

Biomedical Engineering Systems Major

Associate Professor Sam John

Deputy Head of Department of Biomedical Engineering (Academic)



THE UNIVERSITY OF
MELBOURNE

The University of Melbourne acknowledges the Traditional Owners of the unceded land on which we work, learn and live: the Wurundjeri Woi-wurrung and Bunurong peoples (Burnley, Fishermans Bend, Parkville, Southbank and Werribee campuses), the Yorta Yorta Nation (Dookie and Shepparton campuses), and the Dja Dja Wurrung people (Creswick campus).

The University also acknowledges and is grateful to the Traditional Owners, Elders and Knowledge Holders of all Indigenous nations and clans who have been instrumental in our reconciliation journey.

We recognise the unique place held by Aboriginal and Torres Strait Islander peoples as the original owners and custodians of the lands and waterways across the Australian continent, with histories of continuous connection dating back more than 60,000 years. We also acknowledge their enduring cultural practices of caring for Country.

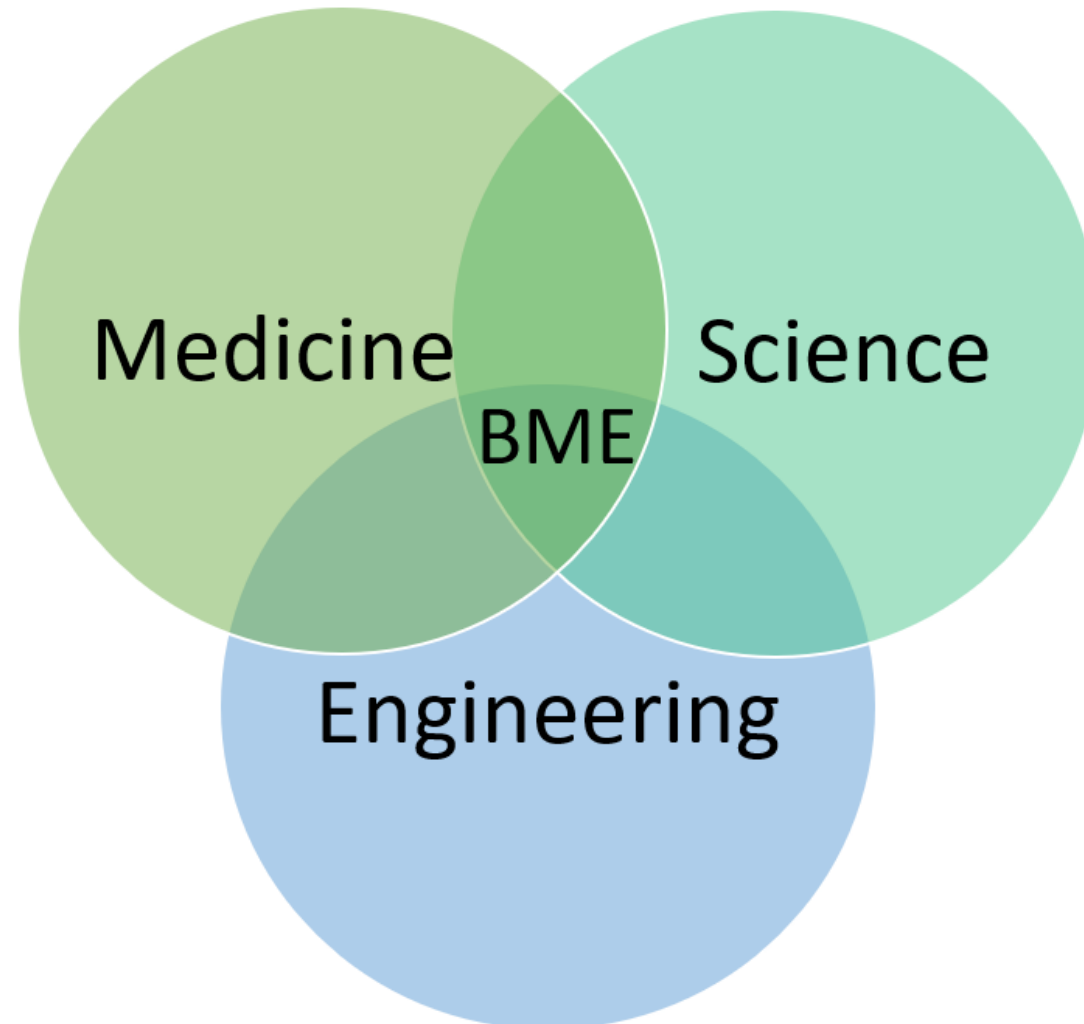
We pay respect to Elders past, present and future, and acknowledge the importance of Indigenous knowledge in the Academy. As a community of researchers, teachers, professional staff and students we are privileged to work and learn every day with Indigenous colleagues and partners.

In making this Acknowledgment of Country we commit to respectful and responsible conduct towards all others according to the Traditional lores of this land, particularly at times of formal ceremony.



Eng

Biomedical Engineering

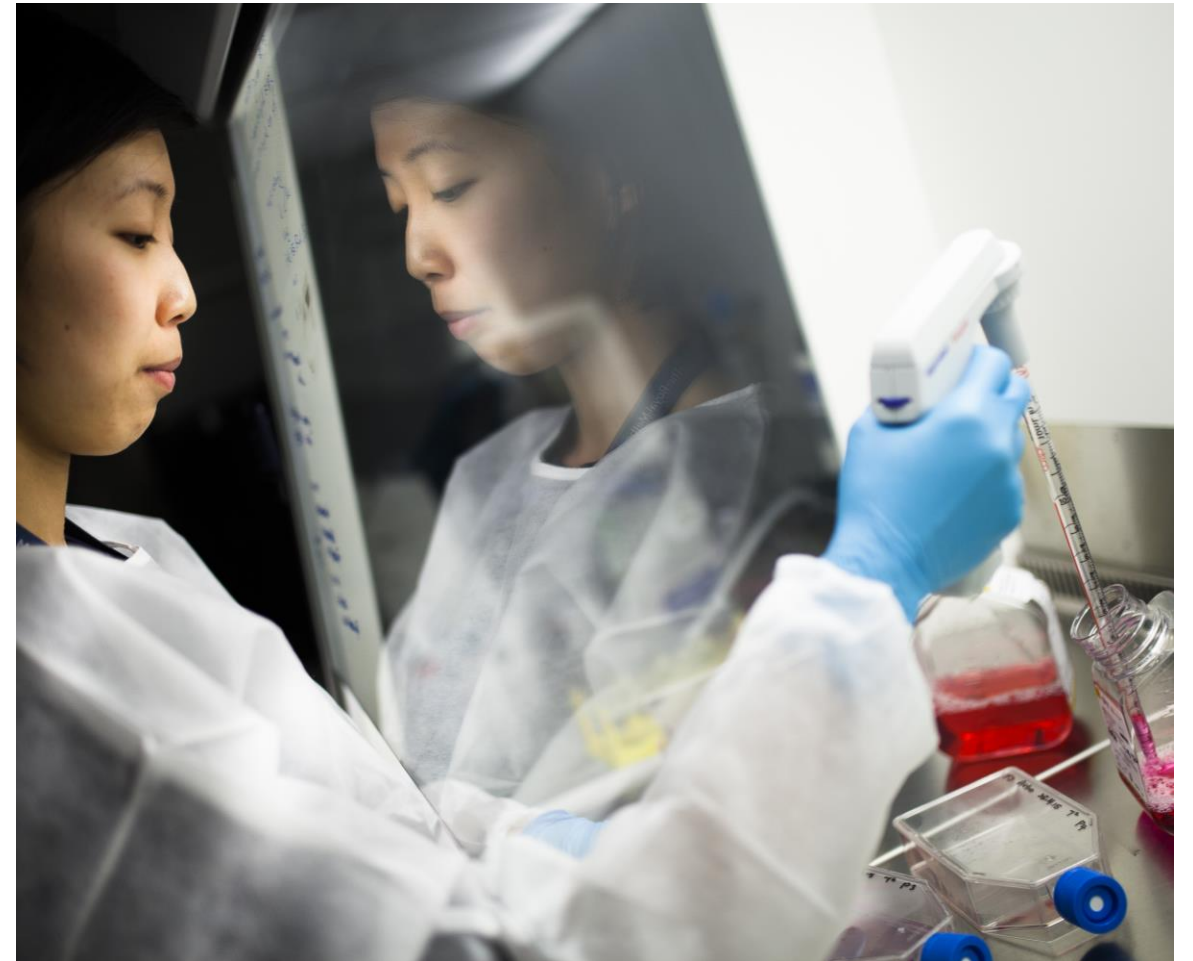


What is Biomedical Engineering?



Biomedical engineers blend biomedical science with engineering techniques to create healthcare solutions.

- As life expectancies increase, engineers, doctors and clinicians are working together to ensure our bodies can take us further than before.
- Meet the healthcare challenges of the future.
- Design new medical devices or help solve clinical problem to help patients in need.
- Apply skills in:
biology, physics, chemistry and maths.

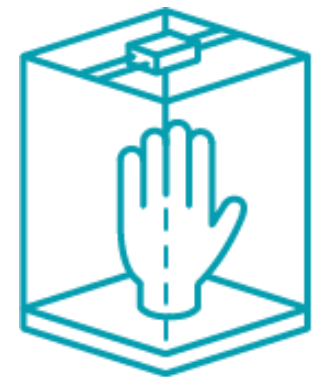
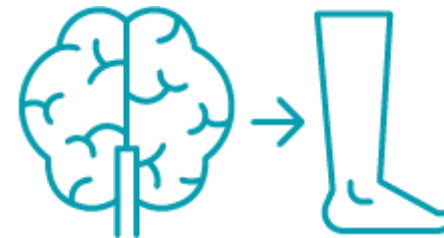
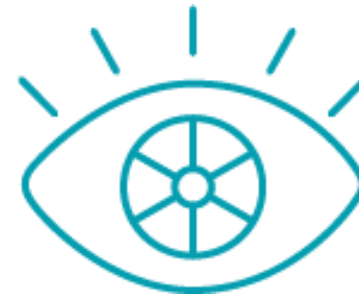


World-leading Biomedical Research at the University



Our biomedical engineering research includes:

- Bionic eye
- Low-cost prosthetics
- Brain-computer interfaces
- Bioprinting and tissue engineering
- Joint implant design
- Ultra-high field MRI imaging



Types of Biomedical Engineering



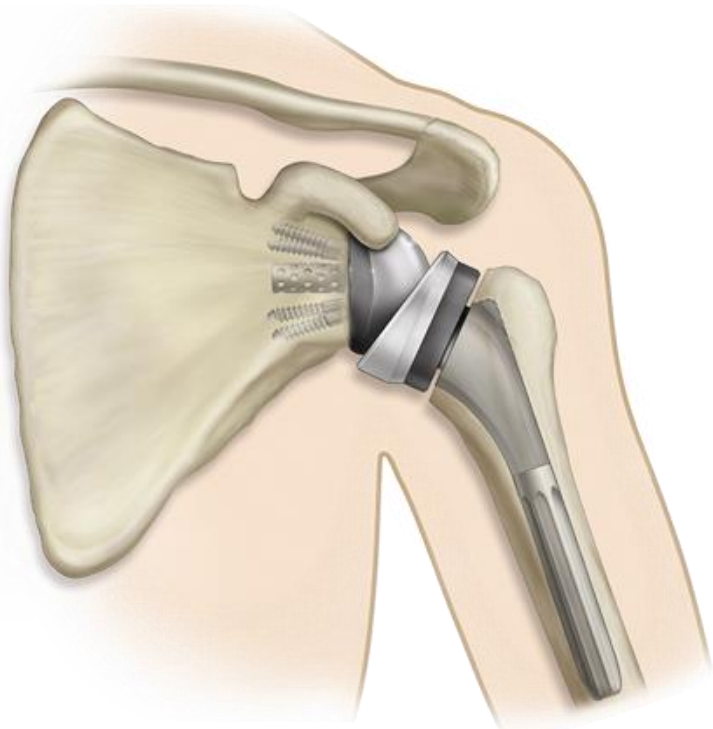
- Biomechanics
- Tissue engineering
- Clinical engineering
- Rehabilitation engineering
- Medical bionics
- Medical imaging
- Prosthetics
- Medical device design
- Bioinformatics
- Systems biology
- Neural engineering
- Nanotechnology
- Biosignals



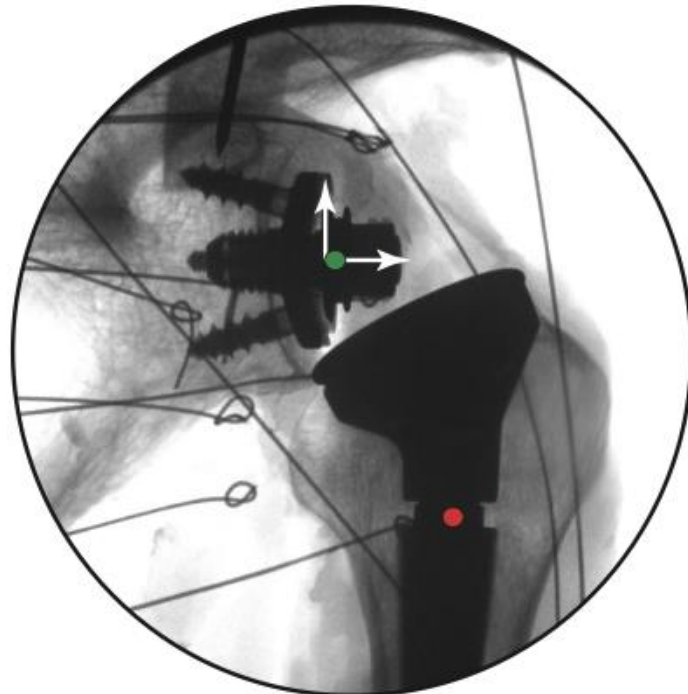
Biomechanics

The study of the forces acting in and on the human musculoskeletal system.

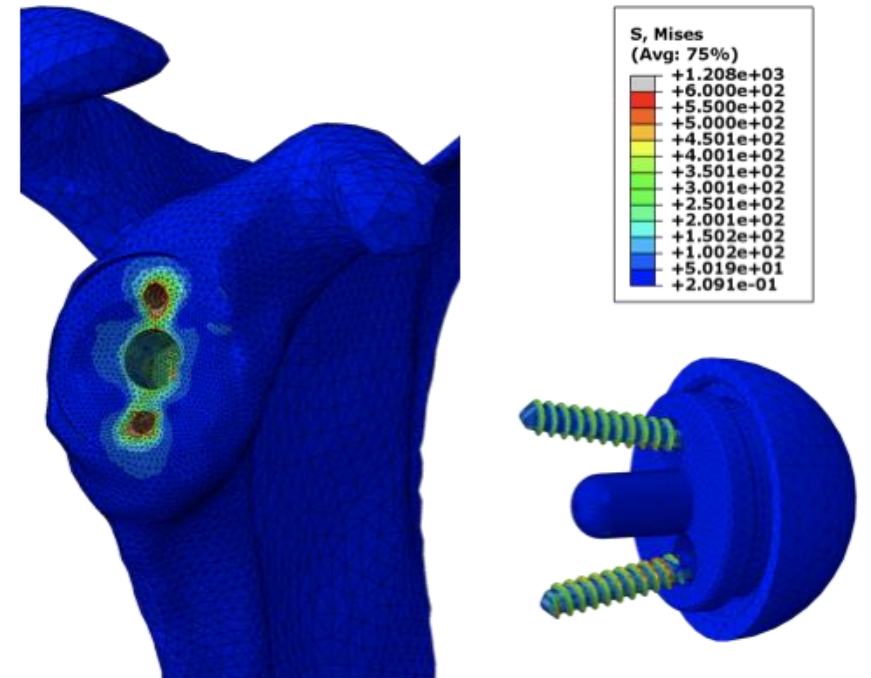
Surgical planning (orthopaedics)



Patient clinical data analysis



Musculoskeletal modelling of bone, joint and implant function



Human movement analysis and augmented reality



Gait analysis in the Computer Assisted rehabilitation environment (CAREN)

