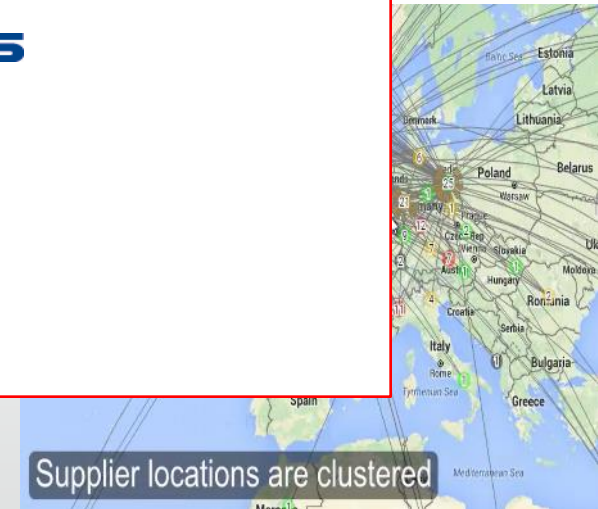
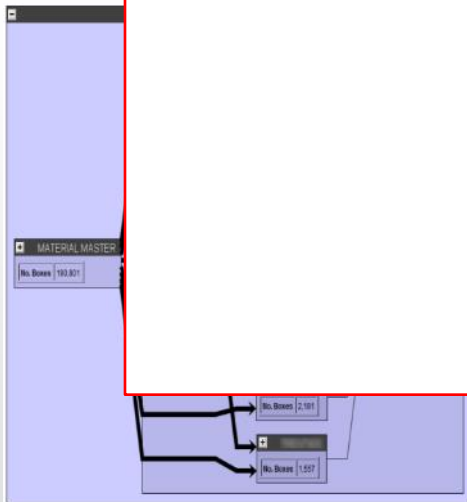
System of Systems



holistic supply chain monitoring, control, and optimisation

mate
ma
da

external
risk data



navigate production system
by product

navigate by suppliers or
plants/facilities

view/analyse on global map
overlays

Thankyou

Questions

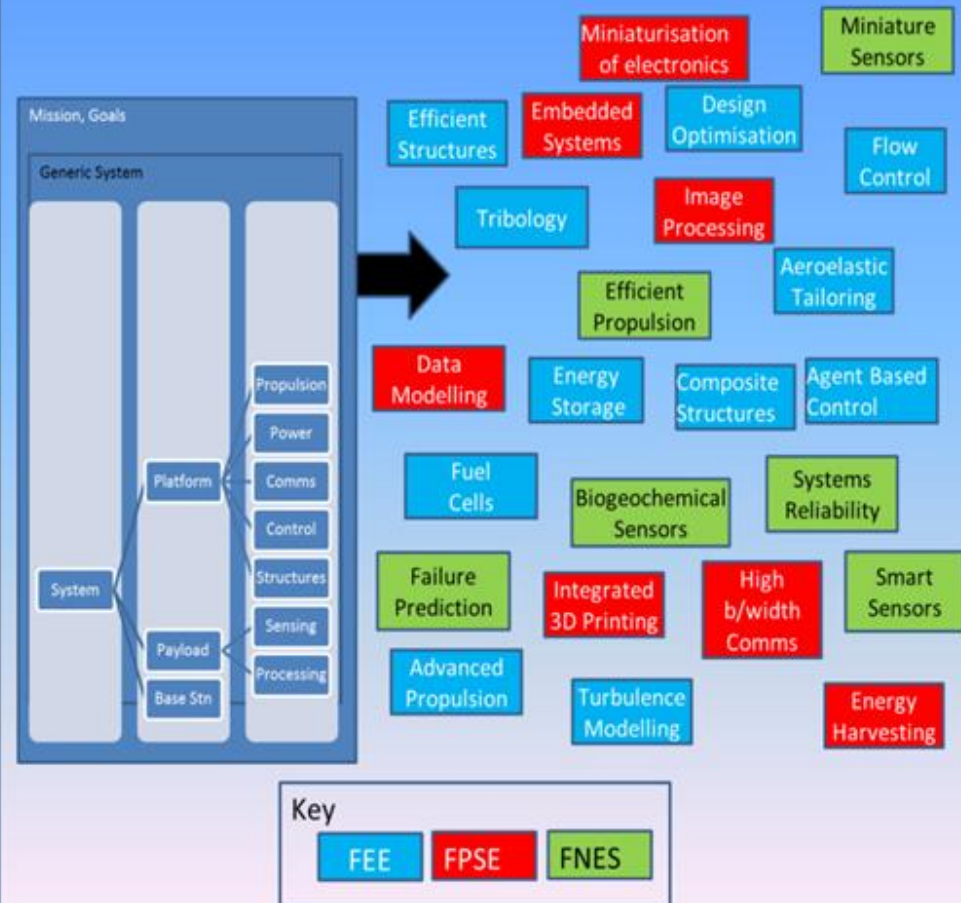
Afternoon session; Next Generation
Autonomous Air Vehicles - in a
congested environment –

