STUDY MELBOURNE
RESEARCH PARTNERSHIPS

STUDY MELBOURNE
Victoria
Australia

THE STUDY MELBOURNE RESEARCH PARTNERSHIPS **INITIATIVE**

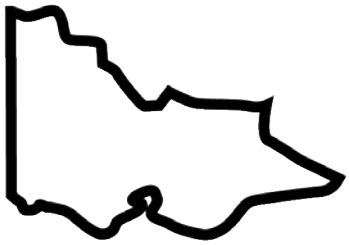
veski is working in partnership with Study Melbourne to deliver one of the key initiatives under the Victoria Government's $33.4 million International Education Short-Term Recovery – the Study Melbourne Research Partnerships program

This initiative is supporting international research collaborations between Victorian universities or TAFEs and an international partner.

GLOBAL COLLABORATIVE INNOVATION & EXPLORATION WITH VICTORIA'S EDUCATIONAL **INSTITUTIONS AT THE EPICENTRE**

Internationally recognised as a global knowledge hub, Victoria attracts some of the best researchers and investments from around the world. Victoria's world-class research institutions and facilities have established it as a leader in research excellence and future-forward thinking

Awarding $2.8m in major research projects, this scheme provides Victorian education providers with vital support for international research partnerships and projects – building strategic international relationships in future growth regions.



This investment is strengthening existing and building new connections between Victoria's outstanding research institutions and the Global research community. It is driving ongoing international research collaborations and deepening strategic transnational partnerships for Victorian educational institutions

The initiative will confirm Victoria as a high-quality study destination, and Melbourne as Australia's number one student city, fifth best in the world, strengthening the prestigious global rankings and reputation of Victoria's public universities and TAFEs.

This document showcases the 15 successful Study Melbourne Research Partnership projects that are propelling Victoria, and the world, into a brighter future.

PROJECT
GOVERNANCE GROUP

The Study Melbourne Research Partnerships program is overseen by the Project Governance Group. The Group provides strategic direction and leadership over the duration of the initiative and includes the following experienced research and innovation leaders

Emeritus Professor A. Ian Smith (Chair)
veski Ambassadorial Fellow
veski Chair 2015 – 2021
veski Board Director 2011 – 2015
Monash University

Ms Kim Cleary
Senior Manager, Market Development &
Global Education Network
Study Melbourne & International Education
Global Victoria

Ms Julia L Page
MD & Chief Executive
veski

Ms Sally Roberts
Fellowships Coordinator
veski

Professor Richard Sandberg
veski Innovation Fellow
Chair of Computational Mechanics
The University of Melbourne

Professor Sumeet Walia
Victoria Fellow in 2018
Research Leader in
Cross-disciplinary Engineering
RMIT University

GÖNÜL SERBEST
CHIEF EXECUTIVE OFFICER
GLOBAL VICTORIA

“Study Melbourne is proud to partner with veski to deliver the $2.8 million Study Melbourne Research Partnerships program to support major research projects between Victorian public institutions and their international industry or institutional partner. Innovation, collaboration and knowledge exchange are the cornerstones of this program.

Supporting Victoria’s world renowned research institutes is critical to attracting international students and top global talent to the state.”

GLOBAL VICTORIA

FUNDED
RESEARCH PROJECTS

The 15 successful Study Melbourne Research Partnership Projects exemplify research excellence. They are led by researchers at the forefront of their fields who are furthering knowledge and technology across a broad range of disciplines

Each project went through a competitive grant selection process, demonstrating the high-impact of the research and the far-reaching benefits of the proposed international collaboration, including commercialisation and internationalisation prospects.

These projects cover fields such as renewable energy, education, biomechanics, the environment and cybersecurity, with many projects employing an interdisciplinary approach. Each project tackles pressing and complex problems such as river pollution, peripheral nerve regeneration, fake news and climate change, with the outcomes set to revolutionise both research and industry.

Research Lead	Victorian Education Partner	International Partner
Prof. Debra Kiegaldie	Holmesglen Institute	Northwestern Polytechnic, Canada
Dr. Bernard Agana	VETASSESS, Bendigo Kangan Institute	CTICEA, China
Prof. Andrea O'Connor	The University of Melbourne	University of Bayreuth, Germany
Prof. Aniruddha Desai	La Trobe University	IIT Kanpur, BITS Pilani, India
A/Prof. Xiao Liu	Deakin University	Gadjah Mada University, Indonesia
Prof. Diego Ramirez-Lovering	Monash University	Universitas Indonesia, Indonesia
Prof. Richard Gray	La Trobe University	University of Haifa, Israel
Prof. John Andrews	RMIT University	Kyushu University, Japan
Prof. Rezaul Begg	Victoria University	CyberDyne, Japan
Dr. James Hutchison	The University of Melbourne	University of Hokkaido, Japan
Prof. Baohua Jia	Swinburne University	Jeonbuk National University, South Korea
Prof. Arnan Mitchell	RMIT University	Chalmers University of Technology, Sweden
A/Prof. Daniel Fabijanic	Deakin University	Virginia Tech, USA
Dr. David Opar	Australian Catholic University	Springbok Analytics, USA
A/Prof. Timothy Scott	Monash University	University of Da Nang, Vietnam