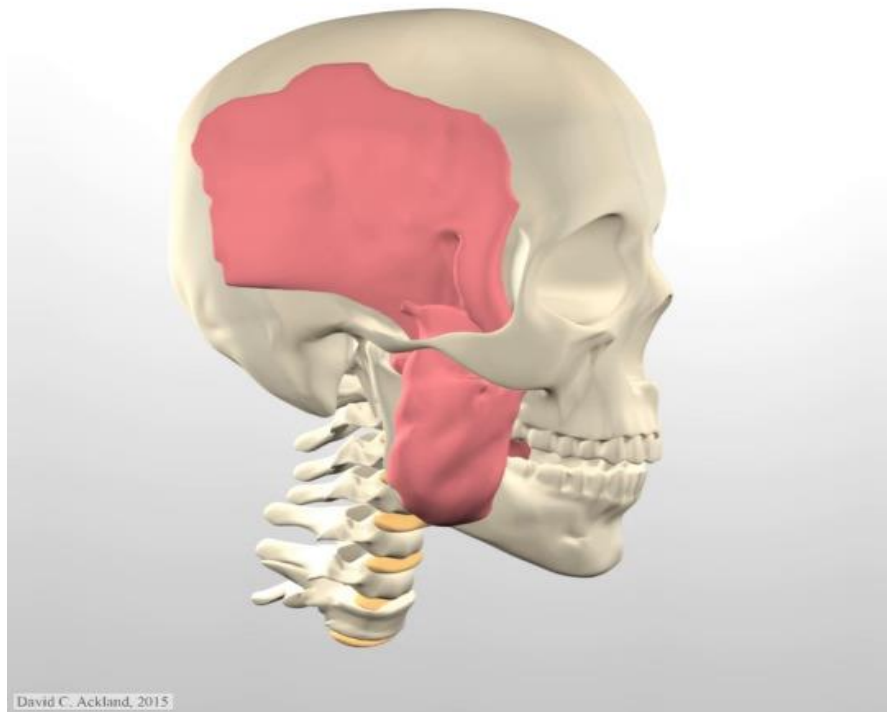


Computational modelling of muscles and joints



From implant design to implantation

Musculoskeletal modelling



3D printing



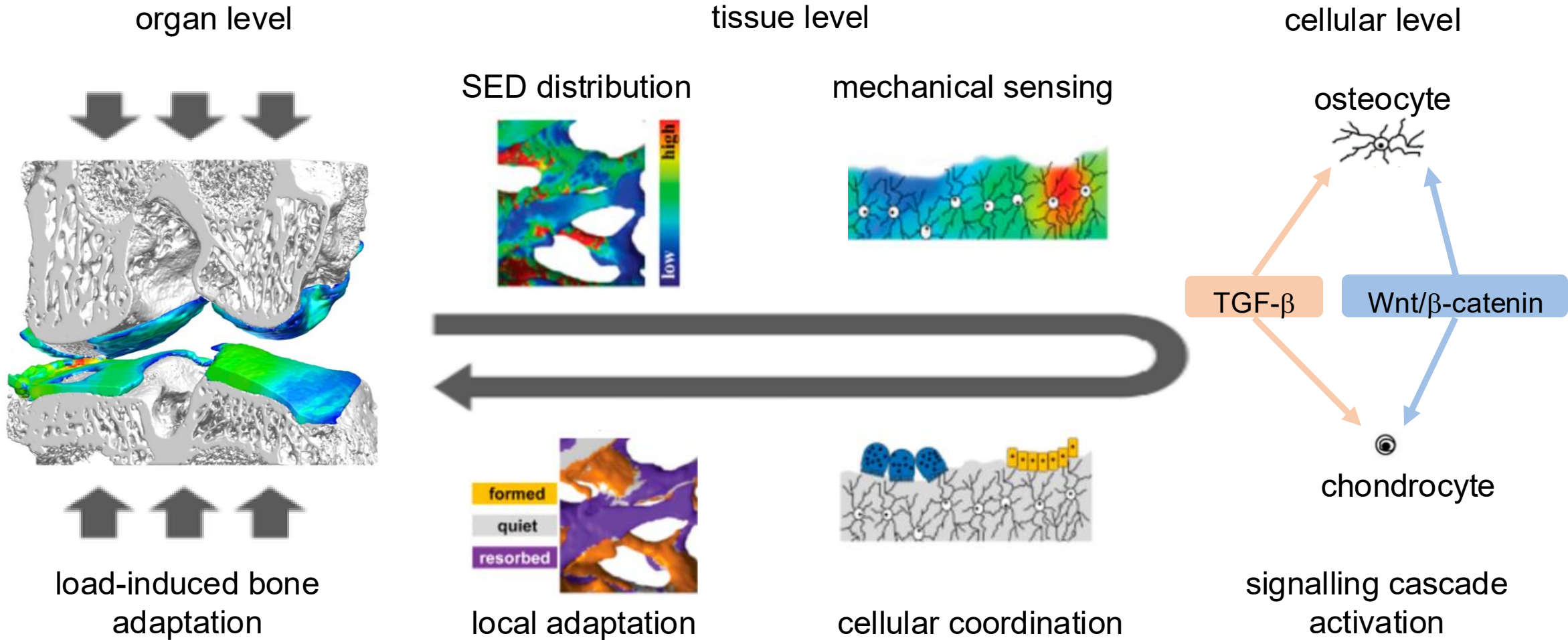
Surgery



Post-operative evaluation



Multiscale Musculoskeletal Mechanobiology

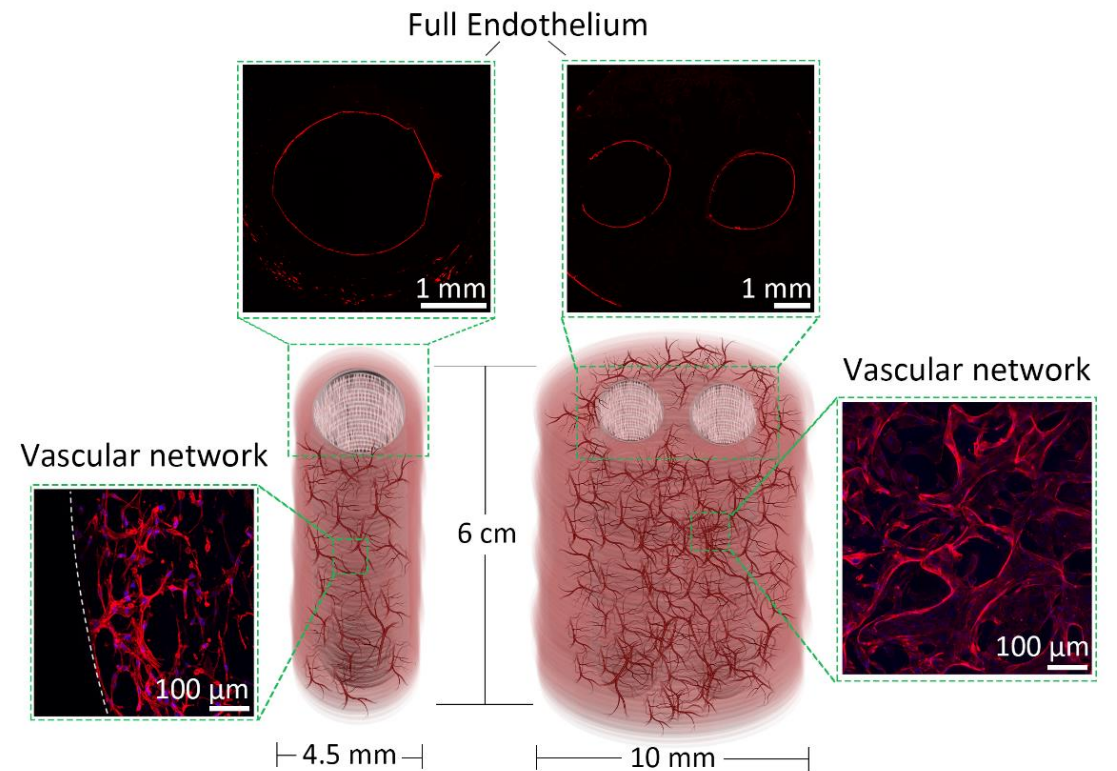
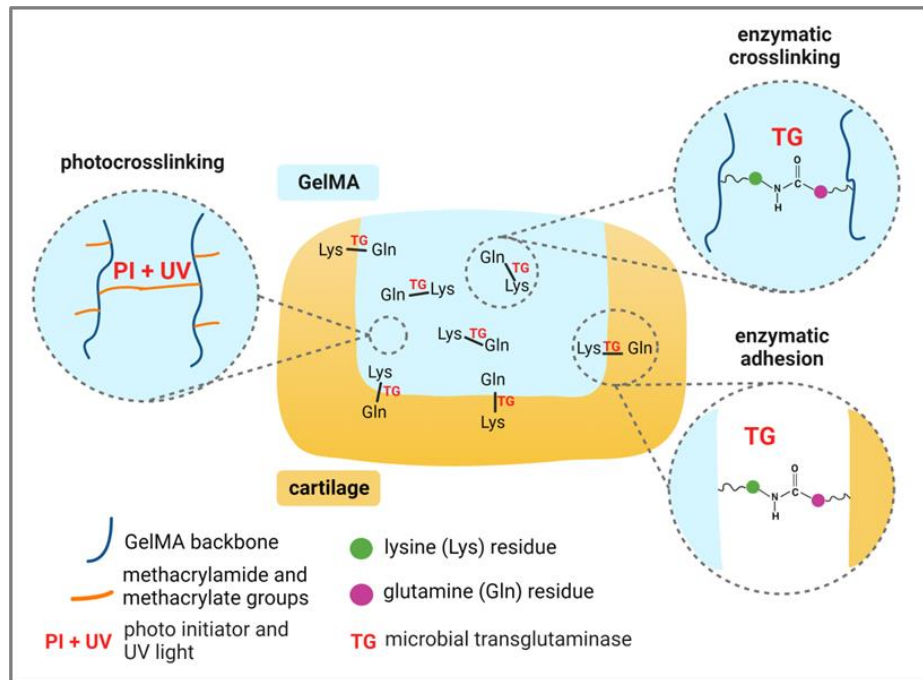


Tissue Engineering

Biomaterials to improve tissue integration

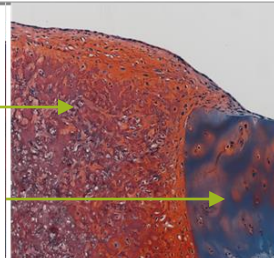


Engineering vascular grafts and vascularized tissues



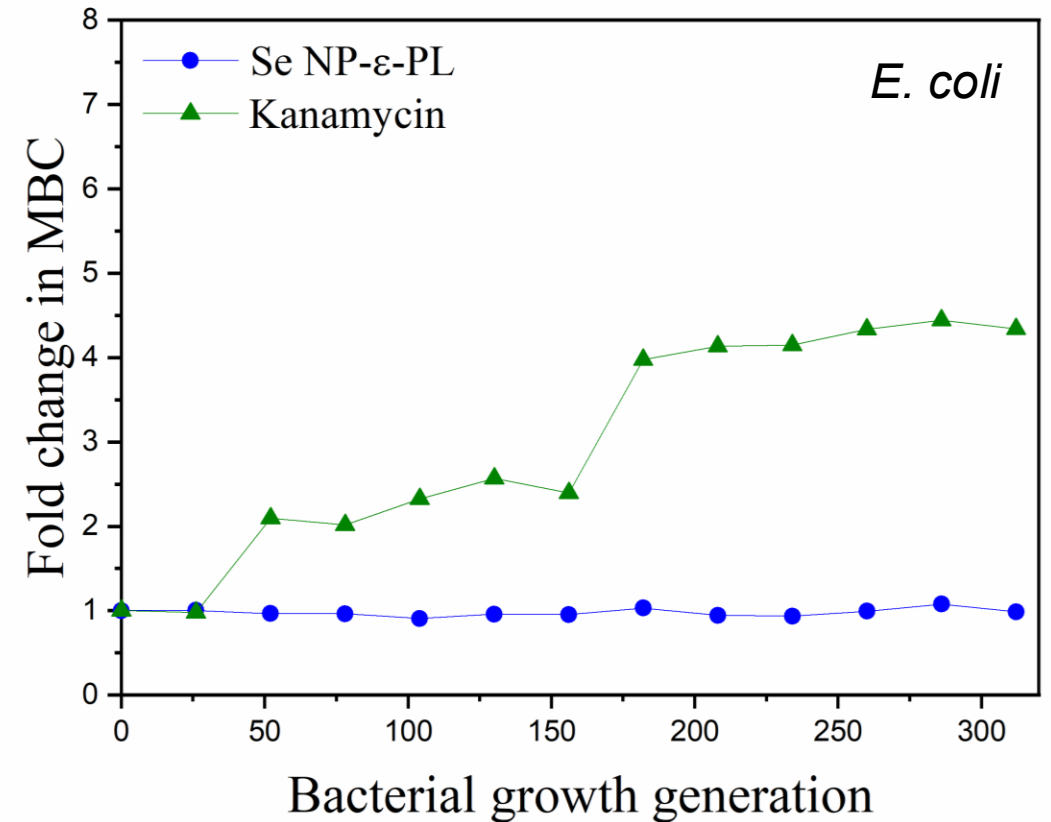
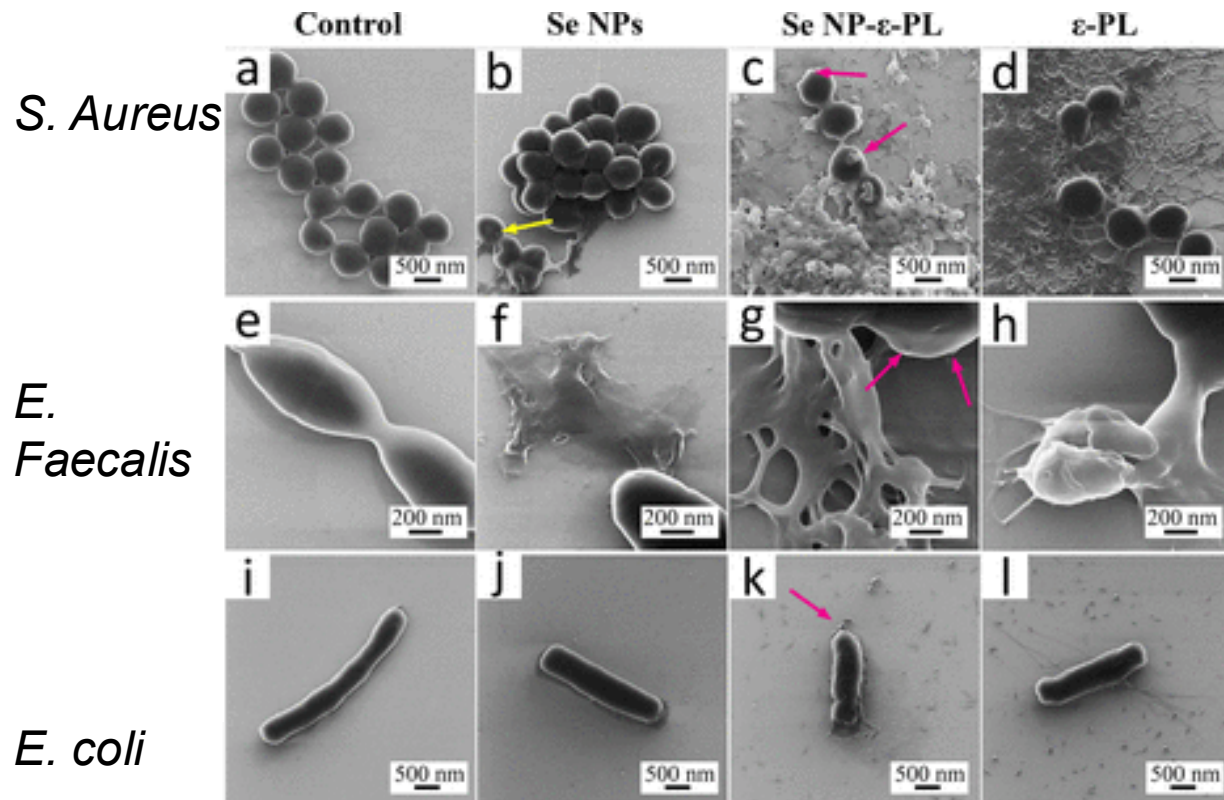
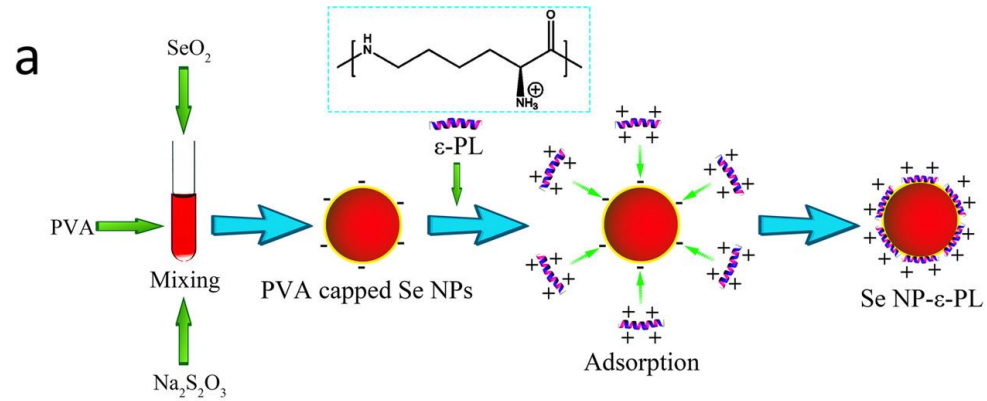
Engineered tissue

Host tissue



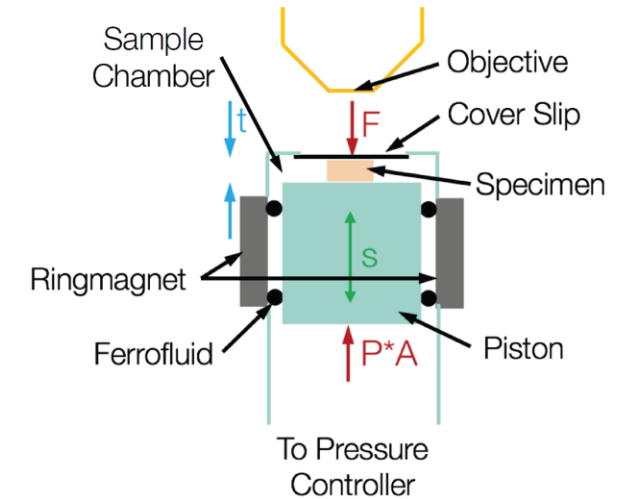
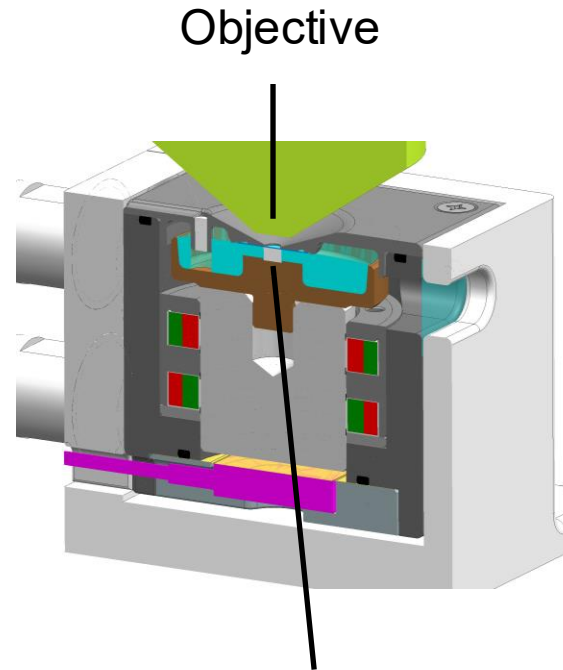
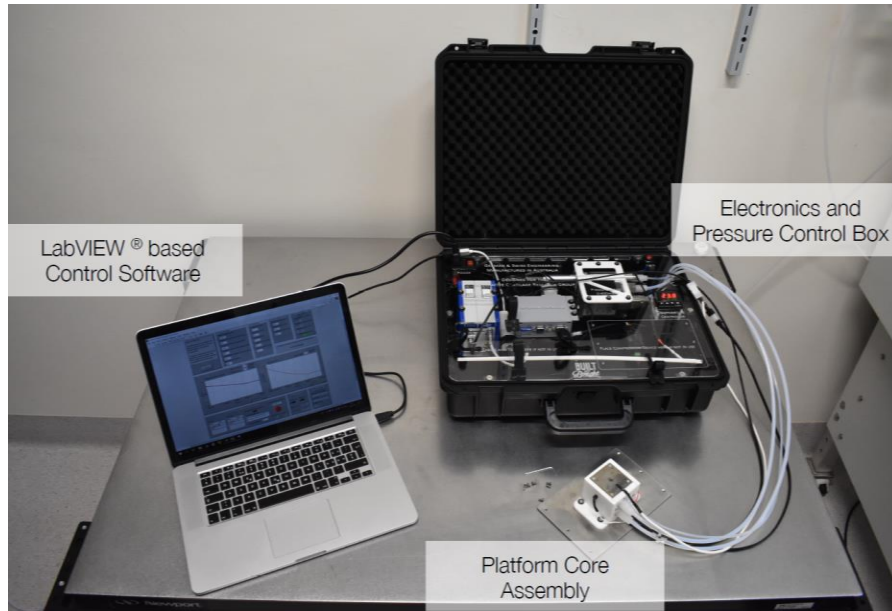
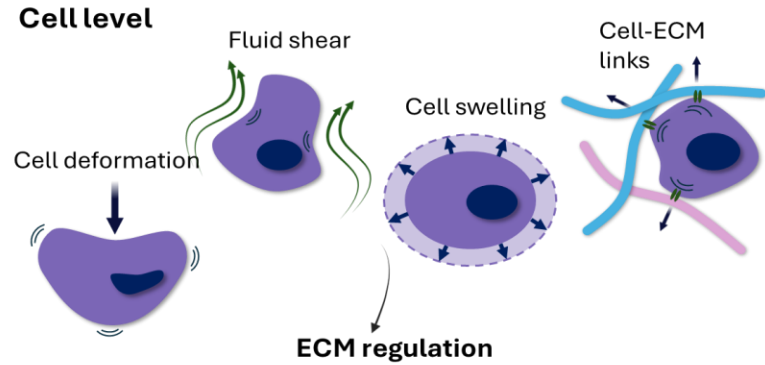
- Safranin-O
- FastGreen
- Hematoxylin

Antimicrobial nanomaterials to combat resistance



MBC: minimum bactericidal concentration
Huang *et al.*, *ACS Applied Materials & Interfaces*, 2020