Autonomous Systems USRG

Existing Southampton Platform Research



Fundamental Science/ Technology



ASSURE

- Southampton is the first (only) non-US university invited to join the American ASSURE consortium
- ASSURE has just won the FAA bid for the centre of excellence in UAS research
- Substantial multi-year FAA funding

The screenshot shows the ASSURE website, which is the FAA's UAS Center of Excellence for UAS Research. The website features a blue header with the ASSURE logo and the tagline "Alliance for System Safety of UAS through Research Excellence". Below the header is a navigation bar with links to Home, About, Research Projects, Partners, News, and Contact. The main content area displays a large image of a blue UAS aircraft on a tarmac, with the text "The Score: ASSURE: 340 UAS USAF: 316 UAS" overlaid. Below the image is a map of the United States showing the locations of member universities. The map includes logos for various universities, with the University of Southampton highlighted in a red circle. To the right of the map is a list of member universities, categorized into "CORE TEAM" and "AFFILIATE TEAM".

CORE TEAM

- Alabama: UNIVERSITY of ALABAMA in HUNTSVILLE
- Alaska: UNIVERSITY of ALASKA in FAIRBANKS
- Arizona: EMBRY AERONAUTICAL UNIVERSITY-PRESCOTT
- California: UNIVERSITY of CALIFORNIA DAVIS
- Florida: EMBRY RIDDLE AERONAUTICAL UNIVERSITY
- Kansas: KANSAS STATE UNIVERSITY
- Wichita State University
- Montana: MONTANA STATE UNIVERSITY
- New Mexico: NEW MEXICO STATE UNIVERSITY
- North Carolina: NORTH CAROLINA STATE UNIVERSITY
- North Dakota: UNIVERSITY of NORTH DAKOTA
- Oregon: OREGON STATE UNIVERSITY
- Ohio: THE OHIO STATE UNIVERSITY
- Pennsylvania: DREXEL UNIVERSITY
- Alabama: AUBURN UNIVERSITY
- Tuskegee University
- Indiana: INDIANA STATE UNIVERSITY
- Louisiana: LA TECH UNIVERSITY
- Canada: CONCORDIA UNIVERSITY
- United Kingdom: UNIVERSITY of SOUTHAMPTON

AFFILIATE TEAM

- Alabama: AUBURN UNIVERSITY
- Tuskegee University
- Indiana: INDIANA STATE UNIVERSITY
- Louisiana: LA TECH UNIVERSITY
- Canada: CONCORDIA UNIVERSITY
- United Kingdom: UNIVERSITY of SOUTHAMPTON

