UNIVERSITY OF NEW SOUTH WALES, (UNSW)

Sections of UNSW relevant to COE

Faculty of Engineering, Kensington, Sydney

School of Mechanical Engineering*

School of Electrical Engineering
School of Chemical Engineering
School of Bio-medical Engineering

Faculty of Science, Kensington, Sydney

School of Material Science & Engineering

Australian Defence Force Academy, Canberra

School of Mechanical Engineering*

*** Some proposals identified**

UNIVERSITY OF NEW SOUTH WALES, UNSW

School of Mechanical Engineering

Relevant facilities	Some major equipment
➢ CFD, Finite element	3 computer rooms
➢ Refrigeration and AC	Controlled ambient chambers
➢ IC Engines	450, 250, 230, 165 kW dynamometers
➢ Heat transfer	Solar thermal test equipment
➢ Aerospace	3.3x3.3 m subsonic, 100x75 mm M3 tunnels
➢ Noise and vibrations	Full size reverberation rooms
➢ Hydraulics	Two phase flow rigs
➢ Mechatronics	2 laboratories, diverse equipment
➢ Materials	25 tonne universal test machine
➢ Wind tunnel	Ground effect wind tunnel

SOME POSSIBLE COLLABORATIVE PROJECTS WITH UNSW, COE

- The following projects have been identified for possible collaboration

- Further projects are being considered

Control of Liquid Jets Operating in the Rayleigh Mode

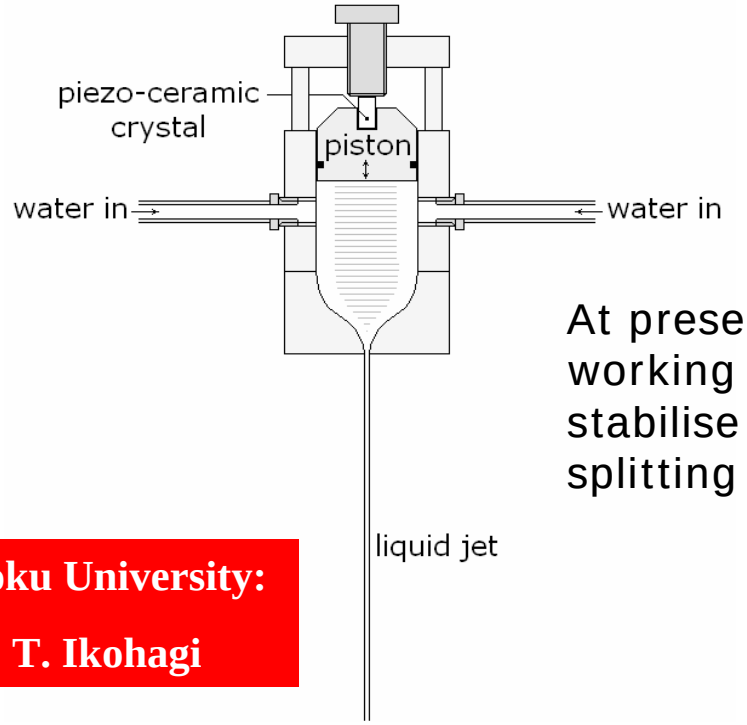
For Section 5: International collaborative research on on Flow Control in Transdisciplinary Field

Dr John Olsen: School of Mechanical and Manufacturing Engineering, UNSW, AUSTRALIA.