Instrumentation for Assessing Tissue Development

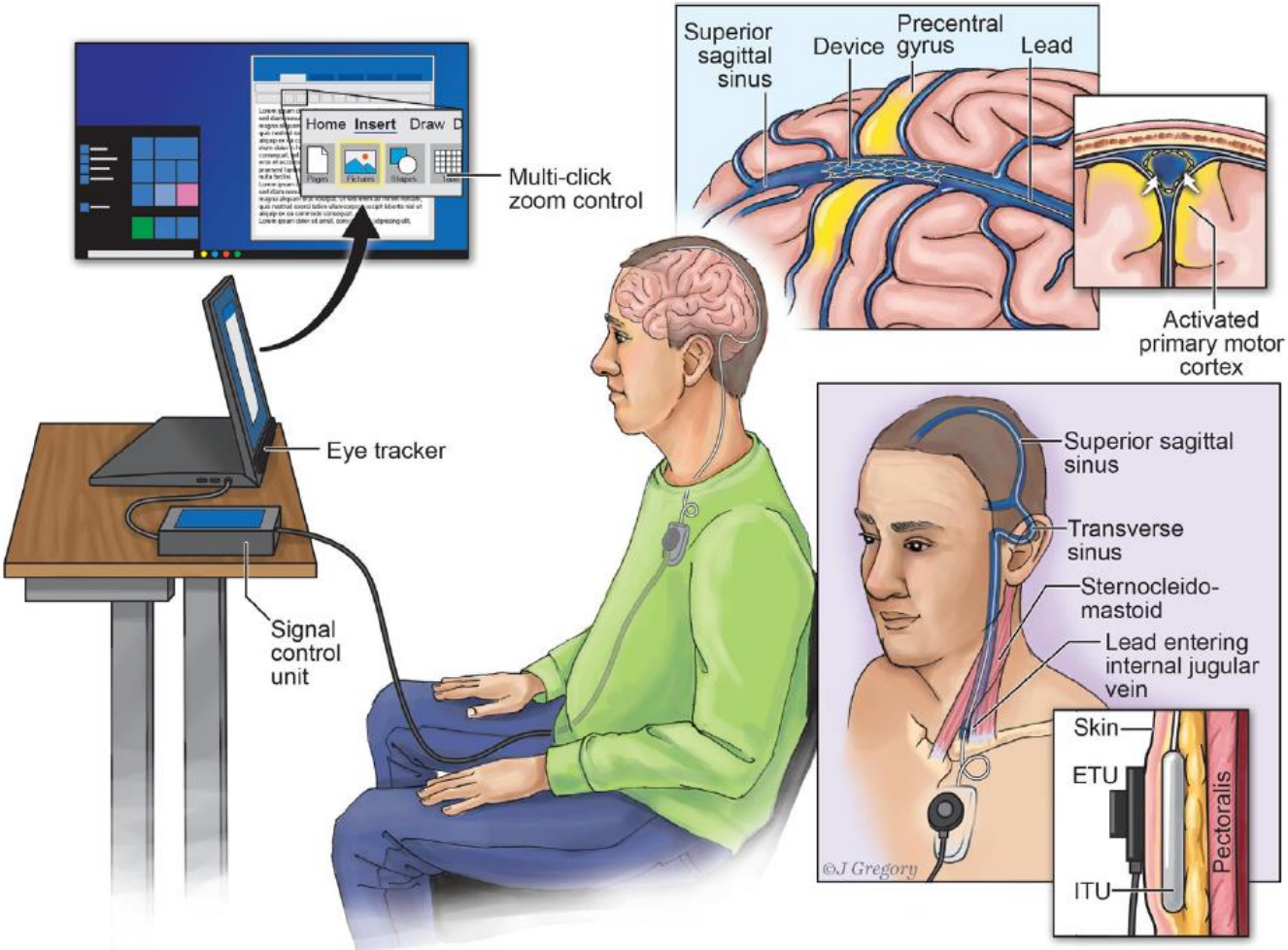
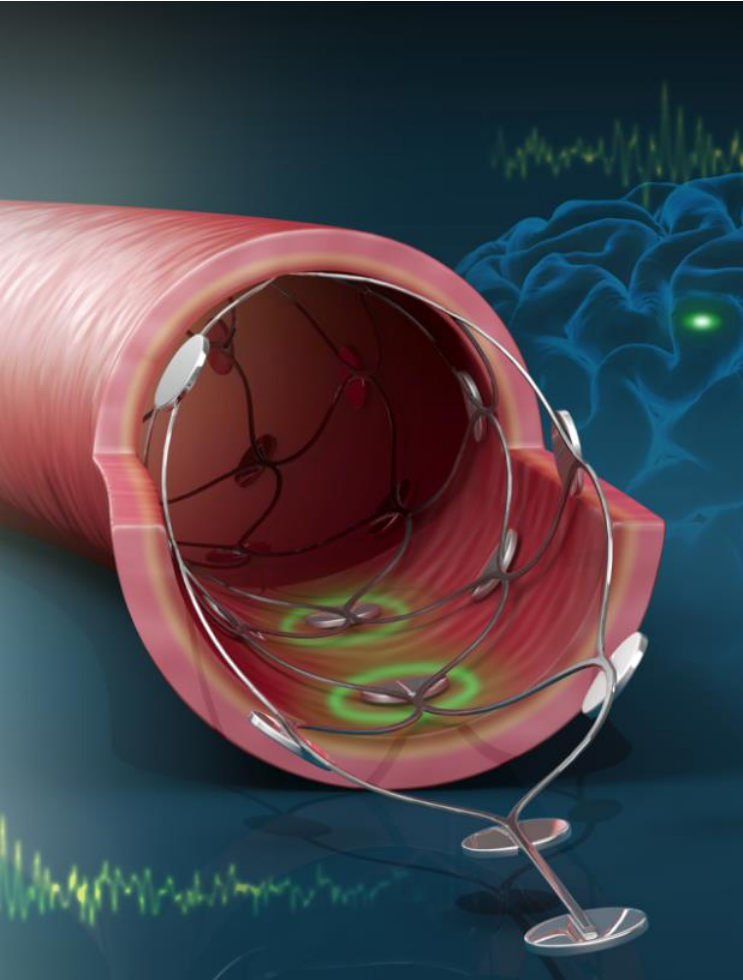


Stok *et al.* 2025, In: *Bioimaging in Tissue Engineering and Regeneration*. Springer
 Boos, *et al.*, *J Mech Behav Biomed Mater*, 2023.

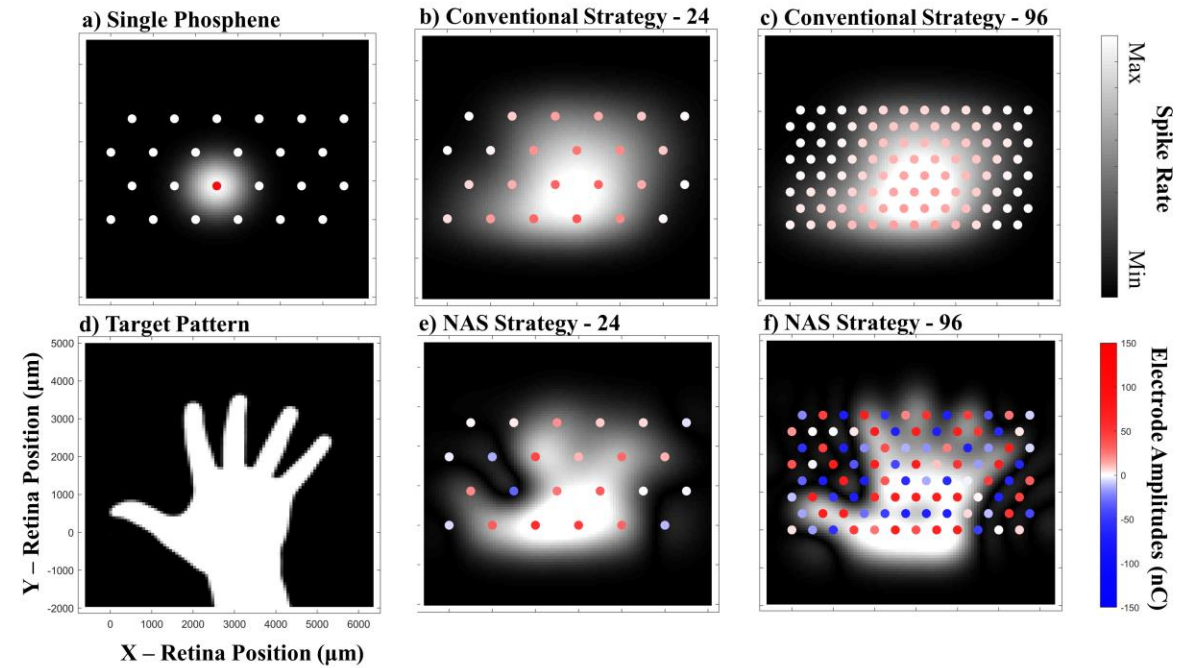
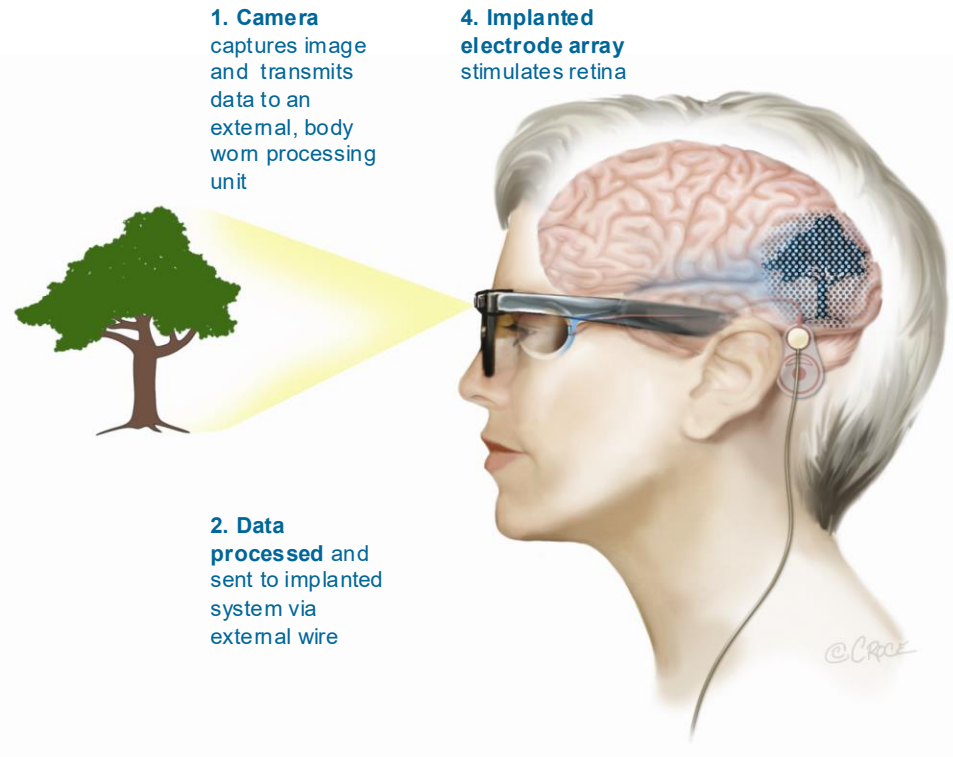
Biosignals



Brain Computer Interfaces



Medical Bionics

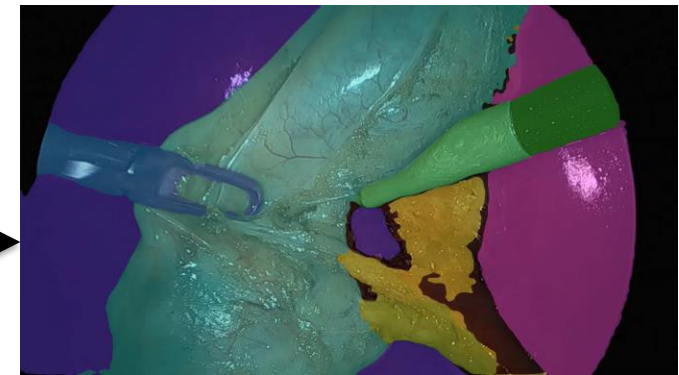
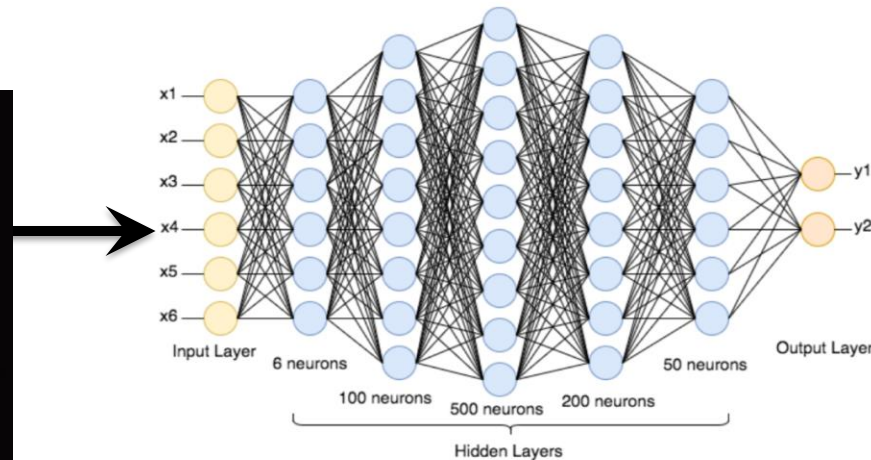
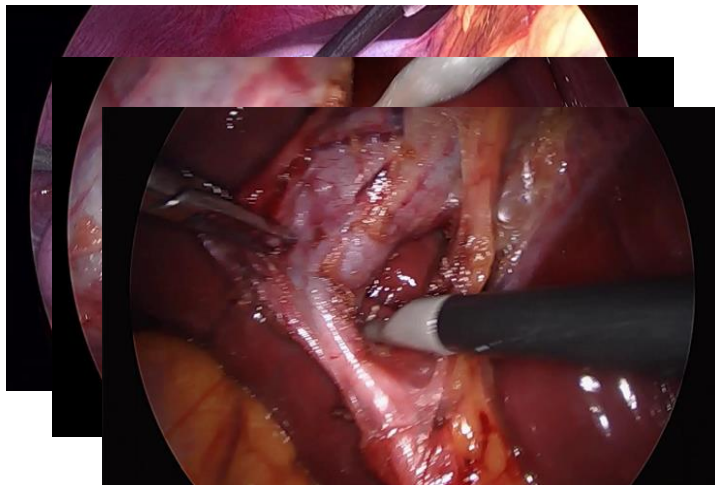


Artificial Intelligence in Surgery

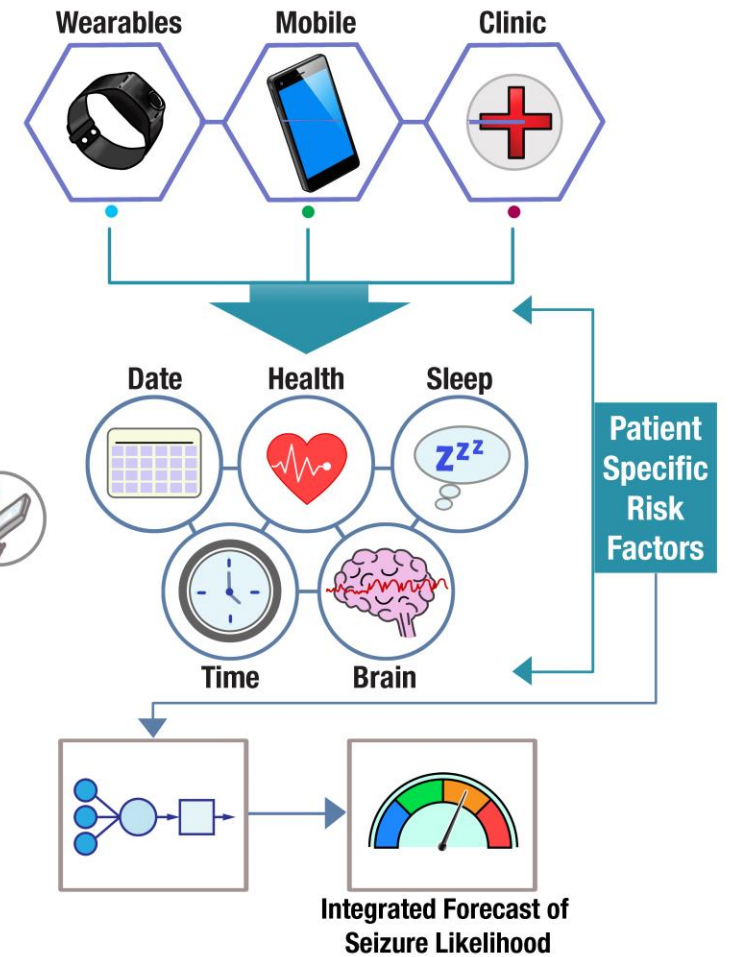
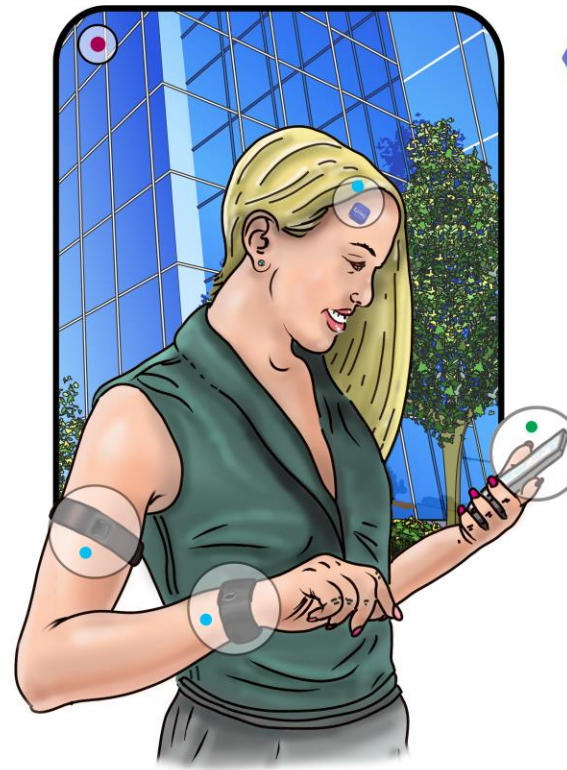


- Use AI to interpret the video display
 - Identify critical view of safety in laparoscopic cholecystectomy

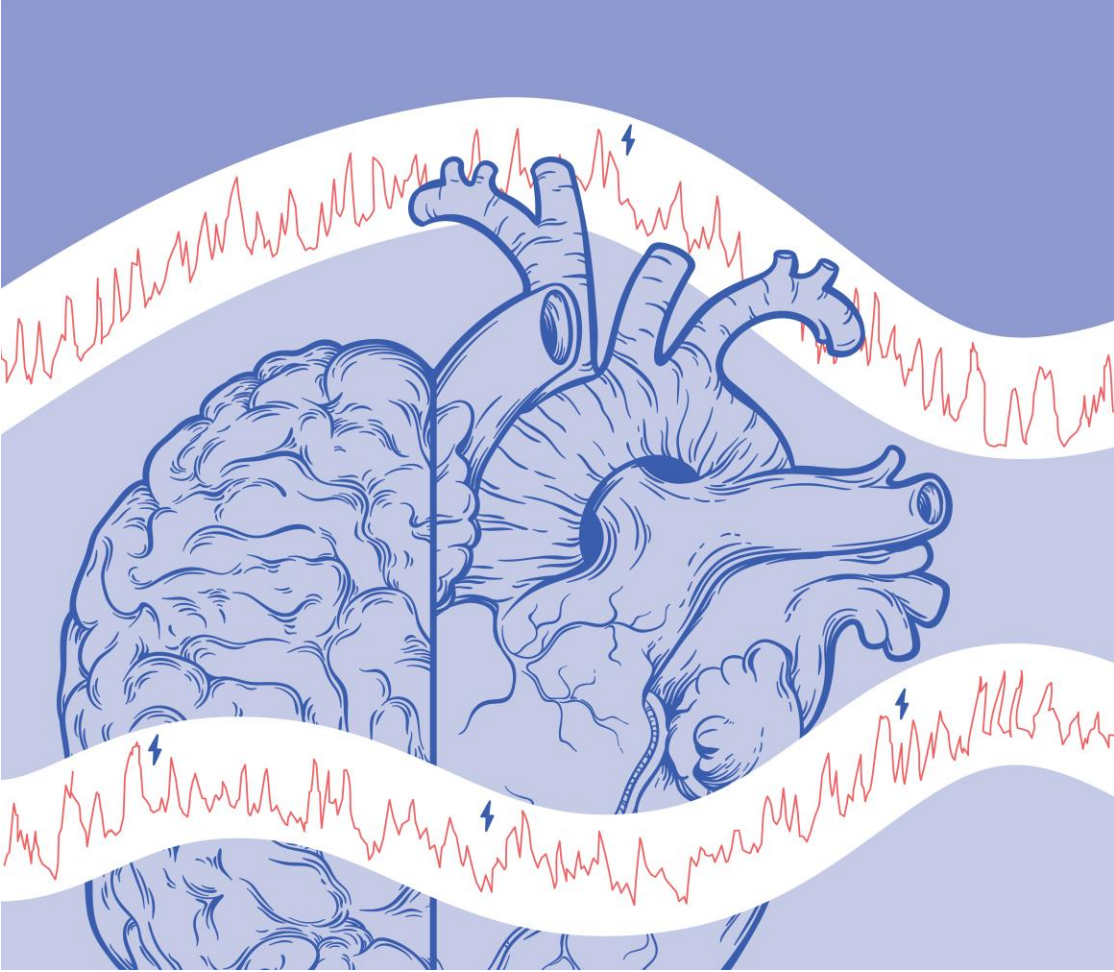
Liao (2025), *Frontiers in Surgery*.