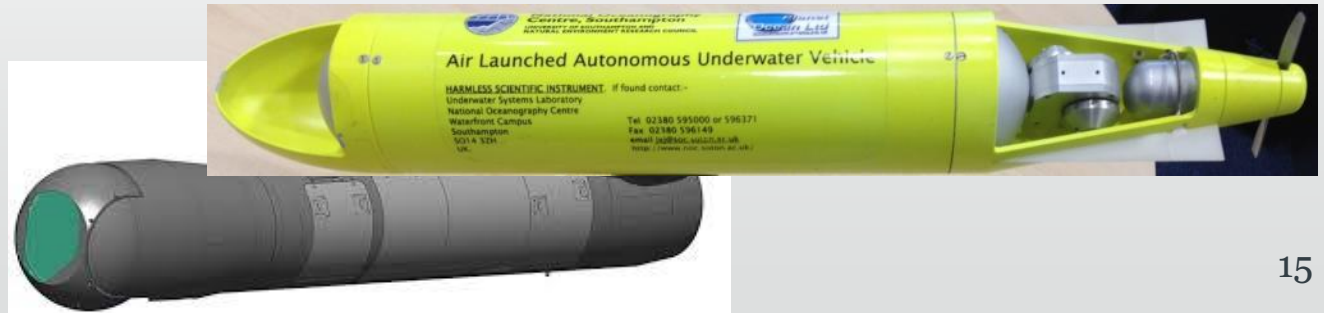
Holistic Systems at Southampton

- Dual redundant autopilot (Southampton Developed)
- Redundant electrical power generation (Southampton Developed)
- Laser height sensor
- Dual data link
- Dual video diagnostics
- Can-bus-based avionics



Low cost platforms for Science/ Civil applications

ATI “AIRSTART”
project
Precision
agriculture
Atmospheric
Science
Pollution
monitoring
Coastal Geology
Search and Rescue
Flood defence
monitoring
Oceanography and
Polar Science
through Agile
Robotic Systems
(OPSARS)



-
- A 3D CAD model of a mechanical assembly, likely a robotic gripper or a similar device. The model is shown in a perspective view with various dimensions and features labeled. Key components include a long, thin, light blue cylindrical part on the left, a central black cylindrical part, and a large, dark grey rectangular block on the right. Dimensions are indicated by pink and blue lines and text. For example, the length of the light blue part is 100 mm, and the diameter of the central black part is 10 mm. The model is mounted on a base with two black wheels.



EPSRC £500k project MAVIS (Massive Airspace Volume Instrumentation System) Vision