COLLABORATIVE RESEARCH **ACROSS 11 COUNTRIES**

With projects spanning 11 countries, the Study Melbourne Research Partnerships program initiative fosters exciting collaborations between Victoria and the international research community

By expanding the global reach of Victorian research excellence, the 15 projects are exponentially increasing Victoria's science, technology and innovation capabilities and connections.

These include partnerships in Japan, India, Canada and more, combining the knowledge, connections and state-of-the-art facilities of more than 25 research institutions in total.

CANADA

The COIL project: Building an international nursing education and research partnership using digital technologies

- Provides a foundation for nursing education to continue no matter where people are located or other challenges facing countries
- New technologies allow nursing educators to engage students in experiential learning, previously off-limits to those living in other countries
- Important project to support development of healthcare workforce in Australia and overseas

Professor Debra Kiegaldie

Clinical Chair,
Health Workforce, Applied Research and Simulation,
Holmesglen Institute

Holmesglen is the only Australian TAFE to offer a Bachelor of Nursing and has invested over $5 million in dedicated teaching wards and simulation centres at its health precinct in Moorabbin, including Holmesglen Private Hospital – the first TAFE-based hospital in Australia. Northwestern Polytechnic, Canada, has overseen a range of applied research activities, from large, major funded, international multi-partnered initiatives to smaller student-based work.

Project Summary

While collaborative online international learning (COIL) offers meaningful, rewarding opportunities to engage across borders, regardless of personal constraints or economic challenges, few examples exist in nursing education. Using virtual reality and cloud-based communication platforms, Holmesglen Institute in Victoria and Northwestern Polytechnic in Alberta, Canada is building a new, experiential -based online learning program for nurses.

The aim is to create multiple online environments that facilitate collaborative research projects, provide access to joint resources, enable nursing students to work together regardless of their global location, and build workforce capacity and capabilities. Additionally, it will cultivate an international community of practice.

Given the impact of COVID-19 on the international healthcare education landscape and the World Health Organization's call for the nursing profession to practice, lead and adapt to increasingly diverse populations, the value of building and sustaining international connections has never been more important. The increased use of collaborative digital learning technologies presents an opportunity to deepen global engagement of place-bound students and educators.

This project is furthering the research collaboration, put on hold during COVID-19, between the two organisations, and will provide reportable research outcomes and tangible products that can be profiled across the international nursing and simulation community. It will also promote Victoria as a pioneering and high-quality education provider in both vocational and higher education.

holmesglen

NORTHWESTERN POLYTECHNIC

CHINA

A case study to explore and inform cross-border qualification recognition opportunities by mapping Chinese vocational qualifications to Australian standards in select fields of study

- Enhancing the international competitiveness of local VET institutes
- Supporting the Chinese "Double High" initiatives
- The recommendations will account for linguistic and cultural expectations attached to qualifications

VETASSESS is at the forefront of discussions about how to check and evaluate qualifications and experience, and is a trusted partner to governments, educators and industries. Bendigo Kangan Institute is one of the largest TAFE training providers in Australia. Chinese Testing, Inspection and Certification Education Association consists of 150 scientific research institutes, vocational colleges, trade associations and enterprises in the field of Testing, Inspection and Certification in China.

Dr Bernard Agana
Assistant Team Leader,
Science & Agriculture,
VETASSESS

Project Summary

The Chinese Testing, Inspection and Certification Education Association (CTICEA) and VETASSESS Australia are collaborating to benchmark Chinese qualifications to Australian standards, supporting the Chinese "Double High" initiatives. This project is aimed at enhancing the international competitiveness of local VET institutes.

This collaborative research in qualification referencing will facilitate an understanding of the best approach to benchmarking of vocational qualifications delivered by CTICEA's member colleges in Australian context. This will help learners of CTICEA colleges achieve the best outcomes for global recognition of their qualifications.

The fields that will form the basis of this research are chemical technology, and environmental monitoring & control technology.

The recommendations will account for local linguistic and cultural expectations attached to qualifications, so that they can be understood in an international platform.

Resulting in an applicable model for qualification referencing based on the Australian recognition systems, this project will amplify Australia's reputation at the forefront of international standards in vocational and higher education sectors. It will open new avenues to extend qualification benchmarking services to other countries.

