

 IITB-Monash  
Research Academy

An Indian-Australian research partnership



Indian Institute of  
Technology Bombay



MONASH  
University

[www.IITBMonash.org](http://www.IITBMonash.org)

Delivering solutions to complex research problems

Against a backdrop of large-scale multinational investment, an increasing number of corporations and governments from around the world are turning to India for Research & Development. The IITB-Monash Research Academy provides industry partners with the opportunity to conduct high impact, outcome driven research.

## IITB-Monash Research Academy

The IITB-Monash Research Academy is an exciting joint venture between two of the world's leading educational institutions undertaking multidisciplinary research in six niche areas: Advanced computational engineering, simulation and manufacture; Infrastructure engineering; Clean energy; Water; Nanotechnology; and Biotechnology and stem cell research.

## Opportunities for business, government and educational institutions

**The Research Academy is committed to developing innovative solutions to research problems, providing flexible service delivery responsive to partner needs.**

### **Key services include:**

- Outsourced R&D
  - Contract
  - Sub-contract
- Collaborative research
- Consultancy projects
- Joint ventures
- Support and incubation of start-ups or established company spin-offs
- Provision of sponsored PhDs - access to India's leading students, who are capable of undertaking research that focuses on your business needs
- Research training that can be provided on a cohort exchange or contract basis

## Academy strengths

### **Undertake R&D at the Research Academy in India to take advantage of:**

- **The global reputations** of IIT Bombay and Monash University, which attract high quality research students
- **Expertise and facilities** provided by two world-class institutions
- **Co-location with IIT Bombay** with direct access to the Institute's facilities and resources
- **Flexible research service delivery** such as contract, collaborative and joint ventures
- **Project and outcome driven research** undertaken to develop relevant, innovative research solutions
- **Location within the commerce hub of Mumbai** - a gateway to research and development networks
- **The use of English** as the common language of business and science

# Areas of research and expertise

The research undertaken by the Research Academy takes into account the demands of business, industry and government. Research focuses on six key themes.

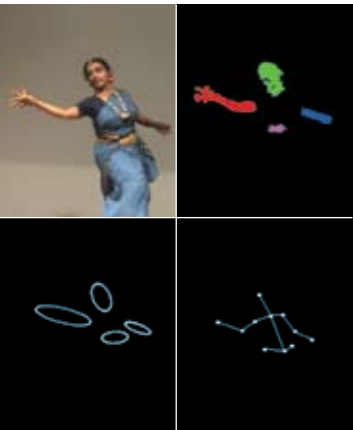
## 1. Advanced computational engineering, simulation and manufacture

### Areas of expertise:

- Computational science
- Computer graphics
- Computer vision
- Data mining
- Database systems
- Dynamical control
- Embedded systems
- Fibre optics
- Image processing
- Microelectronics
- Photonics
- Power electronics
- Power systems
- Robotics
- Signal processing
- Wireless communications

### Areas of application:

- Aerospace engineering
- Advanced manufacturing
- Developmental informatics
- Energy systems
- Environmental engineering
- Geographical information systems
- Structural analysis
- Transportation
- Water resources



### Visual computing

Researchers at the IIT Bombay Graphics and Vision Lab analyse visual information and replicate the remarkable human ability to perceive and process images, static or moving. Current research involves the tracking and capture of actual human motion from monocular markerless videos, and the generation of replica 3D stick figures. This technology is utilised by the entertainment industry, and others, for the generation of virtual characters.

A further breakthrough in this area is the development of content-based video/image retrieval, involving foreground extraction techniques to eliminate 'noise'. Potential applications include: video retrieval for news broadcasting, advertising and distance learning, video archiving, and medical use.

### Faster optical communications

Award-winning engineering researchers at Monash have developed the Optical OFDM, which is the optical equivalent of ADSL. ADSL allows faster communication along telephone lines. Optical OFDM uses similar technology to speed up communications along optical fibres and infrared wireless systems. The technology enables existing fibres to carry four times the data over longer distances without the need for modification or new infrastructure, making internet applications on existing lines much faster.