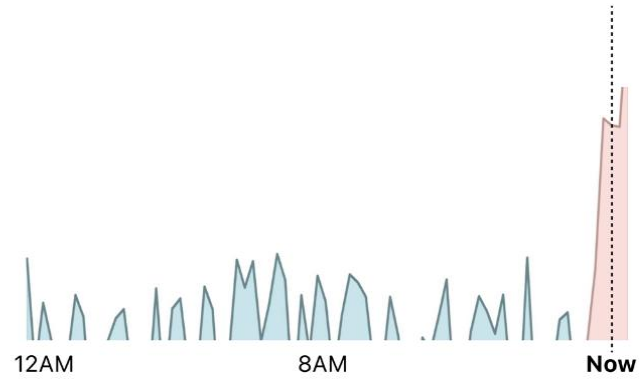
Wearable MedTech



Wearable MedTech



(A) Seizure Warning System



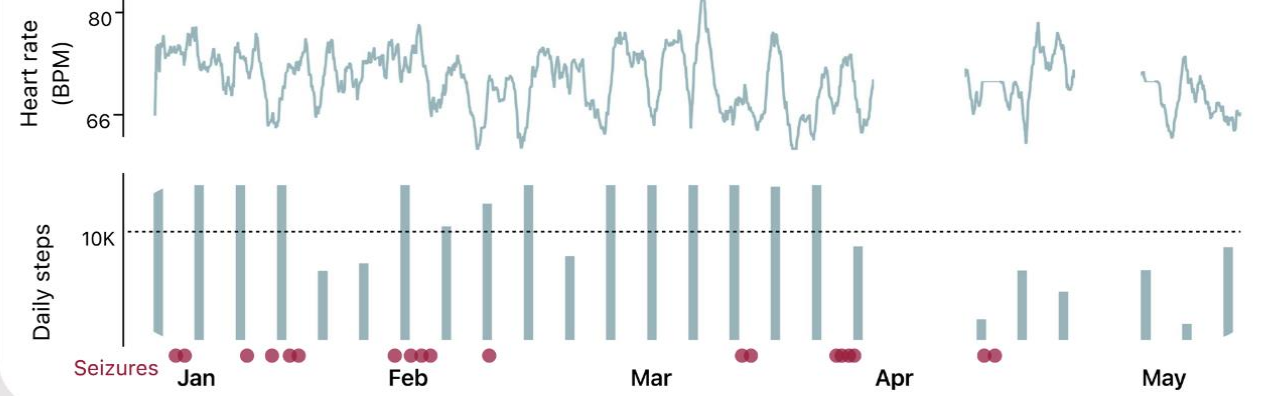
70% You are at **high risk** of a seizure in the next 15 minutes. Move to a safe location.

(B) Seizure Risk System



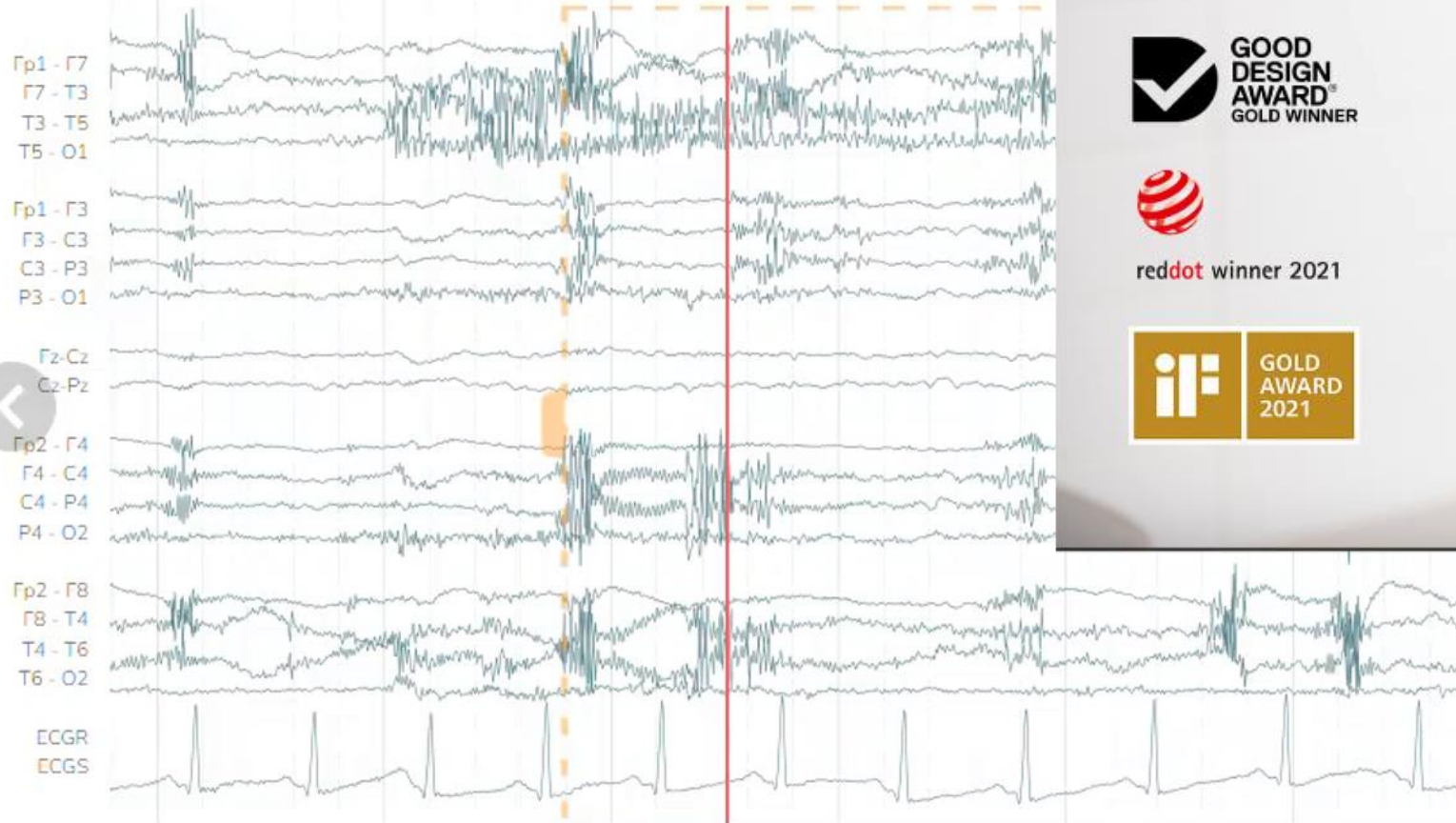
20% Your hourly risk is **baseline**

(C) Wearable Insights

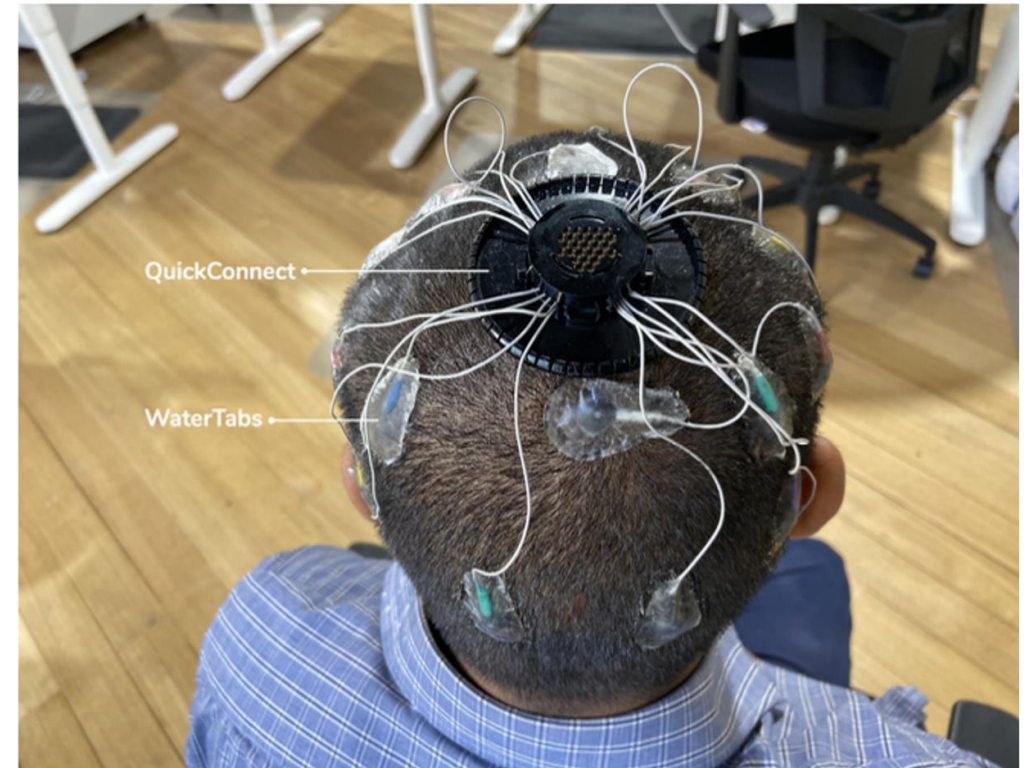
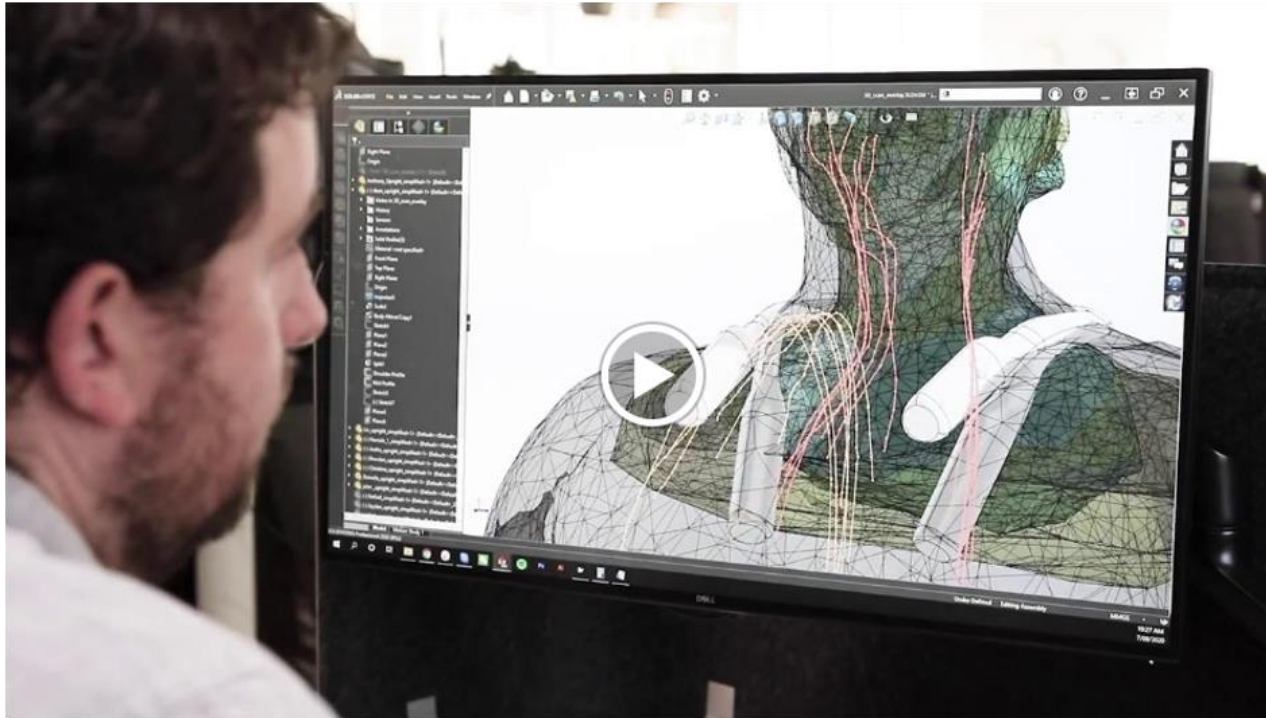


Seizures Jan Feb Mar Apr May

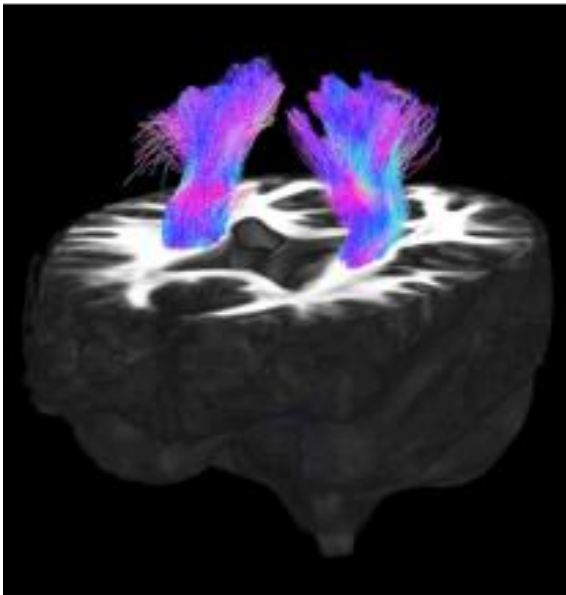
Wearable MedTech



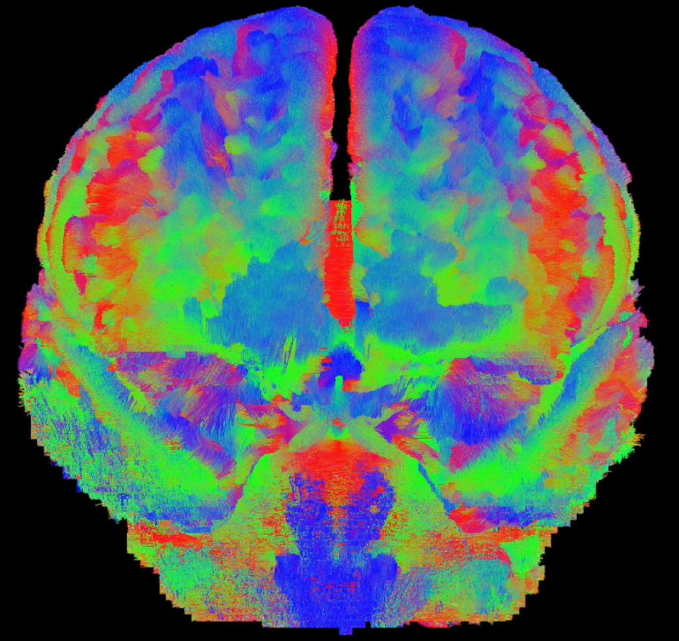
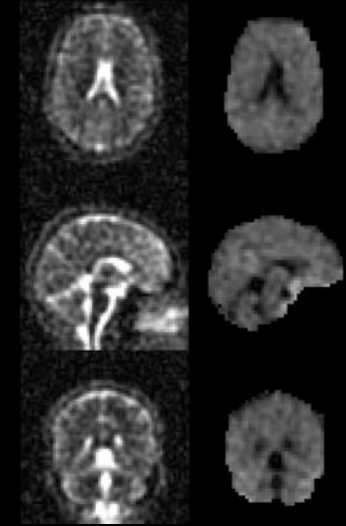
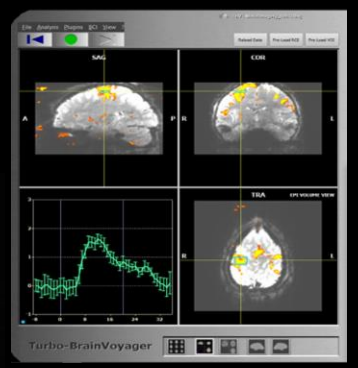
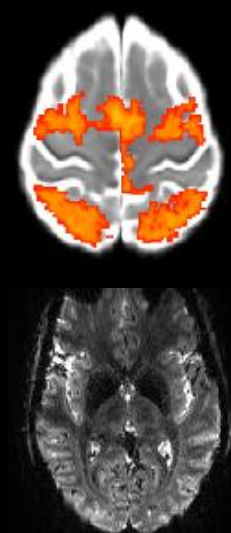
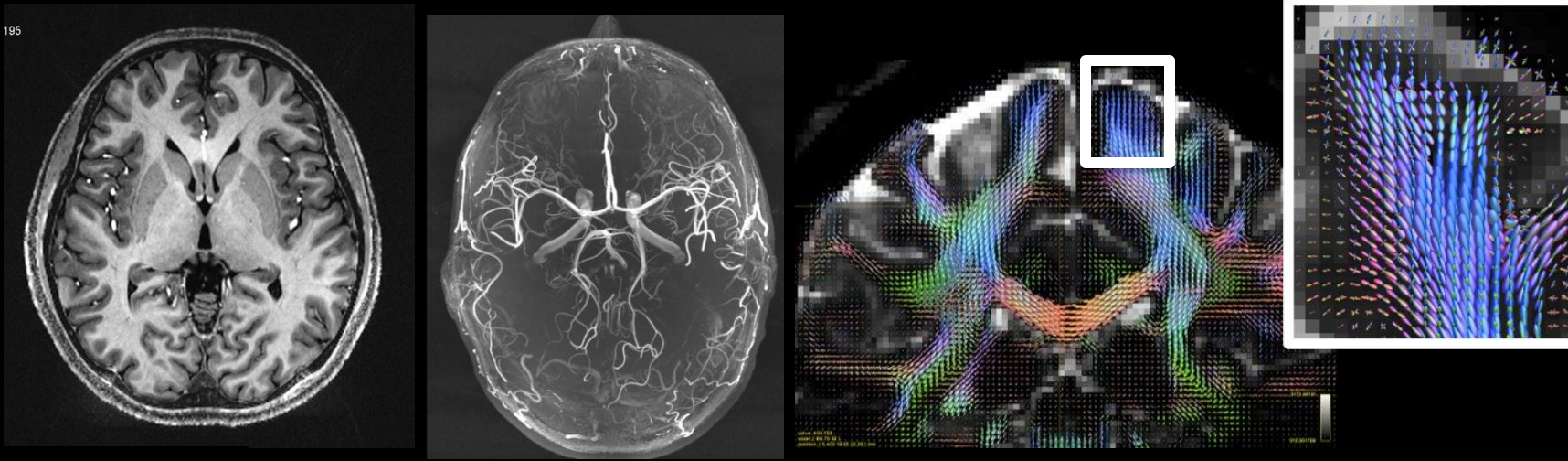
Wearable MedTech