This project is in line with Victoria's objectives for a strong international education sector and will reinforce Victoria's reputation as the Education State. The findings will also open up a whole new vista of collaborative opportunities between different stakeholders, including Victorian education stakeholders and Chinese education sectors.

KANGAN INSTITUTE

VETASSESS

T·I·C
全国检验检测认证职业教育集团
Chinese Testing, Inspection and Certification Education Association

GERMANY

Multidimensional biomaterials for tissue repair

- Developing nerve guidance conduits made from chitosan and recombinant spider silk
- Current peripheral nerve repair methods involve taking tissue from the patient, and can have clinical drawbacks
- Innovative materials may lead to improved surgical procedures, enhanced clinical outcomes and advances in neuroprosthetic limbs

Professor Andrea O'Connor

Shanahan Chair In Frontier Medical Solutions &
Redmond Barry Distinguished Professor
The University of Melbourne

The University of Melbourne has an excellent track record in world-leading engineering research covering a breadth of areas including nanomaterials, biomaterials, tissue engineering, biomechanics, and mechanobiology. The university has strong national and international linkages with industry, hospitals, research institutes, and universities. The University of Bayreuth is renowned for expertise in biomaterials research and places a high value on promoting interdisciplinary research crossing the conventional boundaries of academic disciplines.

Project Summary

Loss of motor, sensory, or autonomic nerve functions can occur due to injury and a range of medical conditions and has serious impacts on patients' independence and quality of life. This collaboration between The University of Melbourne and University of Bayreuth aims to design new biomaterials technology that will help repair and regenerate peripheral nerves.

The University of Melbourne has strong national and international linkages with industry, hospitals, research institutes, and universities, including as a major founding partner in the new Aikenhead Centre for Medical Discovery (ACMD) at St Vincent's Hospital. Lead researcher, Professor Andrea O'Connor, is the inaugural Shanahan Chair in Frontier Medical Solutions and a recognised leader in tissue engineering and biomaterials research.

The University of Bayreuth is renowned for expertise in biomaterials research, led by Professor Thomas Scheibel, whose research led to the formation of the company AMSilk, the world's first industrial supplier of synthetic silk biopolymers. Victorian institutions – Monash University, Swinburne University of Technology and CSIRO – are also involved in the performance assessment phase of this project.

Together they are developing a new kind of nerve guidance conduit, made of biocompatible and biodegradable materials – chitosan and recombinant spider silk. This development of new biomaterials engineering knowledge will enable the creation of more sophisticated and personalised biomaterials solutions, leading to improved surgical procedures, advances in neuroprosthetic limbs, and enhanced clinical outcomes. This project will strengthen Victorian collaborations with the University of Bayreuth, growing the profile of Victorian research and the potential to recruit international researchers and PhD students to Melbourne.

THE UNIVERSITY OF MELBOURNE
UNIVERSITÄT BAYREUTH
CSIRO
MONASH University
SWINBURNE UNIVERSITY OF TECHNOLOGY

INDIA

Making data driven quality management accessible to small scale dairy cooperatives in India

- India's booming dairy industry is affected by poor milk quality, with 41% failing quality tests
- Sensors with inbuilt data analytics and traceability algorithms will detect issues in real-time in the supply chain
- Commercialisation opportunities within industry for the developed sensor systems and analytic algorithms

La Trobe University, the Indian Institute of Technology, Kanpur and Birla Institute of Technology and Science are founding partners of Asian Smart Cities Research and Innovation Network (ASCRIN). La Trobe University brings their expertise in developing and using sensors and data analytics for improving production farming across Dairy, Beef and Sheep sectors. The international partners have world class research and development facilities. The research team has secured access to technology from an Australian Industry partner to use their end-to-end logistics condition monitoring sensors and data platform to undertake field data collection for this project.

Professor Aniruddha Desai
Director,
Centre for Technology Infusion,
La Trobe University

Project Summary

The Indian dairy industry accounts for 19 per cent of the world's milk production and is worth US$145.7 billion, and yet the industry is affected by poor milk quality, with 41 per cent of milk failing quality tests. This project aims to develop next generation low-cost sensor systems that can be used in the dairy supply chain to pinpoint problems in real-time.

Mid-infrared spectroscopic sensors are commonly used to detect the presence and concentration of various molecules, and will be used to detect the deterioration of milk quality. The data from these sophisticated sensor systems will inform actions for supply-chain optimisation.

Lead researcher, Professor Aniruddha Desai, is the Director of La Trobe University's Centre for Technology Infusion. The centre has been operating for over 14 years and has developed an industry standard technology realisation facility for everything from commercial grade microchip design to large-scale big-data analytics and modelling. IIT Kanpur and BITS Pilani teams' expertise lies in their ability to undertake milk sample testing and characterisation.