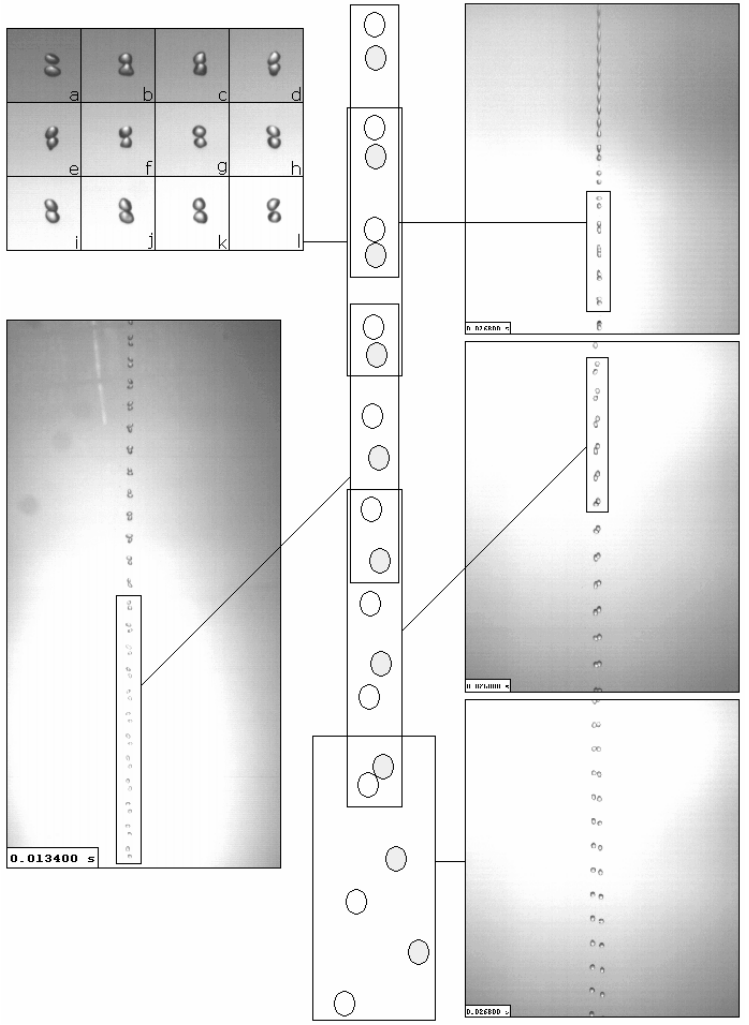
This work is concerned with using periodic excitation to control the break-up of liquid jets and the subsequent interactions that occur between drops, downstream of the break-up location.

The collisions between drops can cause the jet to split into two streams as revealed by a high-speed camera. →

↓ The experimental facility.



At present, we are working on ways to stabilise this jet splitting mechanism.



Tohoku University:

Prof. T. Ikohagi

• Numerical and Experimental Study of Rarefied Flow

For Section 9: Development of Next-generation, High-resolution Numerical Methods for Fluid Dynamics

Dr. Tracie Barber : School of Mechanical and Manufacturing Engineering, UNSW.

- For high Knudsen number flows (such as those experienced by a rocket at high altitude), the usual Computational Fluid Dynamics equations - the Navier Stokes equations - are invalid.

- In order to solve this problem numerically, a new approach has been developed, based on the solution of the Generalised Hydrodynamic equations.

- This existing code will be further developed and utilized for cases involving rocket plume analysis.

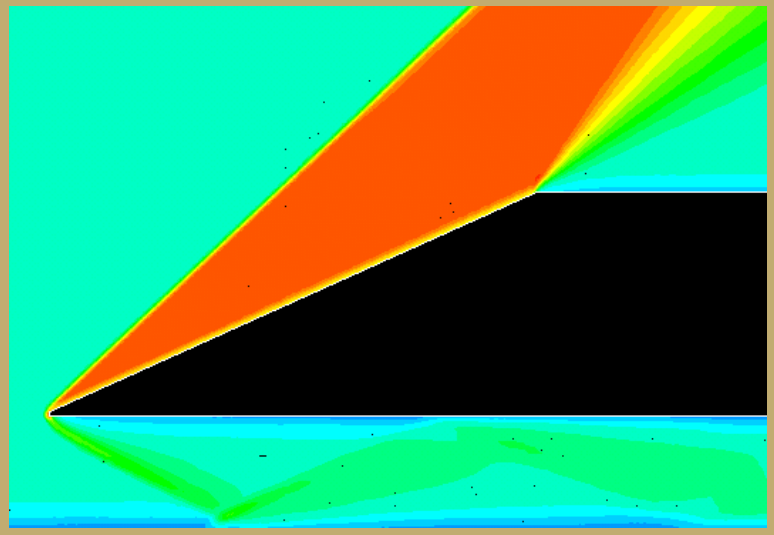
- Preliminary experimental work has been completed at UNSW-ADFA, using the hypersonic facilities with an injection system. This facility may be used in the current project to provide experimental validation for the code.

