



# Structures

Economic and environmental considerations dictate that aerospace structures be as lightweight as possible. Increasingly stringent safety standards and/or performance requirements require the aerospace industry to guarantee structural integrity of its products under normal and abnormal operating conditions. Hence, the static and dynamic analysis of aerospace structures is of paramount importance.

The structures theme is covered by four groups of specialist research areas comprising researchers of international standing.

## **Dynamics and Aeroelasticity**

Fundamental and industrially applicable research and consultancy in many aspects of dynamics, smart structures and aeroelasticity.

## **Impact and Explosion**

The effects of impact and explosion need to be considered in the material selection and the design of many civilian and military aerospace structures.

## **Stress Analysis, Composite Materials and Structures**

Stress analysis of mechanical and aerospace structures under static and dynamic loads, in particular, structures of composite materials.

## **Structures and Fire**

Delivery of safe and efficient structures under normal and extreme loading conditions.

- Research projects in this area have been sponsored by the EU, US Air Force, BAE Systems, Rolls-Royce, Airbus, Corus, Arup, CIDECT and EPSRC

# Research areas

- Structural vibration (including modal testing, non-linear identification, computational analysis and experimental validation, rotor dynamics)
- Aeroelasticity
- Damping
- Human-structure dynamical interaction
- Smart materials / structures
- Behaviour of engineering materials at high strain rates and computational mechanics of impact, explosion and fire effects
- Crashworthiness of aircraft/space vehicles
- Crash barriers and energy absorbing devices
- Safety of aircraft and space vehicles (impact of taking-off debris, space debris and explosion)
- Weapon effects (ballistics, detonation, penetration and perforation)
- Protective technology (protective construction, vehicle armours, body armours) against natural disasters, military attacks and terrorist threats
- Characterisation and micromechanics of composite materials and structures, such as textile composites
- Structural engineering and structural analysis under extreme loading conditions, such as blast and fire (including damage laminated composites)
- Design and analysis of pressurised vessels, such as pipework
- Effects of various material and structural nonlinearity
- Fire safety

# Research facilities

## Dynamics and aeroelasticity

- 5 HP systems with LMS test/analysis software and DIFA SCADAS front ends (max 48 channels)
- A variety of data acquisition systems and other associated vibration test hardware
- Access to a range of wind tunnels
- Various test rigs, including a rig for studies of human-structure interaction and an aeroengine bearing test rig

## Impact and explosion

- A range of drop hammers
- Single stage, high pressure gas gun facility
- Two stage light gas gun facility

- Explosion containment vessels
- High speed digital camera up to 107pps and 10 pictures
- High speed electro-optical non-contact displacement transducer system
- A range of transient digital data recorders (1MHz-1GHz) and ancillary equipment

## Structures and fire testing

- Static and dynamic testing facilities with large strong floors
- High tensile compression and bending test machines
- Large, medium and small furnaces for structural fire testing
- Cone calorimeter
- Various electrically heated kilns

# Relevant postgraduate study

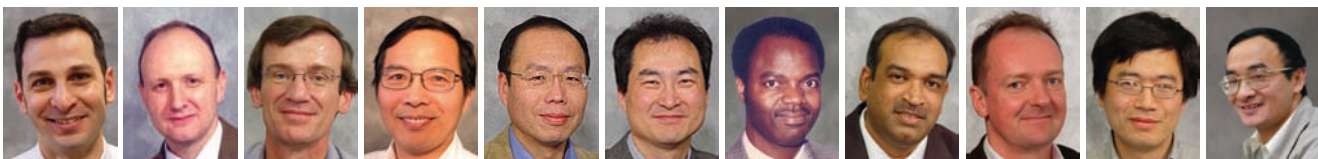
## MSc in Mechanical Engineering Design

This Masters combines elements of engineering analysis with design synthesis to develop problem solving ability. The combination of creative thinking and in-depth engineering analysis to demonstrate feasibility is a key feature.

## Research degrees

PhD and EngD (in collaboration with Rolls-Royce) and significant contribution from and collaboration with companies.

# Academic staff



Dr P Bonello Professor C Bailey Dr K Davey Dr T Ji Dr Q Li Dr S Li Dr O Oyadiji Dr J Sinha Mr T Swailes Dr H Tan Dr Z Wu

Dr H El-Sobky  
Dr A Tafreshi  
Dr Y Wang  
Dr Z Zou

# Contact details

Dr Philip Bonello, Structures Theme Leader  
structures@manchester.ac.uk  
www.umari.manchester.ac.uk/research/areas/materials/structures

The University of Manchester,  
Oxford Road, Manchester M13 9PL  
Royal Charter Number RC000797 J1529L 09.07  
[www.manchester.ac.uk/umari](http://www.manchester.ac.uk/umari)