The partners are jointly funding two PhD projects to support this work during and after the 12-month project delivery.

Due to the large scale of the Indian dairy industry, the commercialisation potential with industry partners is significant. This project will create new intellectual property, including data analytics algorithms for better planning and innovative sensor systems that can reliably indicate 'deviation from normal' within milk.

LA TROBE UNIVERSITY

SensaData

THE PRODUCT MAKERS

INDONESIA

Citarum transformation: A Living laboratory for international research and impact, addressing river pollution

- A platform for a 5-10 year research program in West Java, Indonesia to revitalise rivers through interdisciplinary research
- Designing closed loop water and waste management systems for informal communities
- A first of its kind, the lab will attract high quality researchers and students from around the world to pilot, test, and measure the long-term impacts of the model

Professor
Diego Ramirez-Lovering
Director,
Informal Cities Lab,
Monash University

Monash University's Informal Cities Lab seeks to address wicked, multidimensional challenges through research and development activities spanning spatial, social and economic dimensions. Universitas Indonesia brings extensive research experience in developing and piloting water and waste solutions with vulnerable communities in Indonesia, through collaborations with researchers, NGOs and communities.

Project Summary

River pollution is a multidimensional problem that cuts across technological, behavioural, governance, environmental and economic domains. To tackle this complexity, Monash University and Universitas Indonesia will develop a new approach to addressing river revitalisation challenges through the establishment of a Living Lab design.

Living Labs undertakes place based, process-oriented and reflexive experiments in the multi-stakeholder practice of sustainable development. This project is bringing together an international consortium of partners to bring a range of expertise and disciplines together to research the optimal conditions of river transformation.

The demonstration will take place in a 2.6 kilometre segment of the Citarik River, an upper tributary of the Citarum River in West Java, Indonesia.

Infamously one of the most polluted rivers in the world, its severe environmental degradation results in adverse impacts to the health and livelihoods of 25 million people.

Circular economy principles will inform the choice and design of solutions so as to drastically limit waste generation, keep products and materials in use, promote micro-economies and new job creation, and regenerate natural systems.

The Citarum Transformation Living Lab will create an institutional framework that enables deep collaboration with policy, community and industry partners to achieve real world impact. It will produce a novel and scalable approach to overcoming river pollution in the Global South, and strengthen the collaborative research relationship between Victoria, Indonesia, and Europe.

MONASH University · UNIVERSITAS INDONESIA Veritas, Probitas, Iustitia | Est. 1849 · eawag aquatic research · UNIVERSITAS PADJADJARAN · CSIRO

INDONESIA

Multilingual COVID-19 Fake News Detection and Intervention

- Creating a new system to detect fake news in multiple languages
- Key tool for governments as well as mainstream and social media organisations
- Potential solution to the 'infodemic' facing Culturally and Linguistically Diverse communities

Deakin University's School of Information Technology has world class research capacity in cybersecurity, distributed computing and artificial intelligence. Gadjah Mada University is one of the oldest and largest institutions of higher education in Indonesia and has well-established networks and partnerships with various industry/government institutions, which provides excellent research and commercialisation opportunities.

Associate Professor Xiao Liu

Associate Head of School (International), School of Information Technology, Deakin University

Project Summary

Since the beginning of the global pandemic, a massive amount of COVID-19 information has spread around the world through mass media and social platforms, creating what authorities term an 'infodemic'. Unfortunately, not all information is accurate or trustworthy. Some is even categorised as misinformation or fake news.

Each country has different strategies to control COVID-19, which leads to a huge amount of inappropriate news sharing. These include links to technologies like 5G mobile networks, and unconfirmed treatments and preventative measures like using onions or the sun for protection. Meanwhile, fake news has been produced in various languages allowing messages to spread more easily in particular among ethnic groups.

Clearly, the detection of multilingual COVID-19 fake news is essential for countries with hundreds of ethnic and linguistic groups such as Australia and Indonesia. Unfortunately, existing fake news detection methods remain too general to be effective in multiple languages.

This collaboration between Victoria and Indonesia uses a computational-based detection, machine learning, and human factor engineering approach to design a decision support system that functions as a warning mechanism for misinformation and fake news related to COVID-19. The final tool is being developed for use by organisations and governments in developing appropriate communications and education strategies, with the potential for wider application for future global events.