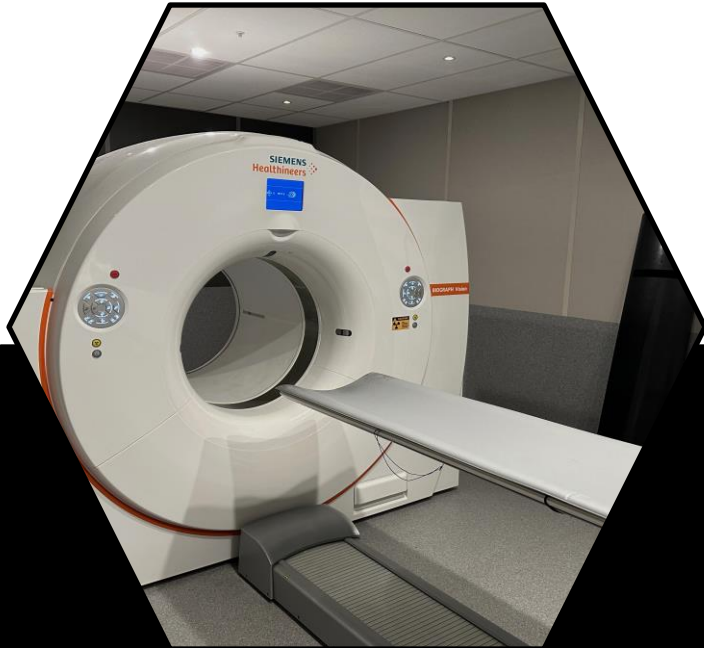


Medical Imaging

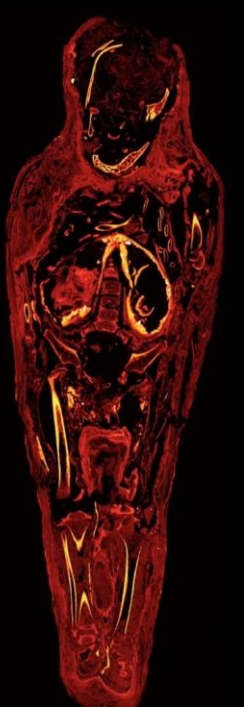
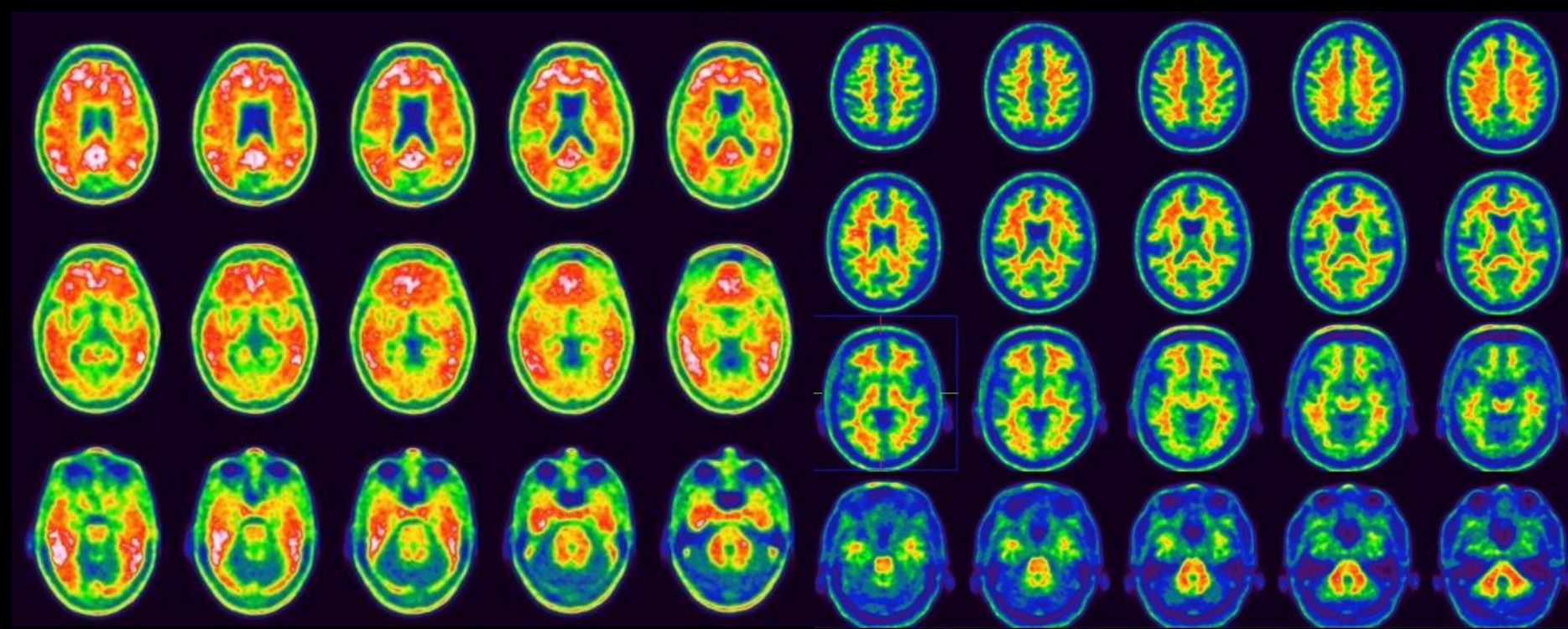


Medical Imaging





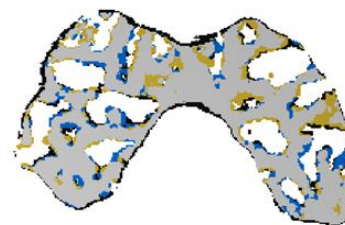
Medical Imaging



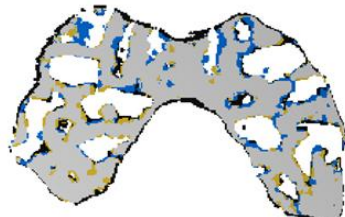
Preclinical *In Vivo* Imaging



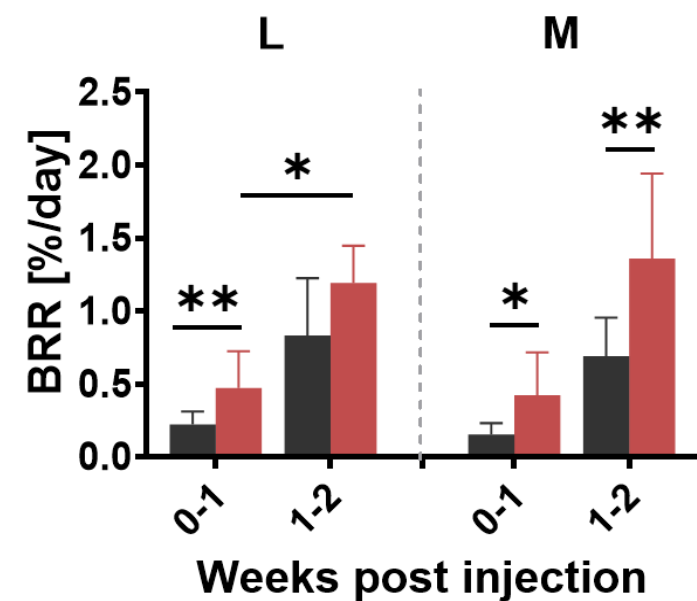
Baseline – Week 1



Week 1 – Week 2



- Formed bone
- Resorbed bone
- Constant bone



- CT
- OA

Biomedical Engineering



And many other areas...
Some not even
thought of yet!

Industry and Employability



Internships

- Undertake 10-15 weeks of professional work experience
- Gain credit towards your degree

Industry projects

- Creating Innovative Engineering
- BioDesign Innovation
- STEM Mentoring Program

Boost your employability

- Career building events and employability workshops

Clubs and societies

- Join the **Engineering & IT Community** in your bachelor's degree
- Sign up for an engineering or IT student club: MUBES, EWB, Melbourne Space Program, Robogals, WISE and more

Endeavour Exhibition - May and October

- Final-year engineering projects

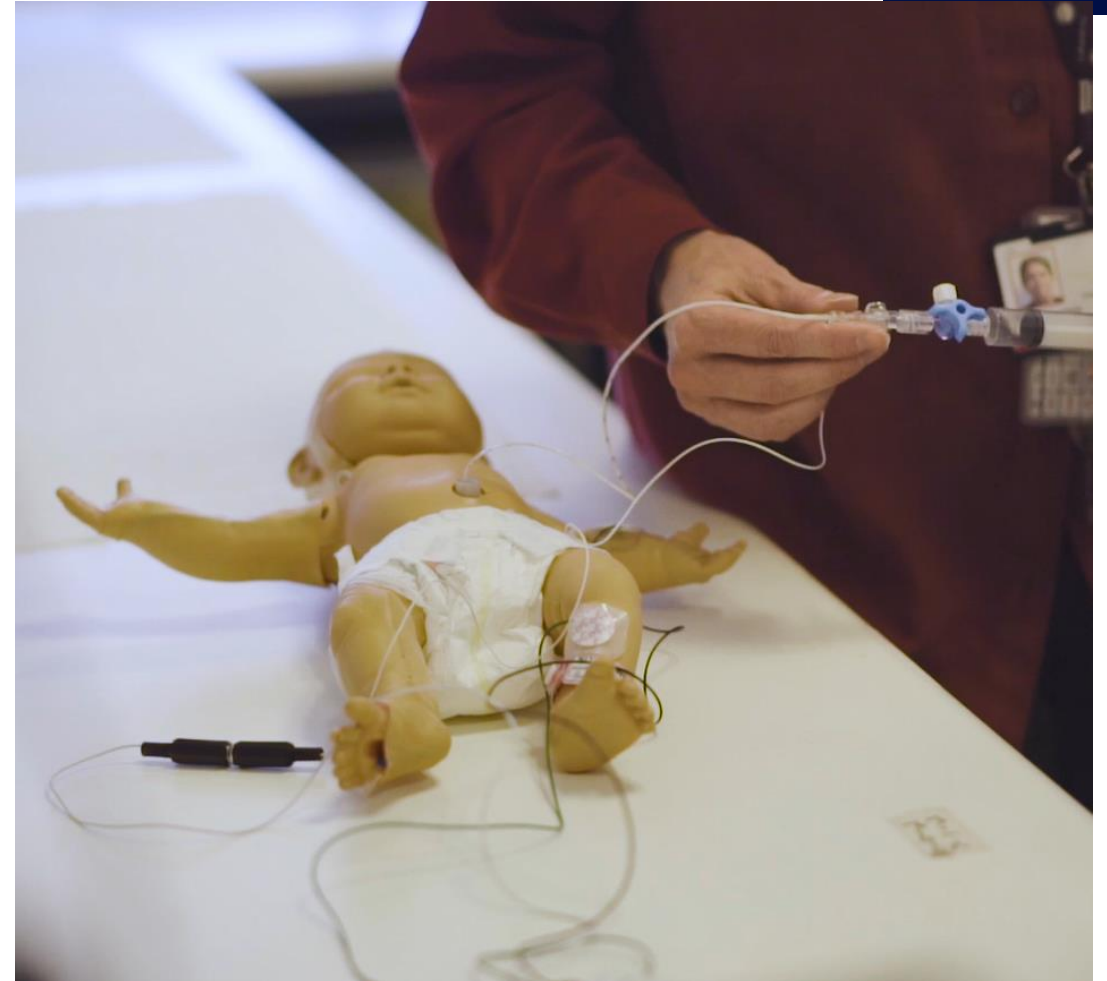


Shing Yue Sheung
Master of Biomedical Engineering

*Chief Operating Officer and Co-founder,
Navi Medical Technologies*

Biodesign Innovation Subject

- Develop a concept for a medical device and design a business plan
- Work with students from the Master of Business Administration (MBA) course and clinicians from Melbourne hospitals
- Success stories
 - Navi Medical Technologies, who have received more than \$2M in funding
 - Stelect, winners of Australia's largest medtech startup competition, Medtech's Got Talent



Graduate outcomes



Industries

- Biotechnology
- Health Services
- Hospitals
- Medical Devices
- Petrochemicals
- Pharmaceuticals
- R&D
- Start-ups
- Consultancy

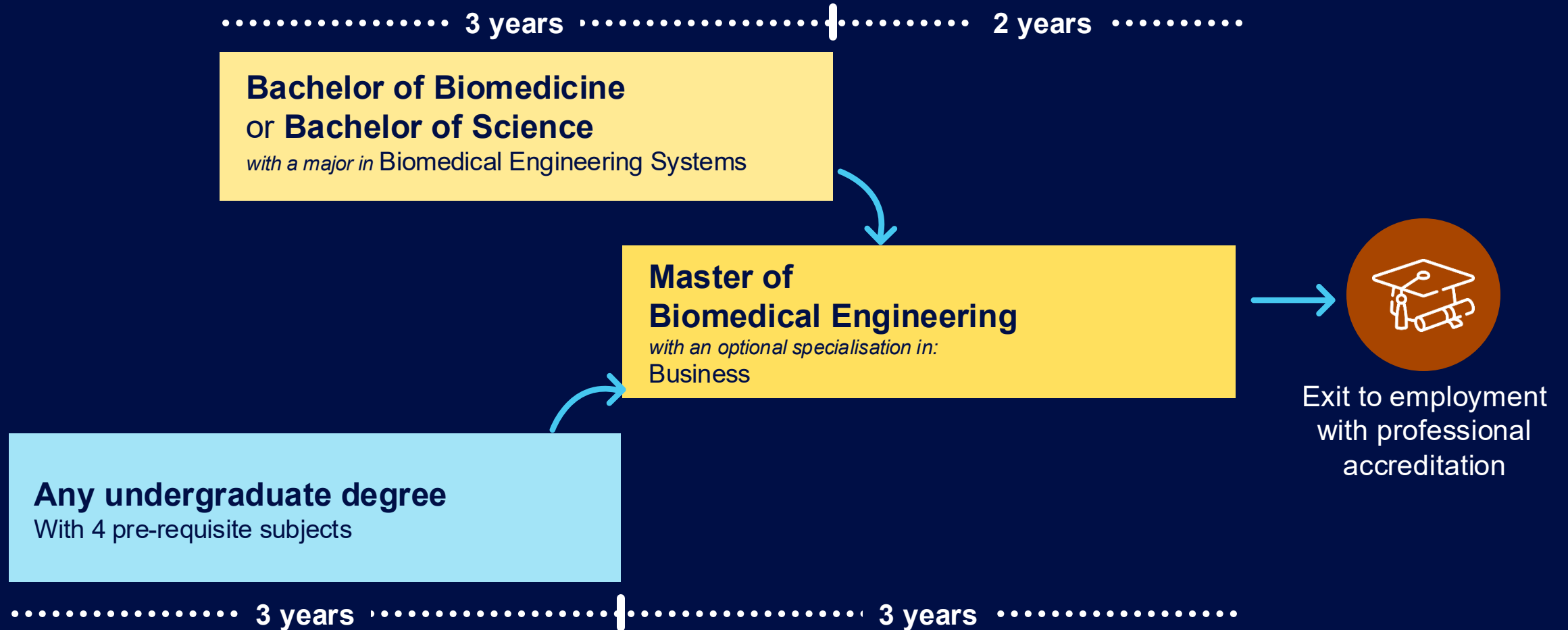
Companies

- Accenture
- Agilent technologies
- Bionics Institute
- Cerner Corporation
- Eastern Health
- GE
- IBM
- OMX Solutions
- Royal Children's Hospital
- Toshiba Medical Systems

Job roles

- Research Associate
- Design Engineer
- Field Service Technician
- Service Engineer
- Startup Founder
- Hardware Engineer

How to study Biomedical Engineering at Melbourne



Bachelor of Science

with a major in **Biomedical Engineering Systems**



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Year 1	Semester 1	Engineering Technology and Society	Calculus 2	Foundational Biology: Life's Machinery	Today's Science, Tomorrow's World
	Semester 2	Engineering Modelling and Design	Linear Algebra	Chemistry 1	Breadth
Year 2	Semester 1	Engineering Mathematics	Applied Computation in Bioengineering	Science Elective	Breadth
	Semester 2	Anatomy and Physiology for Bioengineering	Science Elective	Science Elective	Breadth
Year 3	Semester 1	Mechanics for Bioengineering	Circuits and Systems	Science Elective	Breadth / Science Elective
	Semester 2	Introduction to Biomaterials	Biosystems Design	Science Elective	Breadth / Science Elective

	Core		Major		Elective		Breadth		Recommended
Foundational knowledge that builds towards your major.		Specialised subjects that will be recognised on your transcript.		Subjects from any discipline within your course.		Subjects from disciplines outside your faculty that allow you to explore other fields.			



Master of Biomedical Engineering

Year 1	Semester 1	Biomechanics	Bioengineering Data Analytics	Bioinstrumentation	Bioengineering elective
	Semester 2	Biofluid Mechanics	Biosignal Processing	Interdisciplinary Design for Engineers	Bioengineering elective
Year 2	Semester 1	Biomedical Engineering Capstone Subject	Biomedical Engineering Management & Regulations	Bioengineering elective	Approved Elective
	Semester 2		Bioengineering elective	Bioengineering elective	Bioengineering elective



Core



Elective

Career Outcomes



Our student opportunities

Internships



- » Hospitals
- » Biomedical industry

Student projects



Design your own biomedical engineering instrumentation, from prosthetics to pacemakers, and use our state-of-the-art facilities to fabricate components.

Work on projects such as monitoring the vital signs of patients, a diagnostic tool for stent selection, speech recognition software and more.

Graduate employment opportunities



- » Hospitals (e.g. Royal Melbourne Hospital, Royal Children's Hospital, Epworth Healthcare)
- » Biomedical Institutes (e.g. Bionics Institute, Walter and Eliza Hall Institute, St Vincent's Institute)
- » Government agencies (e.g. CSIRO, Defence Science and Technology Group)
- » Medical device companies (e.g. Cochlear, OMX Solutions, Seer Medical)

Where our graduates work

Industries



- » Biotechnology
- » Finance
- » Health Services
- » Hospitals
- » Medical Devices
- » Government
- » Information Technology
- » Pharmaceuticals
- » R&D
- » Start-ups
- » Consultancy

Companies



- » Accenture
- » Agilent Technologies
- » Bionics Institute
- » Cerner Corporation
- » Eastern Health
- » GE
- » IBM
- » OMX Solutions
- » Royal Children's Hospital
- » Toshiba Medical Systems

Job roles



- » Analyst
- » Clinical Engineer
- » Design Engineer
- » Field Service Technician
- » Hardware Engineer
- » Research Associate
- » Service Engineer
- » Startup Founder



Noon Gudgin

(Thank you)

Associate Professor Sam John
Head of Department of Biomedical Engineering (Academic)



THE UNIVERSITY OF
MELBOURNE

Chemical Engineering Systems

Presenter: Professor Ray Dagastine

What is Chemical Engineering?



- Chemical engineers are meeting the world's growing need for food, energy and water
- Preserve the environment and develop solutions to heal our bodies
- Chemical engineering enables us to create and enhance materials underpinning devices and technologies
- Apply your skills in chemistry and maths
- Develop a skill set that can be applied to an amazing breadth of problems and challenges!!!



What is Chemical Engineering?

A Chemical Engineer is:

- Professional person experienced in the *design*, *construction* and *operation* of a *plant* in which *materials* undergo *chemical* or *physical change* to *fill a need by society*.
- Working in areas including carbon capture and storage, minerals and materials, fuel, plastics, food & beverages, fertilisers, paper, natural gas processing, environmental remediation, biological waste treatment and novel bioproducts made using microbial, plant or animal cells.

OR:

- Professional person experienced in the *design* and *development of chemical products* including materials we use in our everyday lives including food and personal care products, nanotechnological and biotechnological devices, chemicals, pharmaceuticals, etc. to *solve a problem* or *fill a need by society*.

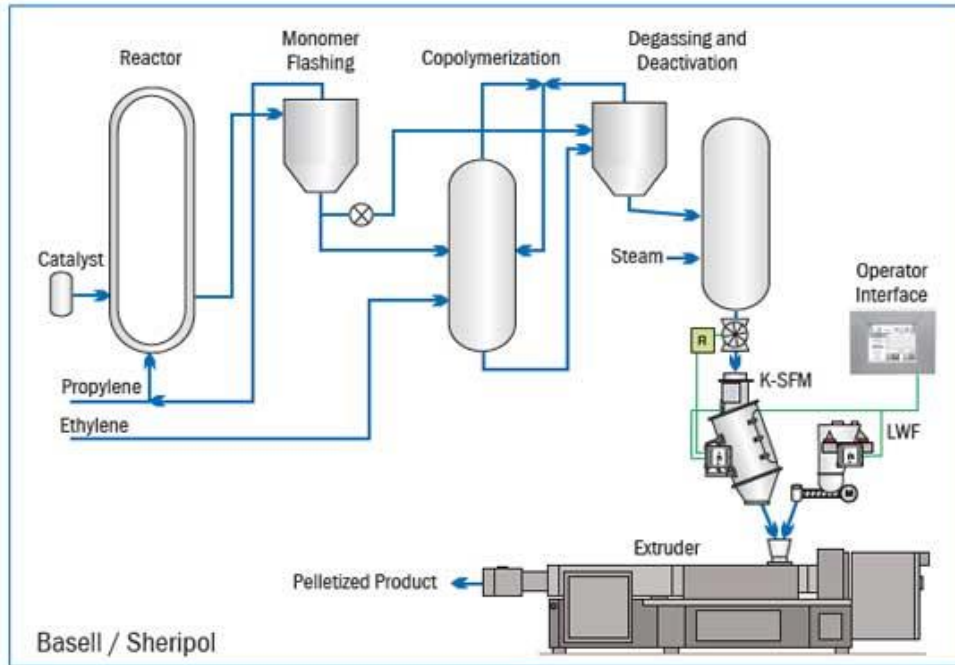


Nicholas Buttigieg
Bachelor of Science (Chemical Engineering
Systems major)
Master of Engineering (Chemical)

Project Engineer, CSL Behring

...but CHEMICAL ENGINEERING IS also...