Mission/Payload
Definition

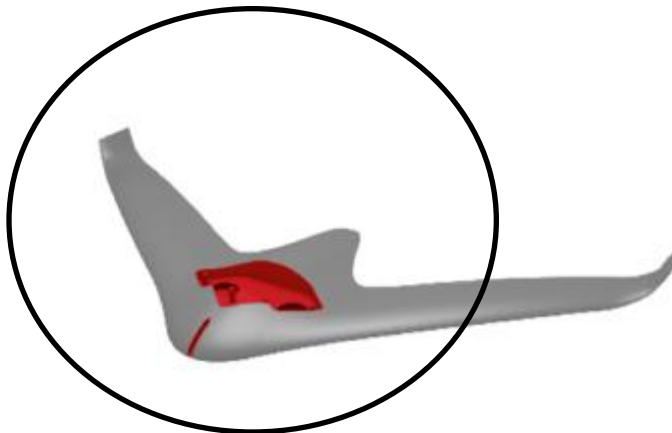


Optimised
Generative
Geometry
Design



Design Process

Flapless control of
Roll, pitch



3D Printed
Fabrication



Innovation Campus

UNIVERSITY OF
Southampton



Opening Ceremonies



UK Research Standing

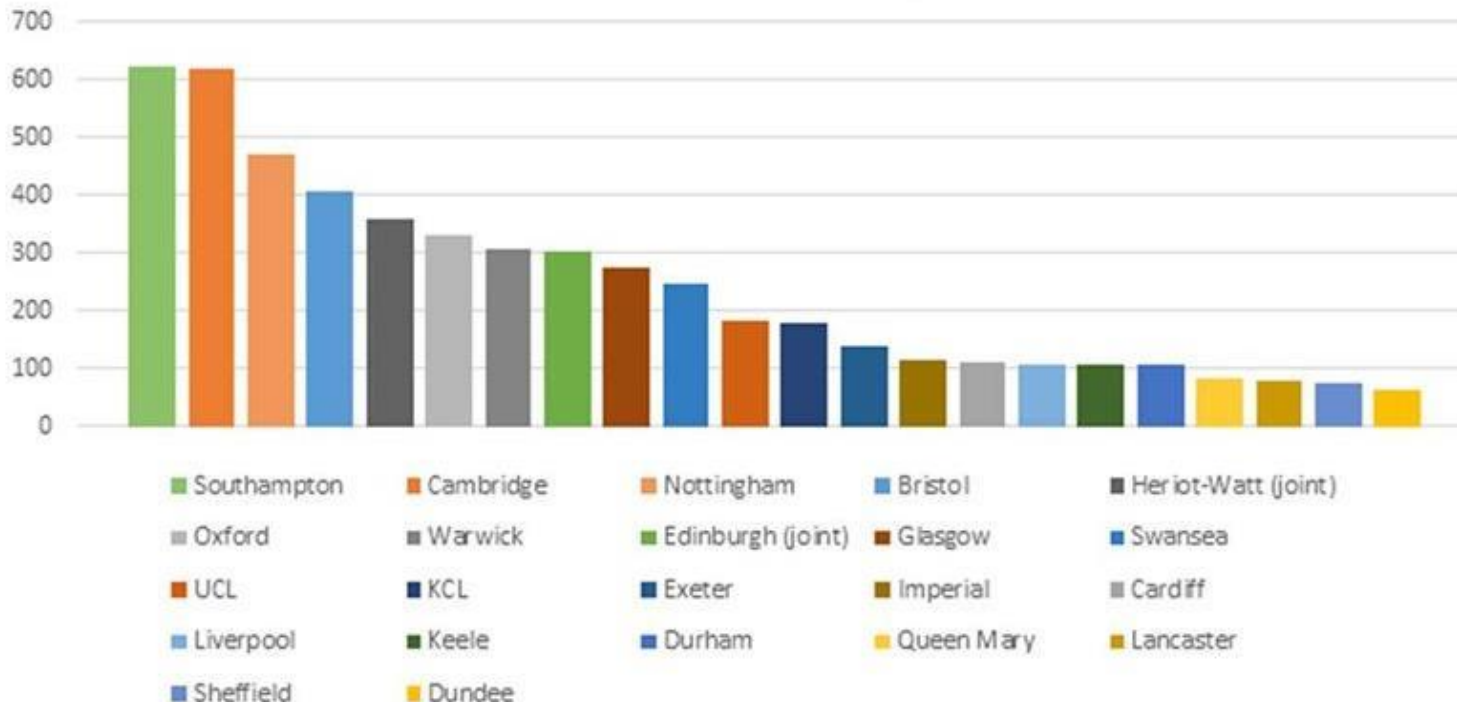
UK universities ranked

Subject area		Engineering: electronic & electrical	How to use these tables »	Find out more about
Rank 2016	Institution	Guardian score/100	Satisfied with course	Satisfied with teaching
1	Southampton	100	93	88.0
2	Surrey	98.4	93.9	94.5
3	Heriot-Watt	95.2	100	93.5
4	Imperial College	93.1	90	88.3
5	Leeds	92.1	93.6	89.5
6	Glasgow	91	95	92.2
7	UCL	89.7	90.1	84.4
8	Strathclyde	89	94.9	89.3
9	Manchester	88.3	90.1	86.6
10	City	87.5	88.9	93.2
10	Edinburgh	87.5	88.9	93.2
12	Exeter	86.6	88.9	93.2
13	Cardiff	86.6	88.9	93.2