Supersonic Ground Effect

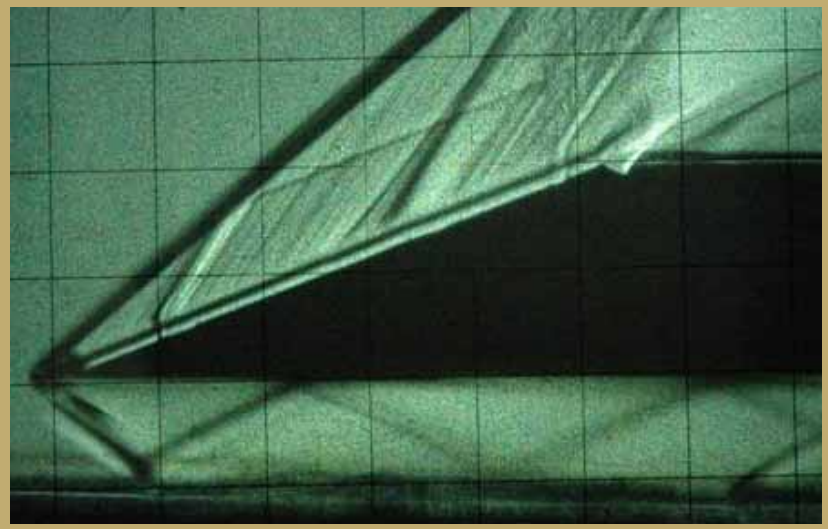
For Section 17: Investigation of Shock Wave Phenomena in Complex Media and its Interdisciplinary Applications

Dr. Tracie Barber : School of Mechanical and Manufacturing Engineering, UNSW.

- Applications: military; land speed record attempts
- Project: Using CFD and supersonic wind tunnel tests, the shock/ground interaction will be studied for a range of Mach numbers, from high subsonic, through transonic and supersonic.



1. CFD density contours



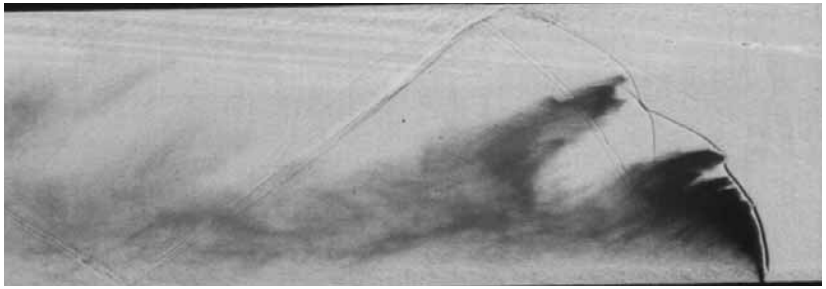
2. Schlieren shock waves

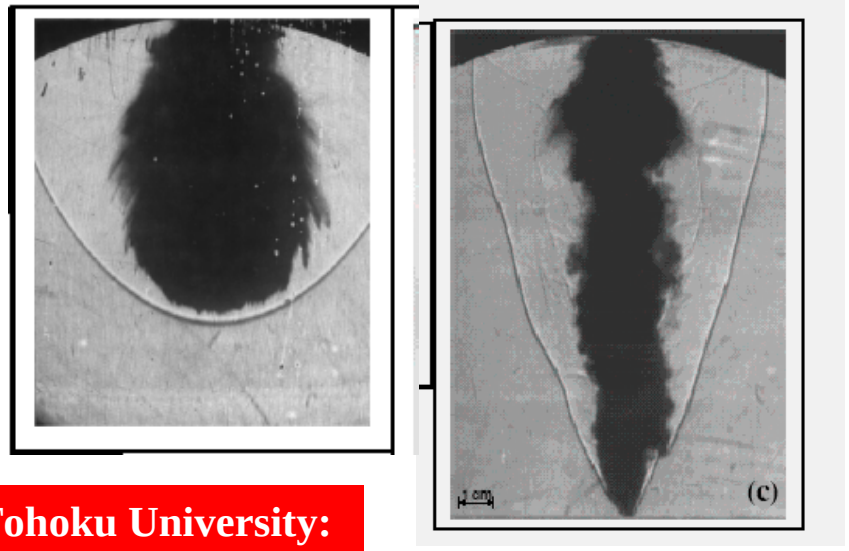
Liquid Fuel Jets Injected Into Supersonic Airstreams

For Section 17: Investigation of Shock Wave Phenomena in Complex Media and its Interdisciplinary Applications

Prof. Brian Milton, Dr John Olsen, Assoc.Prof. Noor Ahmed, .

School of Mechanical and Manufacturing Engineering, UNSW, AUSTRALIA.





Tohoku University:

Prof. K. Takayama

Scramjet combustion requires rapid mixing of fuel and air.