Making Polymers

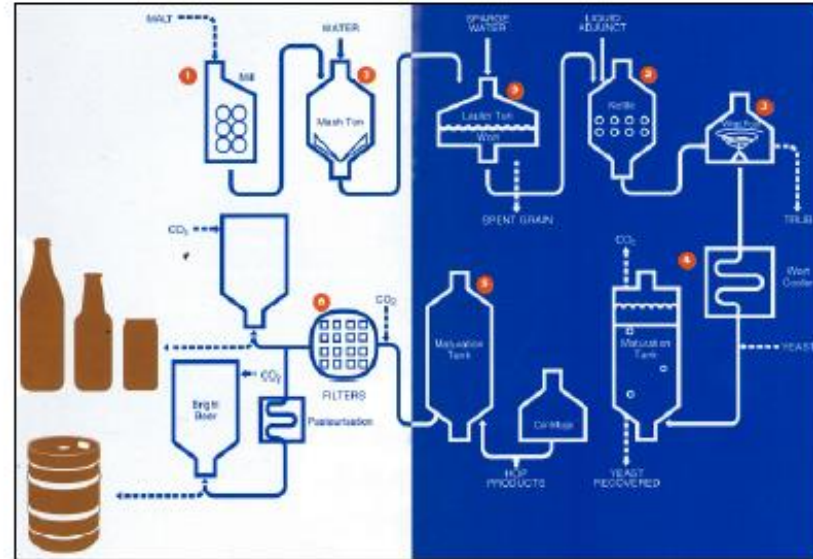


- Chemical Engineering pioneered production of polymers at scale
- Bank notes developed by researchers in our department
- Now, we are solving challenges in making polymers from non-fossil fuel-based sources

CHEMICAL ENGINEERING IS...



Carlton Brewery Process Flow



Making Glass Bottles in Spotswood at the Owens-Illinois Plant

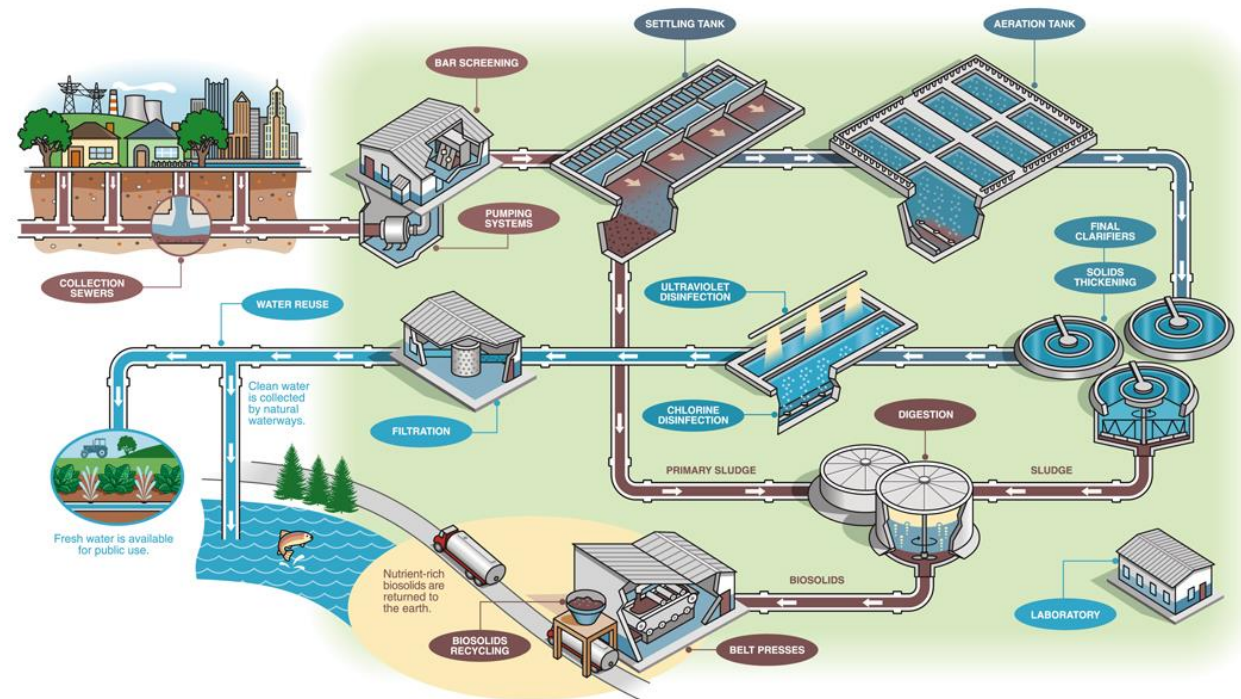


- You could be:
 - designing a fermenter
 - optimising the process or operations
 - Implementing new quality control technologies
- In the summer CUB bottles 1800 bottles a min in 8 hours
- Spotswood makes 600 bottles a minute and runs 24 hours a day

...but CHEMICAL ENGINEERING is also...

- Chemical Engineers work in cleaning up drinking water
- And...making wastewater safe to release back into the environment
- What about toilet to tap?
 - Chemical Engineers UoM recently deployed a toilet to tap water recycling plant to Davis Station in Antarctica !!!
- Fits in the context of making our use of resources and handling of waste more sustainable!

Waste Water Treatment



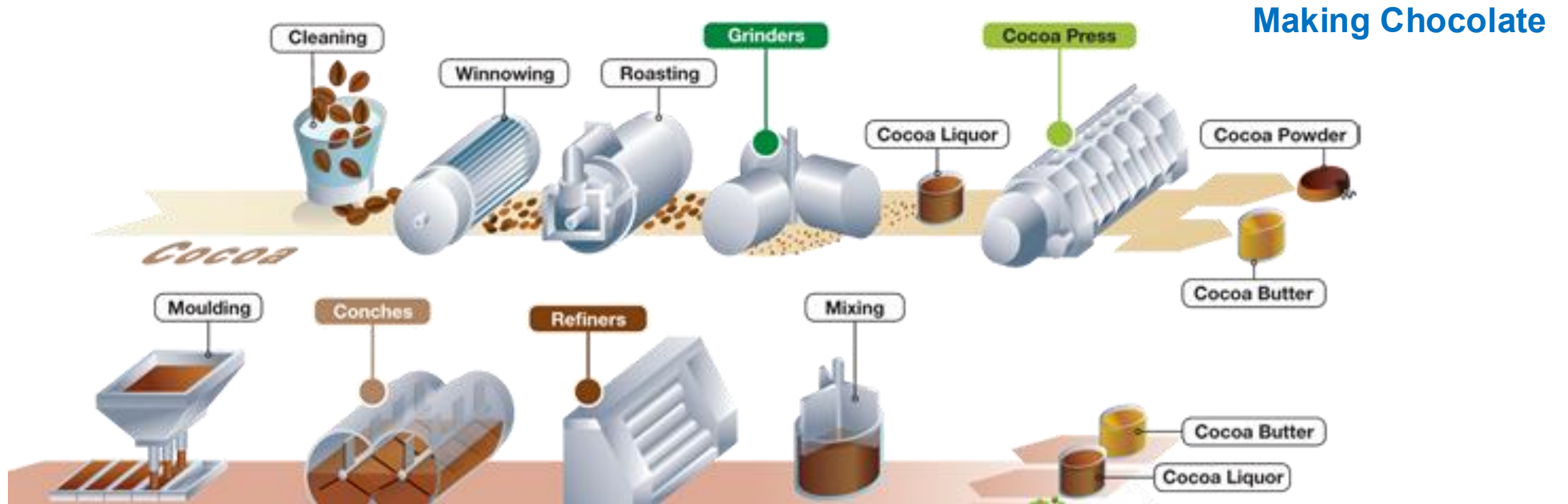
Chemical Engineering is...



Chemical Engineers are trained to work in a wide range of areas

With the same skills you could purify uranium or help make chocolate

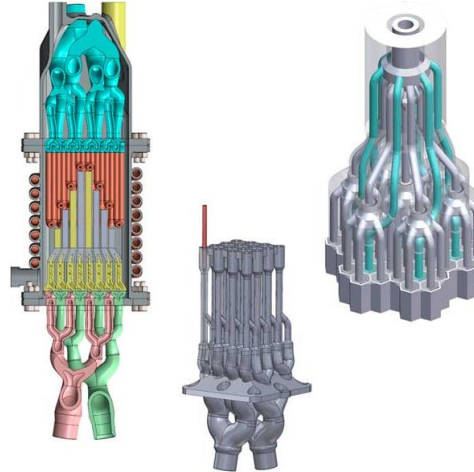
We have graduates in both industries



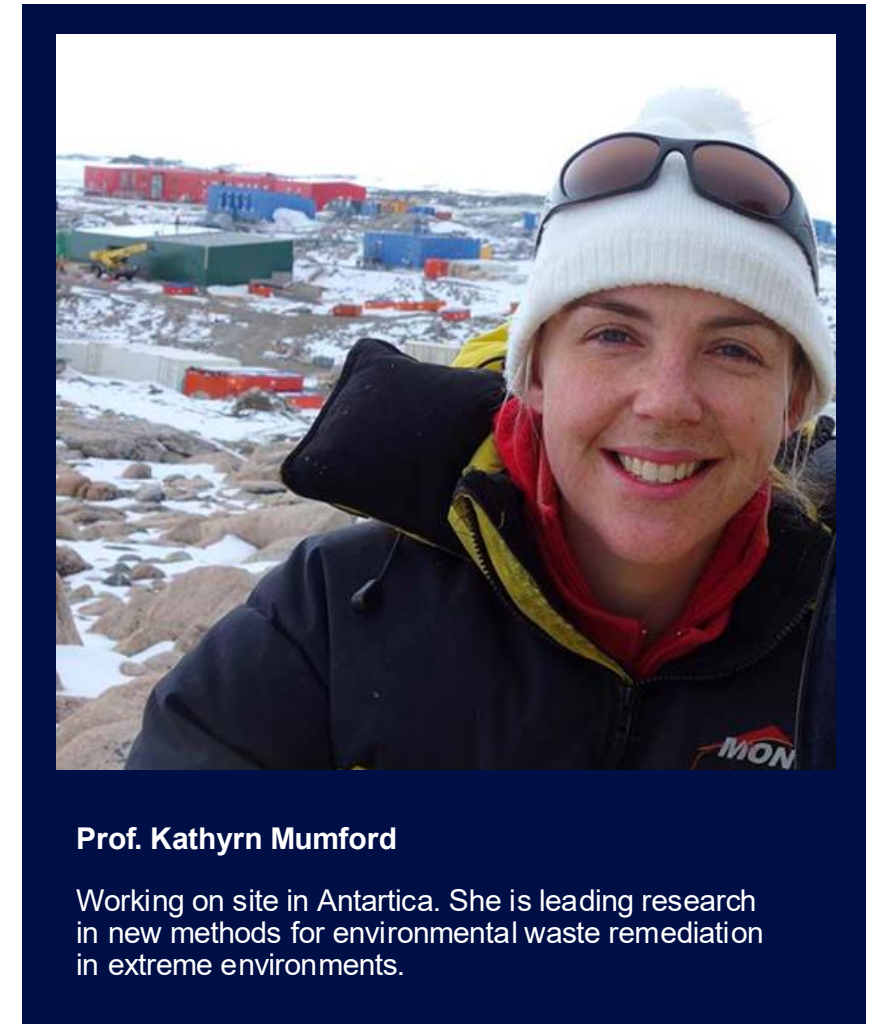
World-Leading Chemical Engineering Research at Melbourne

Our chemical engineering research includes:

- Mobile fuel processing from 3D printed parts
- Making healthy foods from Australia's dairy resources
- Tailored nanomedicine for treating disease
- Greener shampoo and more sustainable chemical products
- Smart ceramic armour to keep soldiers safe
- Keeping Antarctica clean
- *Cutting edge battery technologies*



Our world leading research is driven by strong industrial interactions and partnerships, exposing our students to the cutting-edge challenges facing industry, often connecting students to internships and graduate placements.



Prof. Kathryn Mumford

Working on site in Antarctica. She is leading research in new methods for environmental waste remediation in extreme environments.

Graduate outcomes



Industries

- Bioremediation
- Chemical Manufacturing
- Consultancy
- Cosmetics and Personal Care Products
- Food and Beverage Production
- Minerals and Energy
- Oil and gas
- Petrochemicals
- Petroleum
- Pharmaceuticals
- Renewable Energy & Storage
- Waste and Water Treatment

Companies

- Arup
- BHP Billiton
- BP
- Bulla Dairy Foods
- Carlton & United Breweries
- CSL
- ExxonMobil
- Fonterra Australia
- GHD
- Macquarie Group
- Mars Chocolate Australia
- Melbourne Water
- Mondelez (Cadbury)
- Rio Tinto
- Woodside
- WorleyParsons

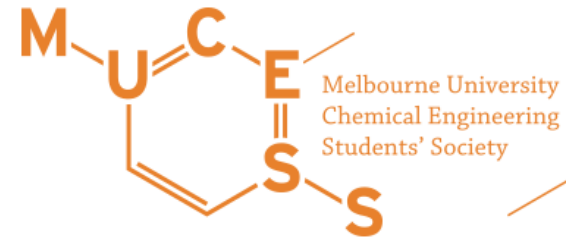
Job roles

- Process Engineer
- R&D Scientist
- Quality Control Officer
- Control System Engineer
- Project Engineer
- Chemical Engineer
- Development Chemist
- Production Engineer
- Facilities Engineer
- Technical Development Engineer
- Supply Engineer
- Operations Support Engineer
- Manufacturing First Line Leader
- Founder
- Entrepreneur

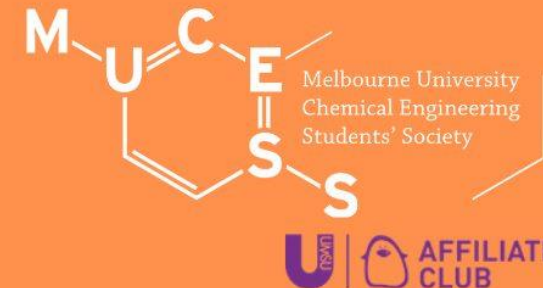
Things to look forward to!!!!



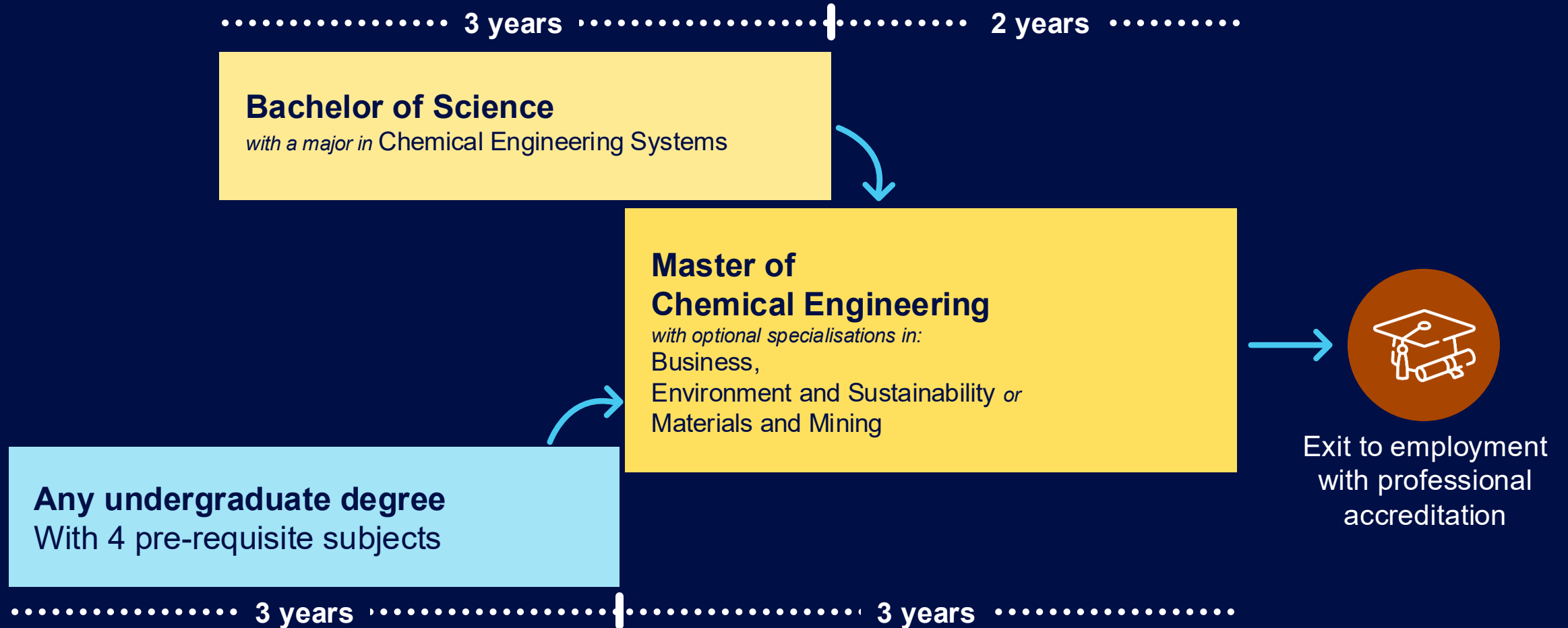
- **Chemical Engineering Internship**
 - Undertake 10-12 weeks on-site working on a project
 - Gain credit towards your degree
- **Connect with industry**
 - Industry projects
 - Creating Innovative Engineering
 - STEM Mentoring Program
- **Boost your employability**
 - Career building events and employability workshops
- **Clubs and societies**
 - Join the **MUCESS** in your bachelor's degree
 - **Endeavour Exhibition - May and October**
 - Final-year engineering projects



<https://www.facebook.com/MUCESS/>



How to study Chemical Engineering at Melbourne



Thank You



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Computing and Software Systems

Bachelor of Science

Presenter: Dr Chris Ewin



Computing and Software Systems Major

The Computing and Software Systems major focuses on providing students with considerable technical expertise in computer science and software engineering, including exposure to a variety of programming paradigms, an understanding of the systematic processes underpinning the software development lifecycle, and an appreciation of advanced topics in computing.