DEAKIN UNIVERSITY

UNIVERSITAS GADJAH MADA

ISRAEL

Enhancing wellbeing and social inclusion of marginalised populations: a two country multi-component project

- The population groups in focus are: the general population who drink alcohol, ageing families living with disability and people with autism
- La Trobe University and the University of Haifa share a vision and mission to undertake research that makes a real and positive difference in people's lives
- Outcomes include policy reports, transferable technology and training packages that can be commercialised

Professor Richard Gray

Theme Lead - Healthy People, Families and Communities, La Trobe University

The strategic focus of La Trobe University's 2030 research plan is addressing questions of global significance in five thematic fields, one of which is Healthy People, Families and Communities. There are fifteen research centres aligned with this theme. La Trobe University and Haifa University both have particularly strong reputations in the fields of disability, autism and alcohol use.

Project Summary

The project aims to enhance the well-being and social inclusion of three marginalised and vulnerable populations in Australia and Israel - the general population who drink alcohol, ageing families living with disability, and people with autism.

The project has been developed by a group of 19 researchers from La Trobe University and the University of Haifa, with fieldwork for the study being undertaken in both Australia and Israel.

Harmful use of alcohol is associated with three million deaths every year. This part of the project will use artificial intelligence to compare the representation of alcohol in social media posts in Israel and Australia. The findings will inform alcohol policy in both countries.

People with intellectual disabilities are living longer, and the help families need to support older people with disabilities to thrive is not well understood.

The project will include in-depth interviews with family members in Australia and Israel to develop a deep understanding of the everyday realities and support that families need at this life stage.

Almost three-quarters of adults with autism are not employed. Part of the study is identifying barriers to employment by translating and using a measure – the Workplace Environment Accessibility Measure – developed by the University of Haifa. Additionally, in-depth interviews will be conducted with people with autism (in employment), their supervisors, and employers.

This project will produce numerous policy reports, transferable technology and training packages that can be commercialised. These outcomes will be able to be expanded for use in other countries to support policy and understanding of similar marginalised groups.

LA TROBE UNIVERSITY

אוניברסיטת חיפה
University of Haifa
جامعة حيفا

JAPAN

Developing the proton battery and proton flow reactor systems for energy storage

- A proton battery system can reduce costs and increase convenience for small-scale applications such as household solar
- A proton flow reactor system will facilitate integration of intermittent renewable energy sources into the national grid
- These products will help maintain reliable and low-cost electricity to consumers, while reducing emissions

RMIT University's Sustainable Hydrogen Energy Laboratory is one of Australia's premier hydrogen-energy research groups. The Institute for Carbon Neutral Energy Research (I2CNER) at Kyushu University in Japan has an international reputation for fundamental and applied energy research with state-of-the-art electrochemical and material science facilities.

Professor John Andrews
Professor,
School of Engineering,
RMIT University

Project Summary

A collaboration between RMIT University's Sustainable Hydrogen Energy Laboratory (SHEL) and Kyushu University will develop revolutionary proton energy storage technology that will shift the renewable energy market.

Two products will result from the project, a proton battery system for small-scale applications, such as household solar, and a proton flow reactor system for grid-scale electrical energy storage and bulk export of a hydrogenated carbon fuel. These are novel means of storing atomic hydrogen in porous carbon materials that have high commercial value, major economic benefits and greenhouse emission reduction potential.

I2CNER focuses on the science underlying energy technologies that hold promise for dramatic reductions in carbon emissions in the next 20 to 40 years. RMIT University's SHEL is a group of multidisciplinary experts, which pioneers research and development in hydrogen energy solutions in Australia and internationally. This partnership offers a direct path to establish further collaborations in these innovative zero-emission hydrogen energy technologies.

This project will help pave the way to commercialising and deploying proton battery and proton flow reactor technologies and create new sustainable employment opportunities for Victorian and Japanese companies. End-users in households and commercial organisations may benefit by the deployment of cost-effective and convenient proton batteries.

Proton flow reactor systems will facilitate integration of intermittent renewable energy sources into the national grid. Such integration will contribute to maintaining reliable and low-cost electricity to consumers, while achieving zero net greenhouse gas emissions in Australia by 2050.

RMIT UNIVERSITY

KYUSHU UNIVERSITY

JAPAN

Using machine learning to optimise HAL exoskeleton joint control

- Victorian knowledge to improve world-leading technology assisting people with disabilities
- Victoria University is one of only a few organisations worldwide to combine advanced biomechanics, robotics, computational intelligence and wearable sensors
- Healthcare applications include serious neurological and musculoskeletal injuries and gait impairments due to stroke, osteoarthritis and diabetes.

Professor Rezaul Begg

Professor of Biomechanics, Chair, Program in Assistive Technology Innovation, Victoria University

Victoria University is one of only a few organisations worldwide to combine advanced biomechanics, robotics, computational intelligence and wearable sensors. CyberDyne developed the world's first Hybrid Assistive Limb (HAL) exoskeleton. Both organisations have world-class facilities including Victoria University's Biomechanics Laboratory.