## 2. Infrastructure engineering

Bottlenecks in infrastructure can inhibit growth and have an adverse impact on competitiveness.

### There is a growing need for:

- Improved measures of life assessment/extension of industrial components that operate in a corrosive environment
- Development of cost effective, improved techniques for the design of future plants and components

IIT Bombay is the only technological education institution in India with an independent centre for corrosion science and engineering.

Monash has the largest corrosion R&D group in Australia and its Institute of Railway Technology has developed unique tools to support the railway industry in Australia, Singapore and Hong Kong.

### Areas of expertise:

- Improved design data for mitigation of stress corrosion cracking (SCC)
- Interplay of microbiological corrosion and SCC
- Caustic and chloride SCC
- Advanced corrosion/wear resistance coatings for light alloys
- Sustainable infrastructure



### Testing for material stress intensity

Monash and IIT Bombay are collaborating with the US Naval Research Lab, Oak Ridge National Lab, Defence Science and Technology Organisation and the Welding Technology Institute of Australia to develop an accurate and cost effective determination of the threshold stress intensity factor of corrosive materials.

### Monash and BHP Billiton on track

Monash's Institute of Railway Technology has developed a fully-automated condition monitoring system for railways. The system, developed in collaboration with BHP Billiton, monitors the health of rail operations throughout the network and collects vital information for the planning of future maintenance and operational strategies.



## 3. Clean energy

Securing a cheap energy supply and minimising adverse environmental impact is high on the agenda of governments around the world. Energy is fundamental to economic development, social well-being and national security. With aspirations of continuously improving living standards in the face of an ever increasing population, the provision of clean, cheap and reliable energy supplies is an R&D challenge.

The collaborative energy research program at the Academy will focus on the development of advanced technologies for the generation of electricity and production of hydrogen or transport oil from coal and biomass with minimised CO<sub>2</sub> emissions.

### Research themes include:

- Advanced coal and biomass gasification for power generation
- Advanced technologies for hydrogen production
- Technologies for efficient utilisation of distributed biomass
- Efficient combustion processes of bio-fuels
- Stable operation of electrical grid networks
- Improved electrical supplies to rural and remote communities



### Environmentally friendly fuel from cashew nuts

The IIT Bombay biomass research group is working on an alternative fuel source made from cashew nuts. The team has developed a gasifier which enables on line separation of vapours from cashew nutshells. When condensed into cashew nutshell liquid (CNSL), the resulting char is gasified downstream. Extraction of CNSL on line helps in the significant reduction of tar in the gas which is economical and environmentally friendly.

A bio-char unit has also been developed which converts bamboo and other woody biomass to charcoal with reduced pollution compared to conventional methods. The resulting charcoal can be utilised as fuel for small heating appliances such as firing a bakery unit in small scale industry. These bio-char units have been deployed at various remote villages in India.

### Alternative fuel

Monash University is leading a research project to turn the Mallee tree into an alternative vehicle fuel that could also help solve Australia's soil salinity problem.

Oil from the wood of the Mallee tree can be super-heated to produce a vapour that can be condensed into liquid. After refining, the condensed liquid could be used as a fuel for diesel engines.

The complex root system of the Mallee also keeps the water table deep within the soil, and salt levels low in the top soil.



## 4. Water

Sustainable management of water resources is a critical issue worldwide. The long-term problem of strained water resources is likely to grow in importance both to industry and as a matter of public concern.

### Areas of expertise

- Ground water and salinity – aquifer storage and recovery, groundwater modelling
- Ground water – waterway interactions
- Urban water management – storm water treatment technology, water sensitive urban design
- Waterway management – river rehabilitation, sustainable water allocation, environmental flows, waterway structures
- Flood management – risk analysis, flood mitigation structures, flood plain interaction



### Urban flood mitigation

Recurring flooding during the monsoons in India impedes free movement of people and transport, and poses a threat to life and property. Flooding leads to outbreaks of epidemics causing loss to business and industry.