Bachelor of Science

Some Career Outcomes



App Developer



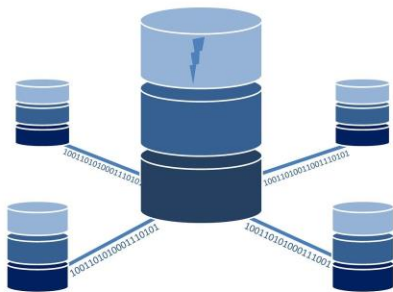
Business Analyst



Cyber Security Expert



Software Engineer



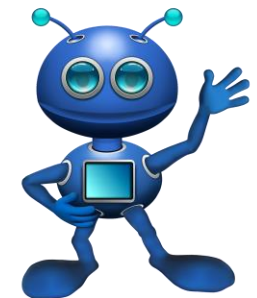
Database Administrator



UX Designer



Game Developer



AI Developer



First-Year

COMP10001 – Foundations of Computing

- Programming with Python
- Programming constructs, abstraction, testing & debugging
- Common data structures and libraries

COMP10002 – Foundations of Algorithms

- Programming with C
- Low-level program execution
- Trade-offs and design decisions; algorithmic complexity
- Common algorithms for searching, sorting

+2 Math Subjects



Second-Year

COMP20003 – Algorithms & Data Structures / COMP20007 – Design of Algorithms

- Correctness and efficiency of different algorithms
- Choosing appropriate algorithms and data structures
- Implementing key algorithms

SWEN20003 – Object Oriented Software Development

- Programming with Java
- Object-oriented principles
- Trade-offs between different program designs
- Design frameworks

INFO20003 – Database Systems

- Design databases to store and retrieve data
- Use SQL
- Database tuning and transactions

COMP20008 – Elements of Data Processing

- Ingest data of different types
- Data pre-processing and manipulation
- Machine Learning



Third-Year

COMP30023 – Computer Systems

- Role of the operating system
- Memory hierarchy
- File systems
- Network protocols
- Cryptographic protocols

COMP30026 – Models of Computation

- Formal logics and proofs
- Automata
- Computability

SWEN30006 – Software Modelling and Design

- Analyse and model software systems
- Use UML
- Software design principles and patterns
- Tools for design and development

COMP30022 – IT Project

- Capstone subject
- Design and develop a system to meet the needs of an industry client



Electives

Electives subjects include (but are not limited to):

- **COMP30013**: Advanced Studies in Computing
- **COMP30019**: Graphics and Interaction
- **COMP30020**: Declarative Programming
- **COMP30024**: Artificial Intelligence
- **COMP30027**: Machine Learning
- **INFO30006**: Information Security and Privacy



Pathways to Further Study

Pathway to accredited graduate degrees:

- Master of Software Engineering
- Master of Information Technology
- Master of Information Systems
- Master of Data Science
- Maser of Computer Science

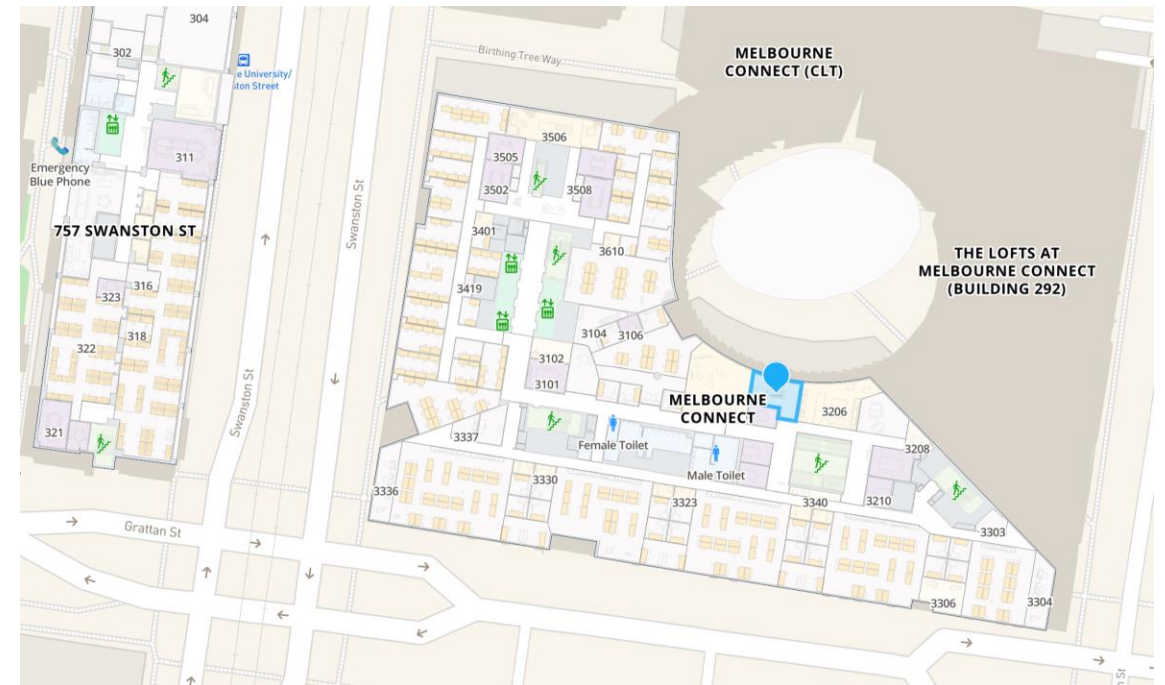


Diploma in Computing

- Taken concurrently with another major / degree
- 100 points of computing study made up of:
 - COMP10001, SWEN30006
 - Four computing electives at Level 1, 2 or 3
 - Two computing electives at Level 3
- Can cross-credit up to 50 points of study with your major



First-Year Centre



<https://cis.unimelb.edu.au/study/first-year-centre>

Thank You



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BSc (Electrical Engineering Systems)

Gavin Buskes

Course Coordinator, BSc (Electrical Engineering Systems), Master of Electrical Engineering
Professor, Deputy Head (Academic), Electrical and Electronic Engineering

Electrical Engineering

Electrical and electronic engineers work on challenging and emerging problems across a wide range of spatial and temporal scales.

From developing new electronic materials that unlock high efficiency solar cells and new integrated circuits; to designing electrical systems and electronic devices and their algorithms to make smarter and higher performing systems and improving the operation of communication systems that connect and coordinate our daily lives.

These systems underpin much of modern society with key applications including renewable energy power grids, autonomous systems, wireless communication and wearable electronics.



Electrical Engineering Systems!



This major introduces you to the fundamental mathematics of signals, systems and information, and the physical science of electrical phenomena. Four Level 3 subjects define the major:

ELEN30009 Electrical Network Analysis and Design	ELEN30011 Electrical Device Modelling	ELEN30012 Signals and Systems	ELEN30013 Electronic System Implementation
--	---	---	--

Underpinned by foundational Level 2 subjects:

ELEN20005 Foundations of Electrical Networks	COMP20005 Intro to Num. Comp. in C	MAST20029 Engineering Mathematics	ELEN20006 Digital Systems
ELEN30009 Electrical Network Analysis and Design	ELEN30011 Electrical Device Modelling	ELEN30012 Signals and Systems	ELEN30013 Electronic System Implementation

Careers

Electrical engineering graduates are known for their strong analytical and problem-solving skills. They find employment in a variety of capacities, ranging from research and technical engineering work to management and finance, across a broad array of areas, including the energy, telecommunications, computer, electronics, defence, manufacturing, automation, transport and biotechnology industries.



Communications and networks

We analyse, design and optimise communications systems and networks for a variety of emerging applications. We use tools and approaches from communication theory, coding, information theory, detection and estimation, systems theory, stochastic processes, game theory, signal processing, network optimisation and much more.



Control and signal processing

We undertake research, education, and industry engagement activities that relate to the modelling, optimisation, monitoring and automation of dynamical systems. Our research expertise ranges from the mathematical foundations of systems engineering, to applications in water and power system management, defence, and biomedical technology.

Control and signal processing



Electronics and Photonics

Advancing the frontiers in photonics and electronics towards the development of novel devices and systems for emerging applications. Our research spans electronics, nano-electronics, photonics, nano-photonics, antenna engineering, microwave and millimetre-wave engineering, and systems engineering.



Power and Energy

Electrical networks are the backbone of the future low-carbon energy infrastructure. Our research spans power and energy system modelling (transmission and distribution), techno-economic modelling, stochastic optimisation, integration of low-carbon technologies, and Smart Grids, from both planning and operational perspectives.

MASTERS SPECIALISATIONS



Artificial Intelligence

Develop expertise in the fundamental principles of machine and deep learning underpinning modern Artificial Intelligence (AI), complement your engineering knowledge with advanced computational skills, and learn how to use AI methods effectively in electrical engineering application domains.



Autonomous Systems

Develop core expertise in fundamental principles of electrical engineering with specific focus on the areas of control systems, signal processing and optimisation that underpin modern autonomous systems in applications from robotics to UAVs.



Business

Study tailored business subjects developed in partnership with the Melbourne Business School, covering how economics, marketing and finance relate to engineering.



Intelligent Networks and Communications

Develop core expertise in the fundamental principles underpinning modern-day communications engineering, discover the technologies behind modern communication networks such as 5G and IoT, and learn how to design the communication systems of the future.



Electronics and Embedded Systems

Acquire core skills and knowledge of the fundamental principles in electronic engineering with an emphasis on designing and building electronic and opto-electronic systems for applications in modern communications, computing, instrumentation, and sensing.



Low-Carbon Power Systems

Develop key expertise in the operation, planning and design of low-carbon power systems and energy markets with deep penetration of renewables, distributed energy resources, and smart grid technologies.



General Masters

Acquire core skills across all the specialisations by tailoring your study choices to your interests.

See <http://www.electrical.eng.unimelb.edu.au/>

OUR VISION = YOUR SUCCESS



From day one, UoM EEE graduates engineer the innovative solutions that are revolutionising technology and addressing the most complex challenges faced by society today.

Our graduates not only create technical solutions by drawing on their extensive knowledge of Electrical Engineering fundamentals and engineering project experience but shape these solutions to fit societal and commercial needs. They are meaningfully connected with their fellow graduates and share as a cohort a rigorous engineering ethos.

Thank You



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Infrastructure Engineering

Presenter: Dr Elisa Lumantarna

Three infrastructure engineering majors



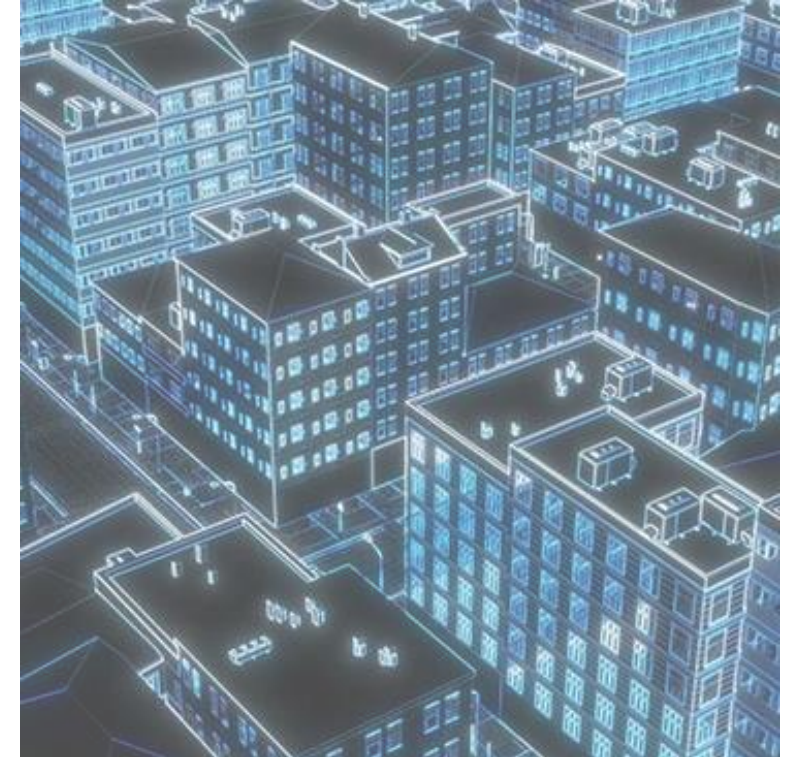
Civil Engineering Systems



Environmental Engineering Systems



Digital Infrastructure Engineering Systems

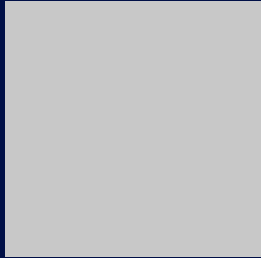




Civil Engineering Systems



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Civil Engineering Systems



What do civil engineers do?

Civil engineers are concerned with our everyday built environment via **conceiving, designing, constructing, supervising, operating, maintaining and decommissioning** infrastructure projects and systems around us to make our life safer, better, and more sustainable.

The infrastructure and systems we work on include:

Buildings
Roads
Bridges
Airports
Tunnels

Dams
Offshore infrastructure
Transport
Water and sewage systems



Potential Career Paths



Become a professional accredited civil, structural or architectural engineer through our master courses:

Coursework

Master of Civil Engineering

#3 in Australia for Civil and Structural Engineering [↗](#) #22 in the world [↗](#)

Coursework

Master of Architectural Engineering

Where to work?

- Leading consulting firms – Arup, AECOM, ...
- Construction companies – John Holland, Lendlease
- Manufacturers
- Government agencies
- and a lot more

Graduates move into a broad range of industries such as

- » Civil Engineering
- » Structural Engineering
- » Construction industry
- » Mining
- » Highway systems
- » Transport systems
- » Oil and Gas
- » Waste and Water Resources
- » Conservation and Natural Resources
- » Renewable Energy

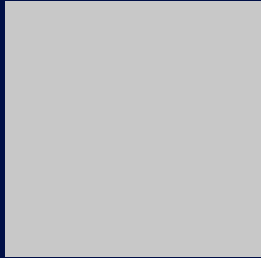




Environmental Engineering Systems



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Environmental Engineering Systems



What do environmental engineers do?



- Devise and promote concepts of **eco-design** and **resource efficiency**
- Deliver solutions for corporate and regional **sustainability** and a **low-carbon economy**
- Improve ways of assessing and treating **contamination** at polluted sites
- Develop improved **treatment** methods for water, wastewater and polluted air
- Devise **recycling** systems and develop uses for recycled materials
- Reduce the volumes of solid and hazardous **waste** through conservation and reuse.

Potential Career Paths



Potential career paths in engineering consulting (industry) and government

Water Resources Engineer: Focuses on planning and maintaining sustainable water systems, e.g., managing water supply, flood control, and stormwater management, etc.

Environmental Consultant: Develops solutions to environmental issues such as pollution control, environmental impact assessments, and regulatory compliance.

Sustainability Specialist: Develop and implement sustainability strategies for businesses or public institutions.

Climate Change Analyst: Analyzes climate change impacts and develops strategies to mitigate its effects, often working with government agencies and non-profit sectors.

Environmental Health and Safety (EHS) Specialist: Ensures that safety regulations are followed within organizations, reducing environmental risks and ensuring compliance.

Renewable Energy Engineer: Design, develop and implement renewable energy systems, such as solar, wind, and hydropower, etc.

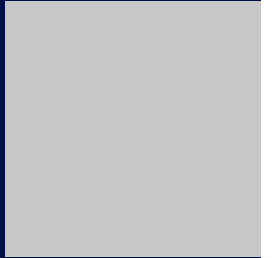
These roles offer diverse opportunities in public, private, and non-profit sectors, reflecting the growing demand for environmental expertise across industries.



Digital Infrastructure Engineering Systems



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Digital Infrastructure Engineering Systems



... where *engineering* meets *information technology*,
and where both are applied to *sustainability*



Study

- **engineering**: data capture, analytics, visualisation /communication: satellite positioning, imaging, laser scanning, UAVs, Internet of Things, augmented/mixed reality, digital twins.
- **information technology**: expert systems (GIS, BIM, databases), cloud services, AI/ML, digital ethics.
- **sustainability**: system-thinking for monitoring, impact assessment, planning.

Graduates move into a broad range of industries related to digital transformation, digital economy, and sustainable development, such as **energy, construction, disaster management, intelligence, land surveying, and transport.**

Digital Infrastructure in Practice

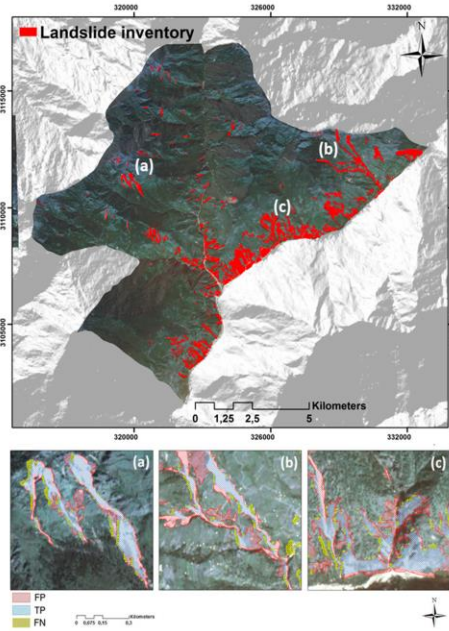


- Windfarm impact assessment
- Emergency management
- Public transport management



- Digital engineering in construction
- Remote sensing and natural resource management
- Autonomous driving with high-definition maps

Potential Career Paths



Disaster Management

NGO: digital mapping specialist; Google Maps, ESRI: digital mapping specialist ... technology executive



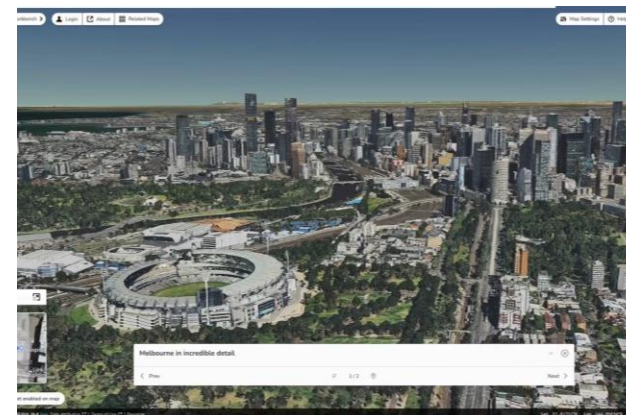
Shared Transportation

Tesla, VW, Volvo: digital sensing and mapping specialist, team leader
HERE Technologies: mobility/logistics service developer ... technology executive



Digital Engineering /Constructions

Suburban Rail Loop Authority , Aurecon, Veris: Digital engineer, engineering surveyor, IT developer, technical lead

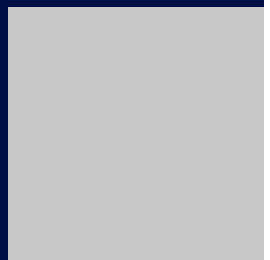


Smart Cities

Victorian Government, ARUP, KPMG, IBM, Bentley: digital services engineer, IT specialist, consultant.