Project Summary

Combining Victoria University's innovative 'smart' joint-controls with the world's first Hybrid Assistive Limb (HAL) exoskeleton developed in Japan, could reduce injuries due to falls. The project aims to tailor the exoskeleton to individual patients using 'smart' joint-controls, drawing on the University's expertise in machine learning and gait biomechanics.

Victoria University has an Assistive Technologies research initiative unique in Australia and is one of only a few organisations worldwide to combine advanced biomechanics, robotics, computational intelligence and wearable sensors. They are applying these skills to develop wearable devices to augment single-joint or whole-limb function and minimise injuries due to falls. Healthcare applications include serious neurological and musculoskeletal injuries, older people, and gait impairments due to stroke, osteoarthritis and diabetes.

CyberDyne's HAL technology uses the impaired individual's residual muscle activation signals (Electromyography – EMG) to restore physical function, using the EMG signals to control motor-driven joint actuators. HAL has attracted worldwide interest due to its ability to assist individuals with profound movement disabilities and has been registered by the Australian Therapeutic Goods Administration. CyberDyne is seeking opportunities to further develop and market HAL in Australia and will contribute their expertise in the design and manufacture of powered exoskeletons. The company was established in 2004 by Professor Yoshiyuki Sankai, a distinguished control and systems engineer at the University of Tsukuba.

Research into assistive technologies and stroke rehabilitation, supported by the project's connections with Western Health and, potentially, the new Footscray Hospital, offer clear pathways to collaborative product development and clinical applications of HAL.

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

CYBERDYNE

筑波大学
University of Tsukuba

JAPAN

New directions for the harvesting and manipulation of thermal energy

- Synthesis of a new class of thermal energy harvesting materials which are cheap, safe, and sustainable
- A major breakthrough in thermal optoelectronic devices and heat management materials
- Increased energy efficiency could lower costs and assist in efforts to mitigate climate change.

The University of Melbourne's Nanoscience Laboratories provide a state-of-the-art laboratory for nanomaterials synthesis and characterisation. Hokkaido University's Research Institute for Electronic Science (RIES) is the hub of the "Hokkaido innovation creation nano-engineering and measurement support network" featuring a wide range of cutting-edge research facilities, particularly clean rooms, nanolithography, and electron microscopy facilities not easily accessed in Melbourne.

Dr James Hutchison
ARC Future Fellow and
Senior Lecturer,
School of Chemistry,
The University of Melbourne

Project Summary

Approximately 90 per cent of the world's energy use involves the generation or manipulation of heat for things like cooling and heating of buildings, and growing food. Future energy economies must better exploit this resource that is often considered a waste product, for example by developing devices which up-convert low energy thermal radiation to a more readily usable form. The University of Melbourne will partner with Hokkaido University to use their combined nanoscience research excellence and state-of-the-art facilities to create new thermal energy technologies.

The aim of this project is two-fold. Firstly, to develop methods to produce ultra-thin, thermal harvesting materials using chemical vapour deposition. Secondly, to interface these materials with photonic nanostructures and demonstrate control of thermal relaxation pathways. The final goal is proof-of-principle thermal harvesting which may inspire future device development.

The proposed project will generate fundamental knowledge on the synthesis of a new class of thermal energy harvesting materials which are cheap, safe, and sustainable.

The project will also generate knowledge on integrating these materials with photonic structures that can modify thermal energy relaxation pathways. This could lead to a major breakthrough in thermal optoelectronic devices and heat management materials for temperature control in buildings. This increased energy efficiency could lower costs and assist in efforts to mitigate climate change.

THE UNIVERSITY OF MELBOURNE

HOKKAIDO UNIVERSITY

SOUTH KOREA

Solar-powered technology to produce hydrogen from the sea

- 'All-in-One' solar-powered seawater-to-hydrogen generator could power a heavy truck for 100km
- New technology supports Victoria's vision for renewable hydrogen to be a part of its economy and the transition to a net zero emission future
- Delivers sustainable water source for hydrogen and dramatically reduces cost of desalination

Professor Baohua Jia
RMIT University (April 2022)
Formerly Swinburne University

Collaboration between Swinburne and RMIT universities and Korea are deliverying mutual benefits to Australia. South Korea's Jeonbuk National University is a world leader in renewable hydrogen generation and technology translation especially in manufacturing renewable hydrogen prototypes, many of which have been commercialised by Hyundai and other international corporations. The project is being supported by the national leading hydrogen platform, the Clayton Hydrogen Technology Cluster.

Project Summary

Bringing Australia and South Korea's world-leading hydrogen expertise together has the power to reduce the price of hydrogen and give Victoria early access to the $11 billion hydrogen economy, creating up to 7,600 jobs by 2050. This project will support the development of a game-changing prototype of a highly efficient product using solar heat to directly produce hydrogen from the sea.