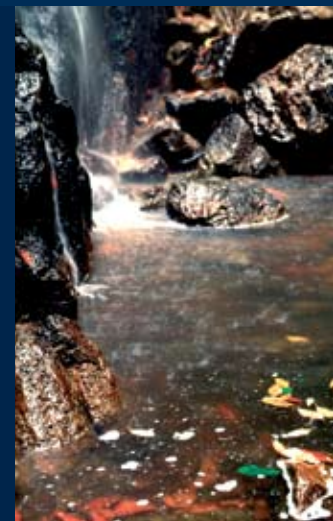
Research at IIT Bombay addresses urban flood control through studies related to overflow. Where structural remedies for storm drains are not feasible, non-structural methods like controlling flows at key points in the drainage system are being explored. The work involves online monitoring of rainfall data in specific catchment areas and formulating real time algorithms to maintain flow at pre-determined levels.

Once the algorithms are in place, the technology is transferred to the local municipality for implementation.

### Storm water goes green

Monash engineers, in a joint venture with consulting firm Ecological Engineering, are helping Australian cities adopt a more sustainable system of water management.

Their answer to the urban water crisis is a biofilter/rain garden. Containing plants that support biological water-cleansing processes in the soil, a biofilter collects and filters storm water as it trickles through layers of soil and gravel. The treated storm water is then used for irrigation or drained back into waterways. The project incorporates a range of disciplines such as engineering, hydrology and soil mechanics.

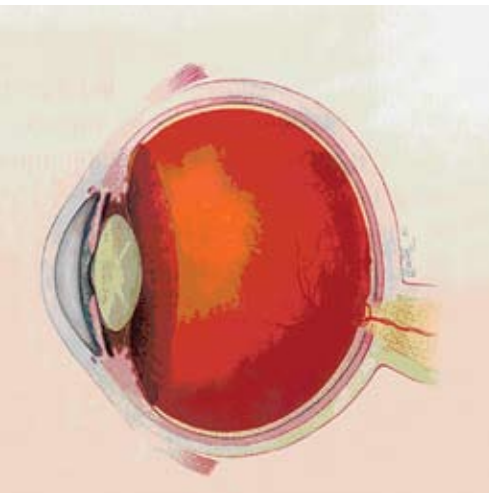


# 5. Nanotechnology

Leading knowledge-based nations see nanotechnology as a core driver for future economic growth and sustainable competitive advantage, and are investing heavily in basic and product-driven nanotechnology R&D.

## Areas of expertise

- Polymer nanocomposites
- Nanostructured materials for corrosion protection
- Nanostructured alloys for magnetic applications and hydrogen storage
- Design, characterisation and modelling of light metal alloys
- Mesoporous and microporous materials
- Nanoelectro mechanical systems

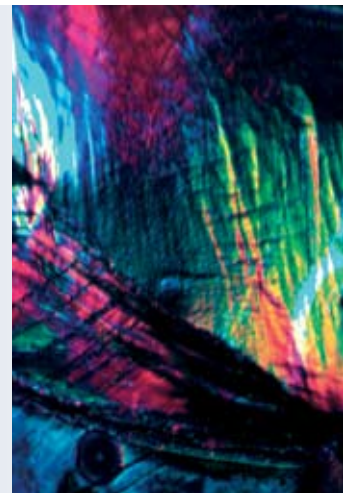


### Nanoparticles for ophthalmic drug delivery

Only 1-2% of conventional eye drops reach the deeper tissue of the eye. Researchers at IIT Bombay have developed a formulation of biodegradable protein nanoparticles for a non-steroidal, anti-inflammatory drug. Used to treat inflammatory and vasculopathic disorders of the posterior chamber of the eye, the nanoparticles allow a sustained release of the drug over a prolonged period.

### A\$14.5 million to improve light metals

Monash Engineering received A\$14.5 million in funding to establish the ARC Centre of Excellence for Design in Light Metals in 2006. The Centre aims to expand Australia's light metals industry by improving the design, secondary processing and durability of wrought light alloys of aluminium, magnesium and titanium. Its primary goal is to improve the design of materials for use in aerospace, automotive, rail and marine transport, packaging and lightweight structures and containers.