UK universities ranked

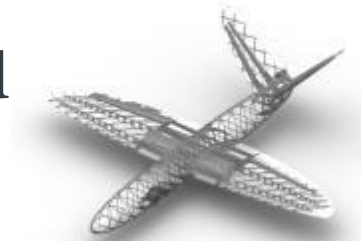
Subject area		Engineering: mechanical	How to use these tables »	Find out more about studying engineering:		
Rank 2016	Institution	Guardian score/100	Satisfied with course	Satisfied with teaching	Satisfied with feedback	Student staff ratio
1	Imperial College	100	87.1	86.4	69.4	17.3
1	Leeds	100	96.0	93.8	87.6	18.5
3	Bath	99.6	97.8	95.1	83.7	20
4	Southampton	99.5	88.3	85.4	63.7	9.1
5	Sunderland	96.1	86.1	91.7	83.4	14.2
6	Birmingham	94.3	88.1	81.5	74.8	21.3
7	Dundee	92	100	97.0	82.4	14.5
8	Cardiff	91.5	92	89.5	71	17.5
9	Loughborough	90.6	88.2	85.1	66.8	11.6
10	Heriot-Watt	90.4	96.0	94.5	72.6	16.7
11	Bristol	88.6	87.9	86.3	54.4	14.2
12	Nottingham	88.5	93.1	88.3	66.7	16
				76.3	66.6	11.8
				92.8	84.1	14.5
				86.1	57.0	20.1

top 22 Universities in General Engineering



Printed UAVs

- World's first 3D printed aircraft



MSc course in Unmanned Aircraft Systems Design

- The only such course in the UK
- CAA approved Pilot training
- In its fourth year
- Cohort size of 15-20 students per year
- Strong EU/UK recruitment



Other UAS Activity

Next Generation Unmanned Systems Science (NEXUSS) Doctoral Training Centre in Smart and Autonomous Observation Systems (SAOS)

University of Southampton University

NEXUSS: NEXt generation Unmanned System Science



- NERC/ EPSRC Doctoral Training Centre in Smart and Autonomous Observation Systems (SAOS) for the environment
- Annual multi-platform “Grand-challenge”



Thorney Island

- Possible Aerial/ Marine Robotics testing facility
- Convenient; 40 mins away
- Secure
- Remote
- Good access to sea
- Presentation to Lt Col Gary Jones Feb next year
- Needs careful management of the relationship



Teaching

- Challenge ; to teach “Systems Engineering” effectively
- “Learn by doing”
 - Year 1; design a part
 - Year 2; design a mechatronic system (design, build, test)
 - Year 3; design an aircraft/ IP
 - Year 4; Group design, build, test



Fourth Year Group Project

UNIVERSITY OF
Southampton

- Two design iterations
- April “air display”



Achievement

- Inaugural winners of UAS challenge
- NOTE IMechE not RAeS!



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SOUTHAMPTON UNIVERSITY ENGINEERING STUDENTS WIN GAME OF DRONES

The UAS Challenge ignited students' enthusiasm for aerospace engineering and celebrated the legacy of engineering heroes.

By **Institution News Team**

July 23, 2015



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The Institution's inaugural **Unmanned Aircraft Systems (UAS) Challenge** saw 14 university teams design and build their prototype Unmanned Aircraft Systems over a

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Autonomous Systems field work facilities

UNIVERSITY OF
Southampton



University Research

ARGUS; Aerial Robotics Group for Universities and Scientists

UNIVERSITY OF
Southampton

- Part of the wider EPSRC RAS network
- First meeting; Parc Aberporth September
- November meeting Southampton
- Major event summer 2016



ARGUS Goals

- Share experience in the development of platforms
- Share experience in the use and operation of platforms
- Act as a focal point in dealing with the CAA and for getting permissions for research
- Act as a lobbying group for future research funding and resources
- Collaborate in facilitating undergraduate competitions (such as the recent IMechE UAV competition)
- Share experience in the use of Aerial Robotics for teaching undergraduate topics such systems engineering, control, comms, data management etc