Liquid fuels have energy density advantages over gaseous fuels (hydrogen)

Intermittent (pulsed) injection has mixing rate advantages over steady injection

Previous work at UNSW:

Subsonic liquid jet into supersonic air (Milton & Archer) , Top picture

Supersonic liquid injection into quiescent air (Milton, Behnia, Takayama, Pianthong), Low and high supersonic jets, left, right pictures.

New project:

Supersonic jets into supersonic airstreams

Mixing of Diesel and Natural Gas Fuel Jets

For Section 12: Effective Utilisation of Natural Energy to Develop Environmental-compatible Energy Systems

Or for Section 1: Flow Optimisation of Vehicles in Relation to Greenhouse Problems

Prof. Brian Milton, Dr John Olsen, Prof. M. Behnia
School of Mechanical and Manufacturing Engineering, UNSW, AUSTRALIA

Use of natural gas in diesel engines has benefits for greenhouse gases, local emissions and fuel resources

It is difficult to use because of its low cetane number

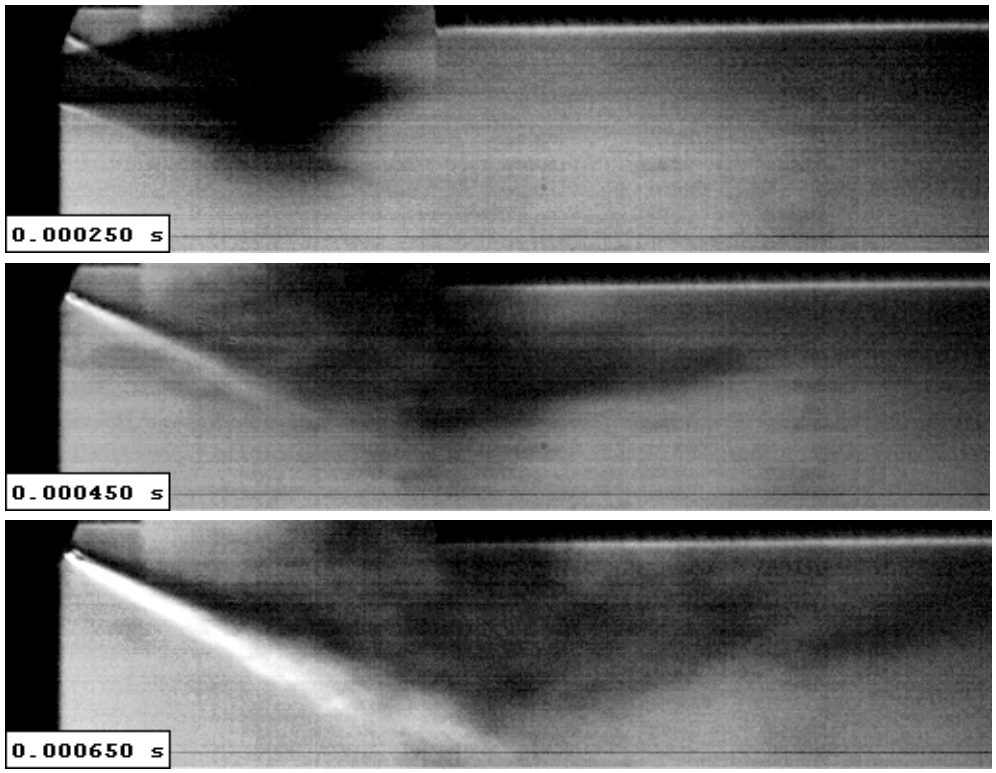
A mixing system to introduce it directly into the engine cylinder together with pilot diesel fuel is being investigated

After start of diesel injection

Injection time from top
0.25 ms, 0.45 ms, 0.65 ms

Converging (at 12.5º) diesel and gas jets

Gas jet starts 0 ms after diesel jet



Buoyancy-induced Air Flow/Heat Transfer Analysis In Double-skin Facades

For Section 14: Materials and Design for Sustainable Development

Prof. Eddie Leonardi, Dr. Victoria Timchenko

School of Mechanical and Manufacturing Engineering, UNSW.

Figure1. Hybrid double skin facade

A numerical study of multifunctional building facades designed to reduce energy consumption of buildings will be conducted.

Of particular focus will be double-skin facades with energy combined components such as photovoltaic-thermal (PV-T) systems. The most efficient use of solar energy collecting surface is targeted in terms of both electrical conversion and air heating or cooling.