# 6. Biotechnology and stem cell research

The IIT Bombay School of Biosciences and Bioengineering is a centre of excellence, furthering multi-disciplinary research in biology-related areas. The School provides an atmosphere conducive to making an international impact in biology-related areas, and endeavors to produce the leaders of tomorrow in this field. The Australian Stem Cell Centre located at Monash University is a world class centre conducting research to develop innovative therapeutic products to treat a range of serious injuries and debilitating diseases.

The Research Academy provides an opportunity to develop a strong capability and presence in this area.

## Areas of expertise

- Fluid mechanics of circulation
- Bioreactors
- Scaffolding for stem cells
- Medical diagnostics
- New vaccines



### IIT Bombay researchers develop life-saving drug

Adult Respiratory Distress Syndrome is a life threatening complication due to direct or indirect lung injury. Leaking of blood cells into the lungs inhibits the function of the natural lung surfactant. Herbal oil based surfactants developed at the IIT Bombay School of Biosciences and Bioengineering can reverse this hematological inhibition acting as a life-saving drug.

Herbal oil surfactant replacements for Neonatal Respiratory Distress Syndrome, a life threatening condition seen in premature babies, have also been achieved.

Efforts are now underway to develop tailor-made surfactants that will be of therapeutic benefit for several other respiratory diseases.

### Designing better vaccines

Monash researchers are developing a method of making vaccines that will lead to highly effective inoculations made in a fraction of the time it now takes. The aim is to reduce vaccine production time from six months to two weeks using DNA as the base for the vaccines making them quicker to make, safer and more stable. The WHO has stated that the development of DNA vaccines should be encouraged for their long-term potential. Monash's Bio-Engineering Laboratory is equipped to handle pilot-scale production of new vaccines using the same cell lines of bacteria that are used by the pharmaceutical industry.



# IIT Bombay

IIT Bombay has made a concerted effort to align its R&D focus with India's goals of achieving technological competence and self-reliance.

The Institute undertakes research projects in key areas in science and engineering, funded by national and international agencies. Many researchers are working on issues of national importance, with around 400 sponsored projects undertaken each year.

The progressive intensification of sponsored research has led to the formation of research groups, which have enabled the development of modern research facilities and highly skilled human resources in key areas. IIT Bombay realises that selective strategic partnerships with key foreign research institutes and leading corporations will continue to play an important role in the future.

IIT Bombay's success is due to its research strength in core disciplines, outstanding intellectual capital, excellent infrastructure and facilities, strong alumni support, and ambition towards achieving excellence in education and technology.

# Monash University

One of the prestigious Group of Eight Australian universities, Monash is ranked in the top 40 universities in the world. (*Times Higher Education Supplement 2006*)

Monash has a reputation as a research-intensive university, recognised for the breadth and depth of its research. More than 3000 research students benefit from the expertise of internationally recognised and talented academics. Monash is home to more than 100 research centres, is involved with 17 cooperative research centres and has research links with more than 110 institutions around the world.

The University encourages and supports innovative multi-disciplinary research, which addresses national and international priorities. Excellent research infrastructure includes well-equipped laboratories, advanced imaging and electron microscopes and the largest wind tunnel in the southern hemisphere. Monash is adjacent to the new Australian Synchrotron, a facility set to provide researchers with many opportunities.

# Industry partners

Initial industry partners working with the Research Academy:

	<p>BHP Billiton is the world's largest diversified resources company. They discover, develop and market a range of commodities including aluminium, energy coal and metallurgical coal, copper, manganese, iron ore, uranium, nickel, silver and titanium minerals, oil, gas, liquefied natural gas and diamonds, to meet the world's resource and energy needs. Technical innovation is a key element to BHP Billiton's strategy to achieve growth and improved financial performance.</p>		<p>The Australian Stem Cell Centre is Australia's premier stem cell research organisation focused on bringing together the best adult and embryonic stem cell scientists to develop treatments for a number of serious human diseases.</p>
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# Contact us

To find out more about how the Academy can help you solve your research problems please contact:

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