Some current research



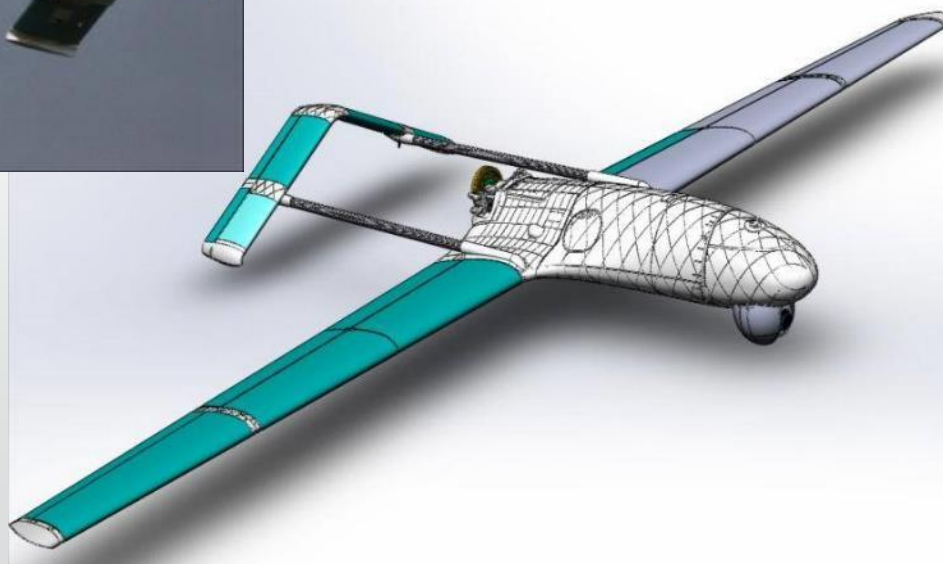
Flight test auto tracking

- Collaboration with Bradley Engineering, Brockenhurst
- Routinely record all flight tests
- Dull manual activity
- Now automated; algorithm written by QinetiQ sponsored PhD student
- Next; auto zoom



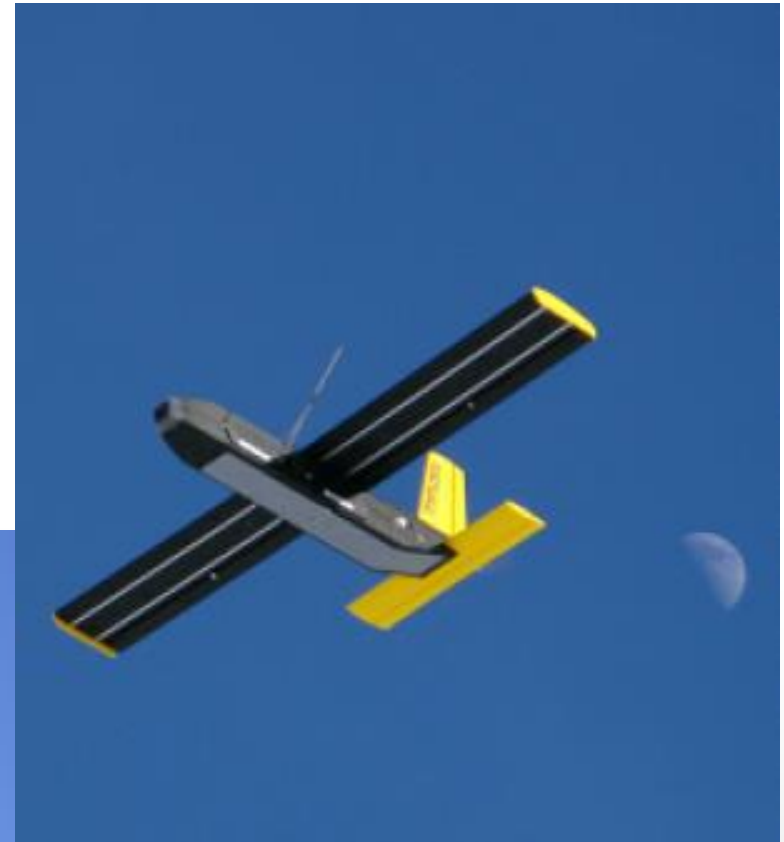
Firsts at Southampton

- UK's first >20kg CAA civil permit



Firsts at Southampton

- UK's first civil BLOS flight



Firsts at Southampton

- AETHER: UK's first tethered UAV



Firsts at Southampton

- Worlds first “Smart” paper aeroplane



Finally: a Future Research strand



Thankyou

Jim Scanlan