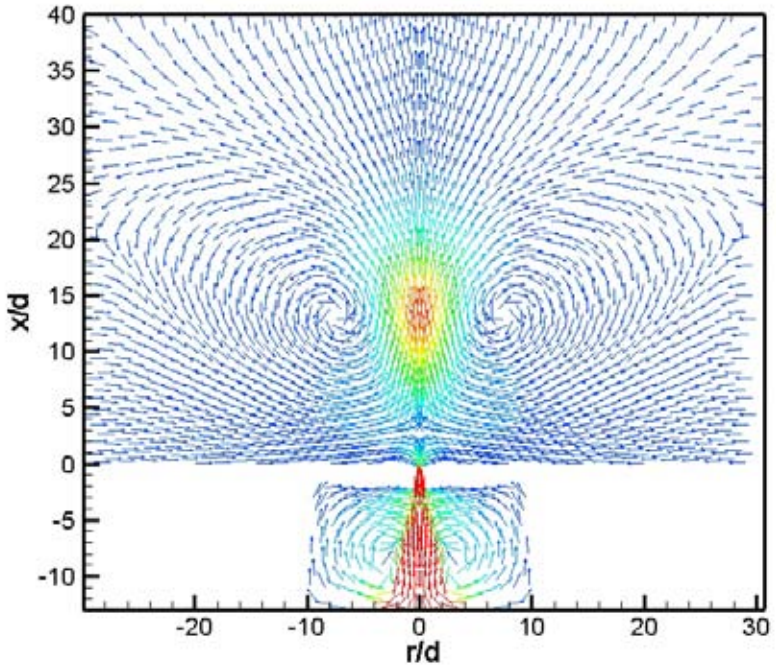
Past studies identified a lack of knowledge of the thermal characteristics of air channel which utilize natural convection.

The Effect Of Forcing Frequency On Synthetic Jet Actuators

For Section 20: Elucidation of Thermo-Fluid Dynamics in Microscale Devices

Prof. Eddie Leonardi, Prof. John Reizes, Dr. Victoria Timchenko

School of Mechanical and Manufacturing Engineering, UNSW.



Synthetic jets actuators are zero net-mass flux devices and their application stretch from mixing and enhancing heat transfer to flow control.

Despite the fact that a large amount of work has been undertaken both experimentally and numerically, little is understood about compressibility of gases and therefore the effects of velocity of sound and the forcing frequency.

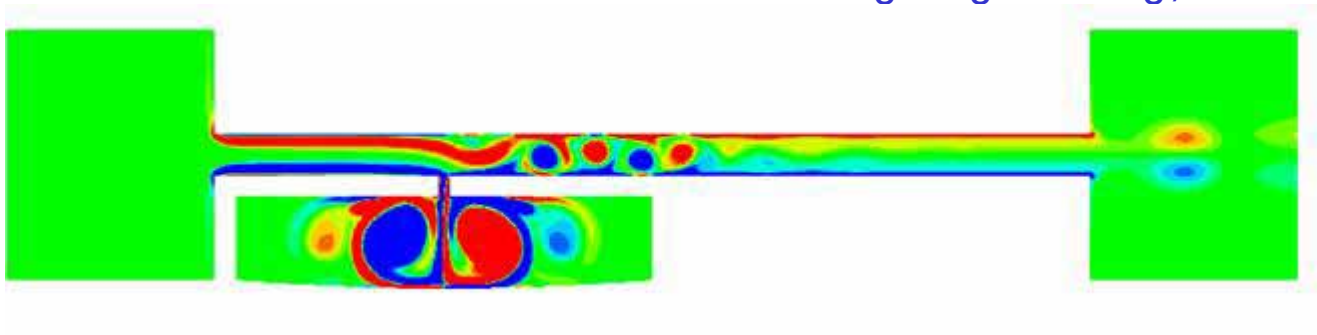
The aim of this project is to determine the effect of the forcing parameters of the actuator and relate it to the geometry and natural frequency of the cavity.

The Effect Of Synthetic Jet Actuators On The Convective Flow In Micro-channels

For Section 20: Elucidation of Thermo-Fluid Dynamics in Microscale Devices

Prof. Eddie Leonardi, Prof. John Reizes, Dr. Victoria Timchenko

School of Mechanical and Manufacturing Engineering, UNSW.



Since the flow regime in micro channels is invariably laminar, the heat transfer rate is much lower than in turbulent flow and needs to be enhanced to dissipate the necessary large amount of heat generated in integrated electronic devices.