This 'All-in-One' solar-powered seawater-to-hydrogen generator could produce 10,000 litres of hydrogen from a 100-square-metre prototype per day, potentially driving a heavy truck for 100 km. It's also expected to cost less than $3/kg, approaching the 2050 global hydrogen price target.

This project will draw on Swinburne University of Technology and Jeonbuk National University's collaboration and their 25-year pioneering research expertise, 10-year industry experience (including more than 40 international patents) and access to world-leading industry partners. It is expected to facilitate fast tracking of the commercial outcomes promised in this project.

The Clayton Hydrogen Technology Cluster are accelerating the commercialisation of the project by bringing in leading hydrogen industry.

This project will generate advanced knowledge, educate students and the workforce, ensuring Victorian education providers retain their prestigious rankings by securing postgraduates and talent in this most exciting area of hydrogen research.

SWINBURNE UNIVERSITY OF TECHNOLOGY
전북대학교 JEONBUK NATIONAL UNIVERSITY
Clayton
RMIT UNIVERSITY

SWEDEN

Rapid prototyping photonics for ultrafast communications, satellites, sensors and bionics

- Impact in high-speed data communications, navigation, and bionic implants
- Combining the research partners technological specialisations in advanced photonic chips and lasers, resulting in faster and cheaper prototyping
- Far-reaching industry applications with commercialisation opportunities

RMIT University's state-of-the-art Micro-Nano Research Facility (MNRF) allows rapid in-house characterisation of devices to enable the complete loop of design, fabrication and characterisation to occur before systems level testing. Chalmers University brings substantial clean room infrastructure similar in scope and scale to the MNRF. The project is supported by the Bionics Institute, Melbourne.

Distinguished Professor Arnan Mitchell
Director,
Micro Nano Research Facility,
RMIT University

Project Summary

Photonics is a multi-billion-dollar industry in Australia that underpins revolutionary technologies such as fibre-optic Internet, autonomous vehicles and next-generation bionic implants.

This project is creating new technology that will enable entire photonic systems to be rapidly 'printed' as microchips or on bio-compatible materials. These advances will enable faster and cheaper production of prototypes for industry and biomedical end-users and streamline mass manufacture.

RMIT University is a world leader in integrated photonic chips for high-speed communications, precision measurement and navigation systems. In mid-2020 they demonstrated the 'world's fastest Internet from a single chip' using optical frequency combs.

Swedish university Chalmers is recognised as a world leader in Vertical Cavity Surface Emitting Lasers (VCSELs) which are advanced optical light sources. These are extremely low cost and operate into the visible and ultraviolet wavelengths, which is particularly important for environmental and biomedical applications.

This project will interface Chalmers' VCSELs with RMIT University's photonic chips to create updated technologies. These will include a photonic chip transmitter for high-speed data communications, fibre-optic movement sensors for navigation, and flexible bionic implants for nerve stimulation in collaboration with the Bionics Institute. These advances will be revolutionary in each industry and have significant opportunities for commercialisation.

RMIT UNIVERSITY
CHALMERS UNIVERSITY OF TECHNOLOGY
Bionics Institute

USA

Miniature solid-state 3D metal printing for space applications

- Current metal printing technologies are too big to take into space
- Unique process doesn't require heat and can use any available scrap metal
- Strong interest from United States Airforce

Associate Professor Daniel Fabijanic

Research Academic, Institute of Technology Research and Innovation, Deakin University

Deakin University is a leader in the innovative use of digital technology and its Advanced Manufacturing and Simulation Lab is known globally for its research in the production of lighter weight parts using advanced metals, fibrous materials and hybrid materials using the latest cutting-edge manufacturing processes. Virginia Tech and MELD Manufacturing Inc. bring a wealth of Additive Friction Stir Deposition (AFSD) processing knowledge to the project.

Project Summary

Researchers in Victoria and the USA are developing a new way of printing miniaturised, light-weight metals to take into space. The project builds on Deakin University's work with MELD Manufacturing to optimise a unique solid-state metal additive manufacturing process called additive friction stir deposition (AFSD). By forming a new partnership with Virginia Tech, with strong interest from the United States Air Force, the project will unlock new avenues for interaction and student pipelines in an exciting area of innovation.

Uniquely, this manufacturing process operates without melting the input material and can use any scrap metal, making it ideal in zero-gravity environments. A solid bar of the deposition alloy is rotated under axial pressure against a deposition plate to create frictional heat, which significantly softens the metal.

Successive layers are then built up to create 3D parts with fine microstructure and wrought properties. Currently capable of manufacturing large parts, the scale needs to be significantly reduced for use in space.