Because conventional jet impingement cooling requires a source of pressurised fluid, plumbing and complex fluid packaging, the alternative of using synthetic jets in micro channels has been suggested and partially explored.

The aim of this project is to optimise the location and strength of the synthetic jet so as to maximise the heat transfer.

Blast Wave Attenuation By Porous Media

For Section 17: Investigation of Shock Wave Phenomena in Complex Media and its Interdisciplinary Applications

Dr. Harald Kleine Australian Defence Force Academy, UNSW, AUSTRALIA

The effective attenuation of blast waves is a topic of continuing interest.

Results of different investigations are often inconsistent and contradictory, as it is difficult to control all parameters of the problem accurately.

Benchmark tests for blast and shock wave interaction with porous screens, to be conducted both in adequate shock tubes and with small explosive charges. The project includes the experimental determination of short- and long-term pressure reductions by means of spatially and temporally resolved pressure measurements and time-resolved visualisation as well as numerical simulation of the process.

Shock tube experiments:
To be conducted at UNSW and Tohoku University

Explosive testing:
To be conducted at Tohoku

CFD:
To be conducted at UNSW and Tohoku

Tohoku University:

Prof. K. Takayama

Cooperative Control of Multiple Autonomous Unmanned Aerial Vehicles

For Section ??: To be determined,

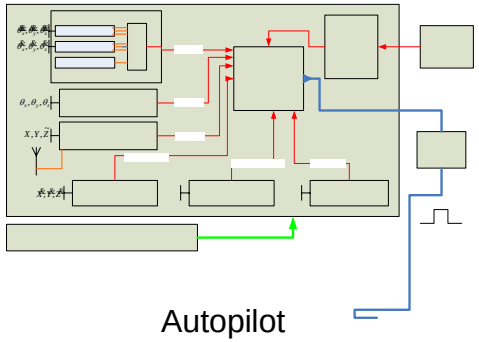
Dr Tomonari Furukawa, School of Mechanical and Manufacturing Engineering, UNSW

Proposed areas of study

- Dynamics and control of Unmanned Aerial Vehicles (UAVs)
- Decentralised architecture for cooperative data fusion and control
- Development of UAVs
- Development of autopilots for autonomous control
- Development of hardware-in-the-loop system

Cooperation of UAVs

Development of UAVs



Autopilot

Micro Aerial Vehicles

For Section ??: To be determined,

Dr Tomonari Furukawa, School of Mechanical and Manufacturing Engineering, UNSW

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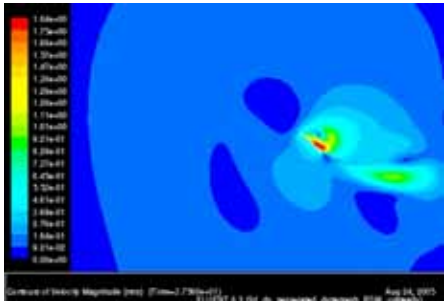
Proposed Areas of Study

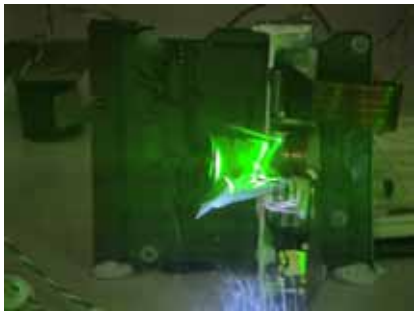
- Low Reynolds number aerodynamics
- Simulation and visualisation
- Multi-mobility of MAVs
- Optimal control and flapping motion
- Micro sensors and micro actuators
- Sensor fusion and control
- Development of MAVs
- Remote and autonomous control
- Localisation and mapping

Urban search-and-rescue as possible application

Development of MAVs



Simulation of aerodynamics



Visualisation of aerodynamics

How To Achieve Collaboration

Difficult at present. Despite booming economies in developed countries, governments are increasingly oriented towards private affluence and public squalor

➢ **Staff exchange:**	**Short duration (up to 6 months) possible, funded by individual universities**
➢ **Research student exchange:**	**Need longer duration, but funding difficult. Requires special grants**
➢ **Facilities:**	**Need to optimise shared facilities on individual programs. Joint grant applications need to consider appropriate placement of facilities**
➢ **Government grants:**	**Cooperation on applications with international background required by COE, with support from all memebers**
➢ **Industrial Support**	**Identify commercial prospects**