This project will focus on creating a miniature version of AFSD process, particularly challenging given the effects of scale will not be linear. Even for the same input bar size, each material requires a different load, torque and translation speed to achieve a sound metal deposition. Experiments must be performed to develop this understanding.

The collaboration will forge a new academic partnership in the USA for mutually beneficial interactions, and create a local commercial opportunity in advanced manufacturing.

DEAKIN UNIVERSITY

VIRGINIA TECH

MELD MANUFACTURING

USA

New technologies to model human locomotion: innovative and translational approaches with implications for human health

- A more affordable and portable method which allows for highly individualised results
- Treatment of conditions that affect walking and running, as well as performance enhancement
- Opportunities for commercialisation of a product to assist clinicians and consumers

Australian Catholic University's experience in Sports Science and Exercise research is world-renowned with the newly established Sports Performance, Recovery, Injury and New Technologies (SPRINT) Research Centre. Springbok Analytics is a medical technology company from the USA with revolutionary artificial intelligence MRI processing technology.

Dr David Opar

Director,
Sports Performance,
Recovery, Injury & New
Technologies Research Centre,
Australian Catholic University

Project Summary

Tools that assess walking and running capability are important for treating various musculoskeletal and neurological conditions, as well as for enhancing performance. This project will develop a new approach to gait analysis by using wearable sensors – inertial measurement units (IMUs). This approach will be more affordable and portable than the current gold standard of optical motion capture, which is expensive, and involves a specialised lab and staff.

A world leader in developing MRI image processing technology, Springbok Analytics is the international industry partner working with the Australian Catholic University on this project.
Together they will pair IMUs with MRI imaging to develop models of human locomotion. Springbok Analytics has developed an artificial intelligence driven approach to automatically segment lower limb MRI scans, which reduces analysis time of MRI data by 95 per cent.

This new technique will enable the provision of unrivalled insights into enhancing performance, recovery from injury and off-setting the effects of ageing. These advances have a high probability of producing opportunities for commercialisation as the potential product would be beneficial to consumers and clinicians alike.

As part of this project there are opportunities for The Australian Catholic University to jointly host and mentor research students, as well as further opportunities for students from the USA to complete their doctoral studies in Victoria.

ACU
AUSTRALIAN CATHOLIC UNIVERSITY

Springbok
ANALYTICS

VIETNAM

Development of a low-cost, bimanual device for stroke neurorehabilitation

- A bilateral, low-cost device will allow patients to retrain their muscles from the comfort of their own homes
- Most current technologies are expensive and require patients to spend a considerable amount of time in hospitals with physical therapists
- Will help patients to become stronger and to rebuild self-esteem

Associate Professor Timothy Scott

Associate Dean
Graduate Research,
Faculty of Engineering,
Monash University

The Faculty of Engineering at Monash University is a vibrant, well-resourced, research- intensive engineering school with a state-of-the-art fabrication facility and prototyping centre. Fabrication support will also be provided by the Mechanical and Aerospace Technical Services Group (MAETSG), a well-staffed facility capable of machining, manufacturing components and systems, and fabricating items in a wide range of metals and non-metallic materials. The University of Da Nang Makerspace has extensive fabrication and quality assurance capabilities and includes two fully-equipped wood and metal workshops.

Project Summary

A joint project by Monash University and the University of Da Nang is developing new, low cost technology that enables stroke patients to independently conduct neuro-rehabilitation physical therapy exercises. This bilateral, low-cost device will allow patients to retrain their muscles from the comfort of their own homes or from nearby clinics.

Most current technologies are expensive and require patients to spend a considerable amount of time in hospitals with physical therapists. Unfortunately, physical therapy units in the developing world are often understated and lack the support necessary to properly care for stroke patients. As it is difficult for patients to receive proper retraining procedures, they usually do not reach their full potential for regaining motor function.

By giving stroke patients the tools and means to retrain their muscle coordination and mobility, it helps them not only to become stronger, but to rebuild self-esteem and regain independence in their everyday lives. Designed to reduce premature therapy discontinuation by 'gamifying', the stroke rehabilitation process, these compact size devices can be packed into small parcels, ready to ship to hospitals or directly to people's homes with straightforward and immediate set-up instructions.

The project will utilise additive manufacturing facilities within both Associate Professor Scott's own lab and the Woodside FutureLab, as well as those available in the Monash Makerspace, a state-of-the-art fabrication facility and prototyping centre. It will also utilise The University of Da Nang Makerspace which has extensive fabrication and quality assurance capabilities.

The ultimate trajectory will be to carve out a niche in the multi-billion-dollar stroke rehabilitation industry with an inexpensive device that helps patients retrain their upper-limb motor skills from home.

MONASH University

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