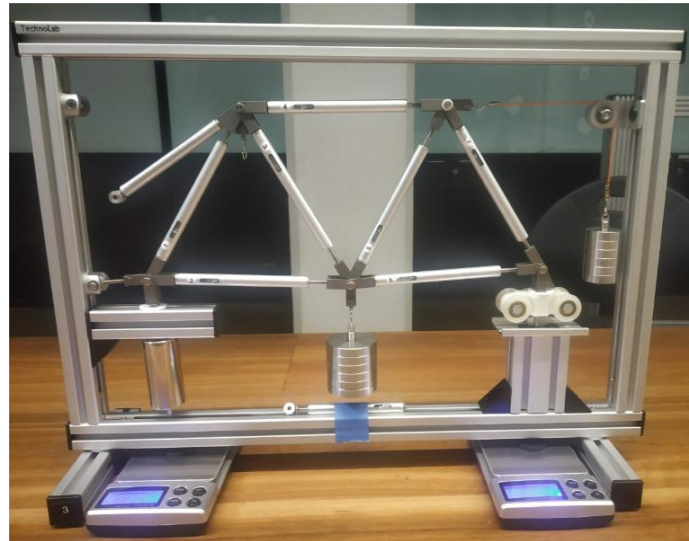
Examples of teaching and learning activities



Workshops



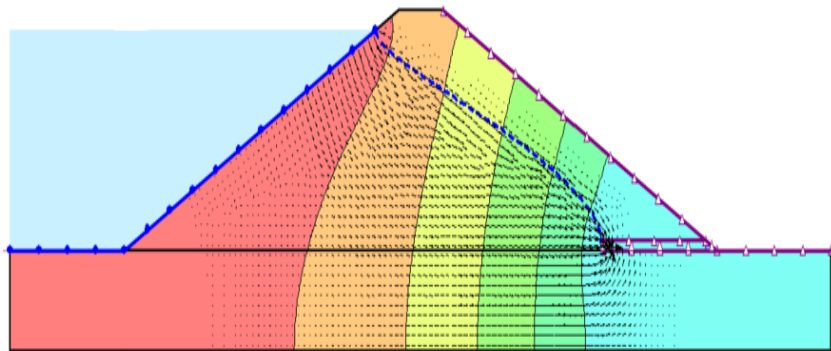
Rock identification



Member	b/L_0	b/L_m	F_exp (N)	F_calc (N)	C
12	0.534	0.622	1.144	1.094247346	C
13	0.471	0.437	-0.442	-0.54910601	T
23	0.519	0.425	-1.222	-1.094247335	T
24	0.488	0.579	1.183	1.094247346	C
34	0.481	0.405	-0.988	-1.09424735	T
35	0.392	0.341	-0.663	-0.54910601	T
45	0.534	0.617	1.079	1.094247346	C

Member	l	c	s	u_g2	v_g2	u_g1	v_g1
Member 12	1000	0.5	0.86603	0.00025	0.00043	-0.00025	-0.00043
Member 13	1000	1	0	0.001	0	-0.001	0
Member 23	1000	0.5	-0.86603	0.00025	-0.00043	-0.00025	0.00043

Truss forces and modelling of truss



Modelling seeping through dams

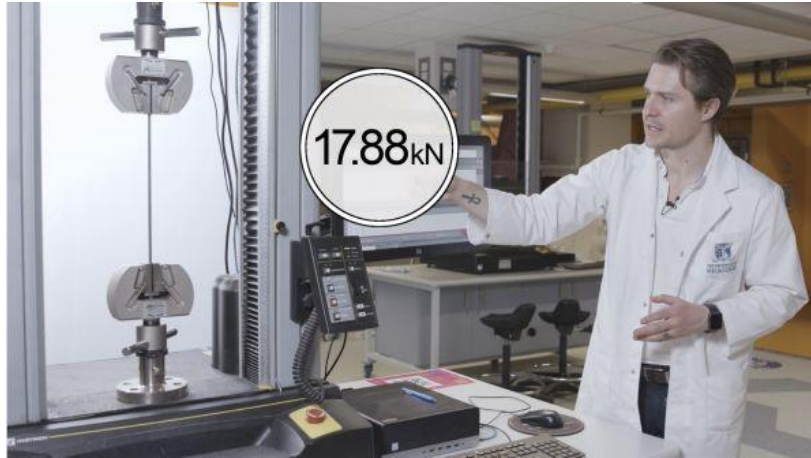


Modelling of coastal flooding

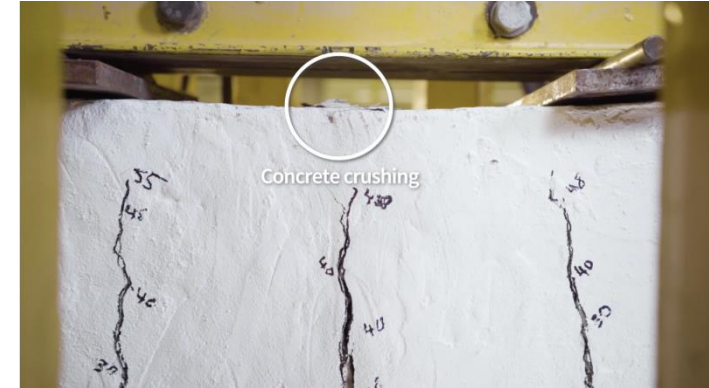
Practicals



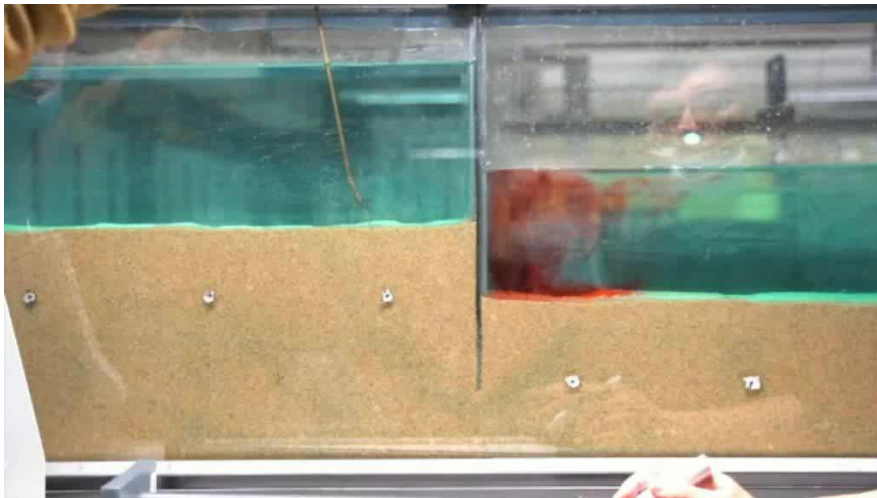
Soil classification



<https://le.unimelb.edu.au/vm/our-work/faculty-of-engineering-and-information-technology>



Bending test of reinforced concrete beam



Observing seepage



Sand boiling/quicksand condition

Field trip and Field measurement



Land surveying



Geological mapping by industry guest lecturers



Murray-Darling Water field trip

Real-world design exercise

Cores in Civil, Environmental and Digital Infrastructure Engineering Systems



Improving sustainability of a suburban Melbourne house

Economic, Environmental, Social, Technical performance

Using techniques such as:

Thermal performance simulation
n-bottom line analysis



- How thick do walls need to be to achieve same degree of insulation?

- Fill in the "PV Costs" and "PV Revenues" columns.
- Calculate the project's net present value (NPV).
- Calculate the benefit-cost ratio (BCR).
- Should the project go ahead? Discuss.

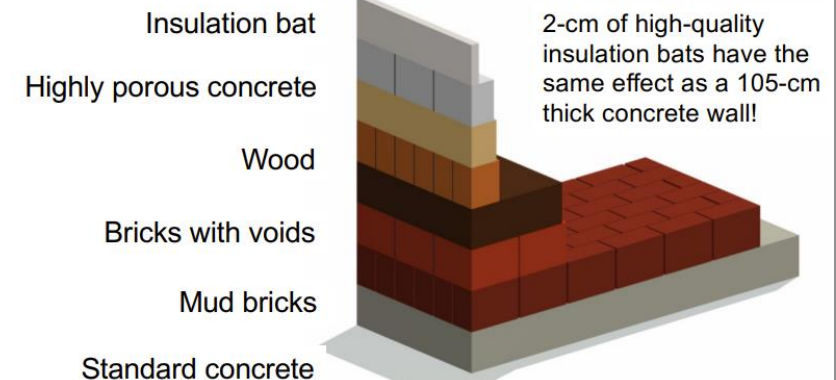
$$PV = \frac{FV_n}{(1+i)^n}$$

Net present value

$$NPV = \sum PV \text{ revenues} - \sum PV \text{ costs}$$

Benefit-cost ratio

$$BCR = \frac{\sum PV \text{ revenues}}{\sum PV \text{ costs}}$$



Real-world design exercise

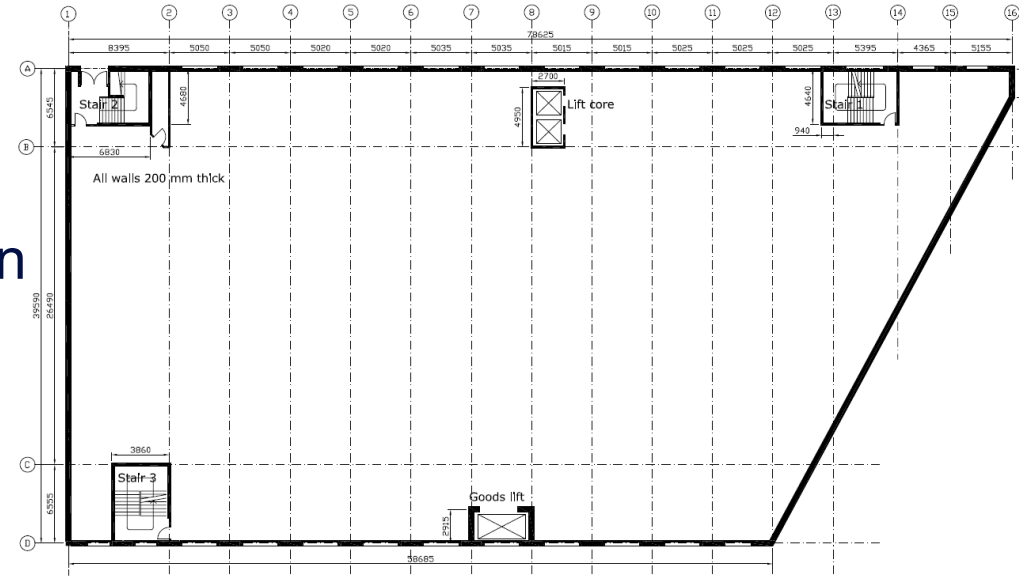
Cores in Civil Engineering Systems

Structural Design of a real building

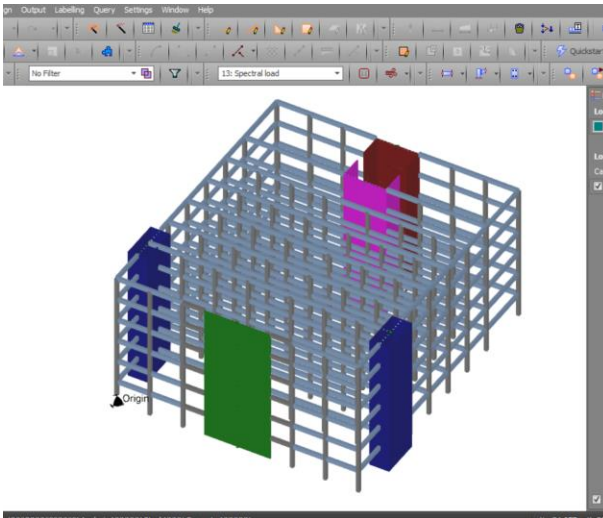
Using industry standard software and Australian Standards

Problems set by industry

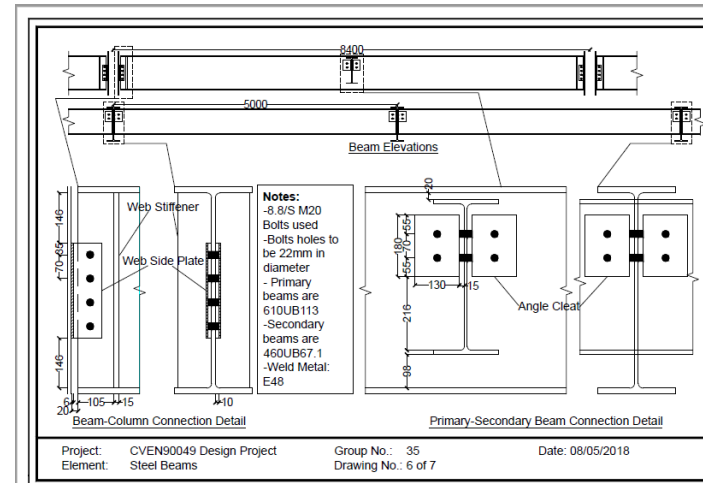
Industry mentorship



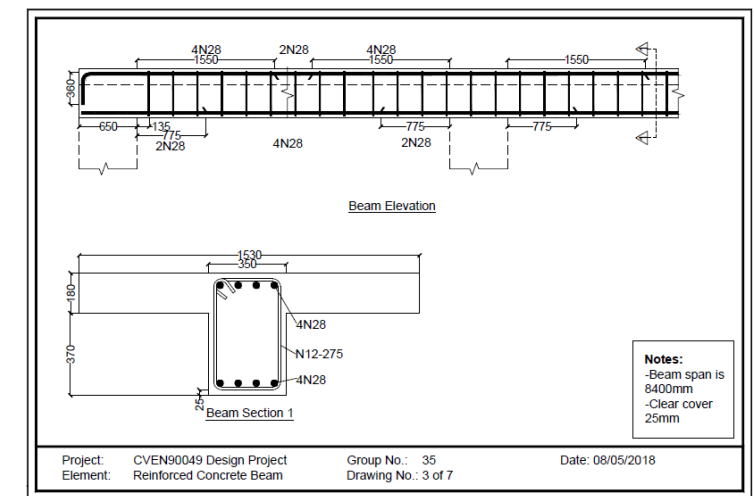
Design an office building



Analysing structures using SPACE GASS



Steel and Reinforced Concrete design solutions



Real-world design exercise

Capstone of Civil Engineering Systems Major

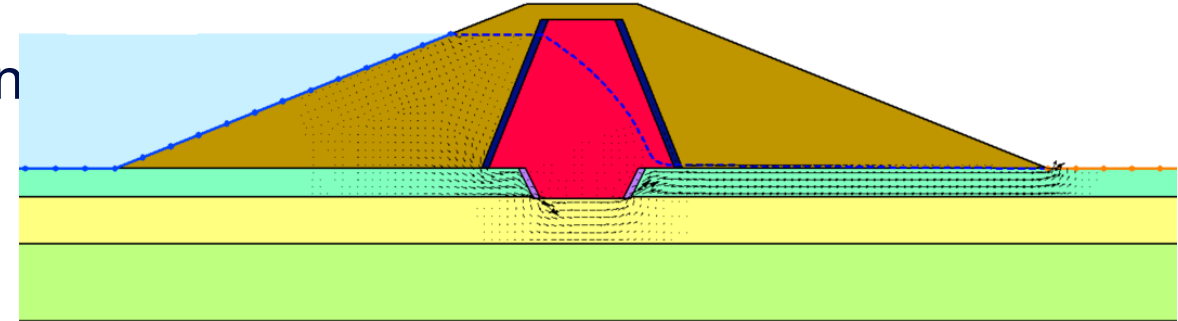


Design of infrastructure

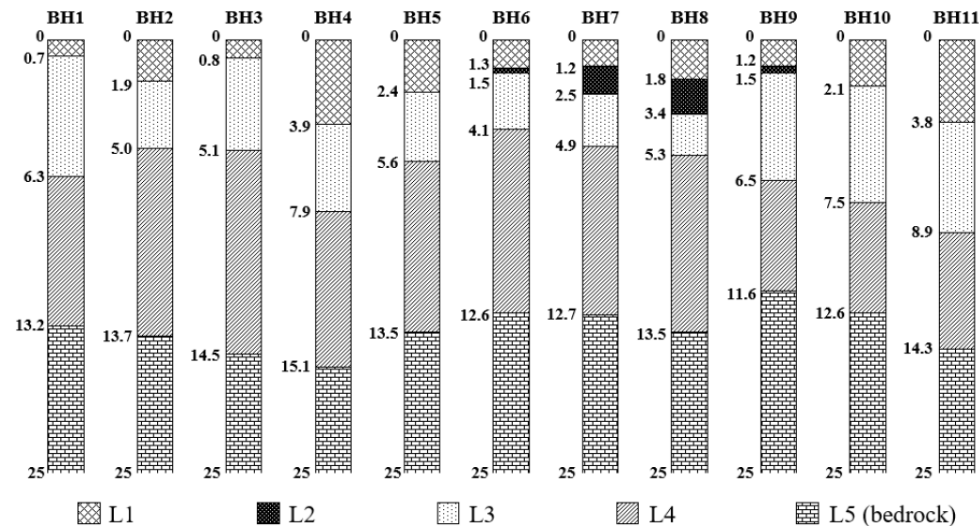
Integrating knowledge from water, geotechnics and structures

Using industry-standard software

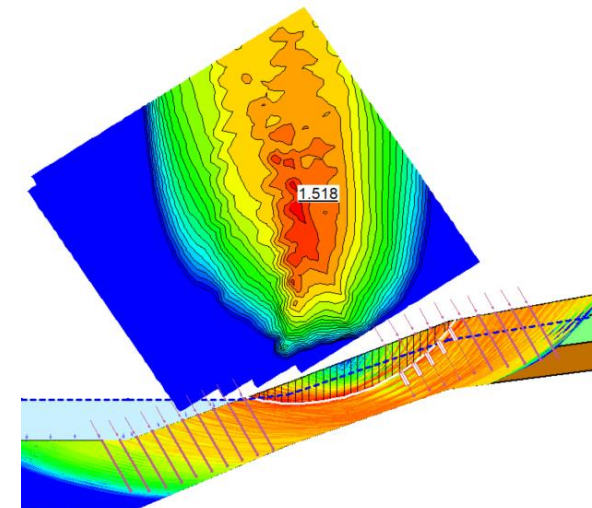
Industry mentorship



Design a zoned earthfill embankment dam



Interpret site investigation data



Analyse the stability of the slope

Thank You



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Mechanical Engineering Mechatronics Engineering Industrial Engineering

Presenter: Jimmy Philip



Department of Mechanical Engineering

Jimmy Philip

jimmyp@unimelb.edu.au

» What is:

Mechanical Engineering

(option: Aerospace/Business/Manufacturing/Materials)

Mechatronics Engineering

(option: Manufacturing)

Industrial Engineering

» Careers and industry

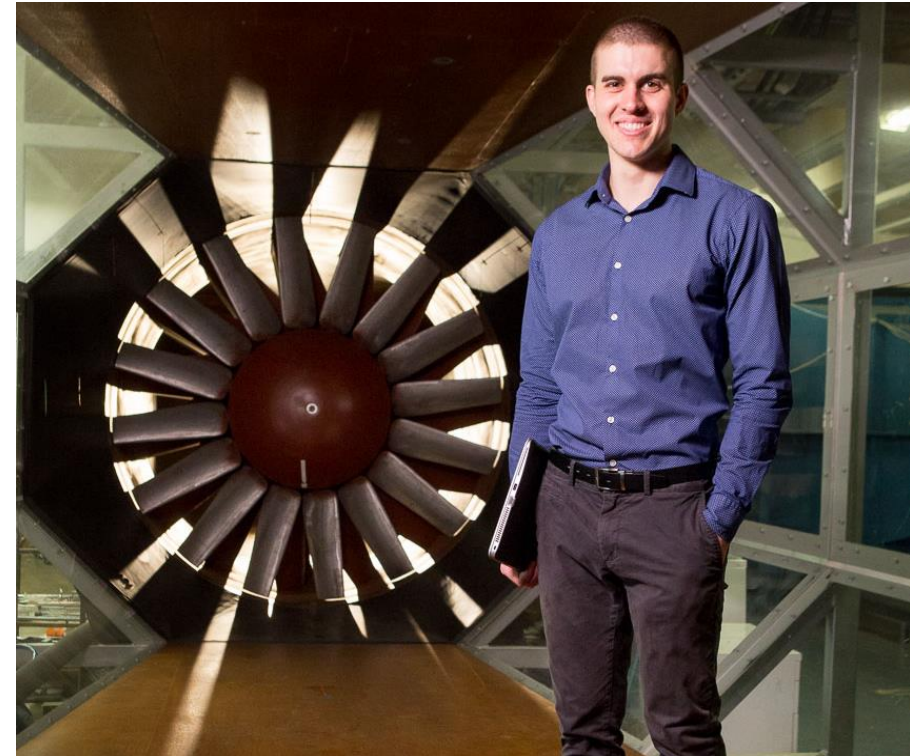
» How to study **Mechanical/Mechatronics/Industrial**





What is Mechanical Engineering?

- » Mechanical engineers design, construct, operate and maintain machines, robots, energy systems and manufacturing equipment
- » Develop products such as:
 - » Mobile phones
 - » Gaming consoles
 - » Cars
 - » Wind turbines
 - » Or the robots that make them
- » Apply your maths and physics skills



James Gregory
Design Engineer, Boeing Aerostructures
Australia
Bachelor of Science
Master of Engineering (Mechanical)

Where our mechanical graduates work

Industries



- » Aeronautics
- » Automotive
- » Biomechanics
- » Manufacturing
- » Minerals and Energy
- » Power Generation
- » Robotics
- » Transport

Companies



- » ANZ
- » Arup
- » BAE
- » Boeing
- » Bosch
- » Boston Consulting Group
- » Carbon Revolution
- » CSIRO
- » Deloitte
- » DST Group
- » ExxonMobil
- » Ford
- » Honeywell
- » Leica Microsystems
- » PwC
- » Siemens
- » Yarra Trams

Job roles



- » Consultant
- » Mechanical Engineer
- » Subsurface Engineer
- » Process Engineer
- » Acoustic Engineer
- » New Energy Vehicle Engineer
- » Hydraulic Engineer
- » Commissioning Engineer
- » Industrial Engineer
- » Quality Engineer
- » Project Business Analyst

Our student opportunities

Industries



- » Infrastructure and construction
- » Aerostructures
- » Biotechnology
- » Manufacturing
- » Mining and resources
- » Water resources
- » Health

Student projects



- » Read, write and debug programs in high-level programming languages such as C
- » Access cutting edge laboratories and a heavy engineering workshop for materials testing, engine and turbine testing, wind tunnel investigations and metal forming processing



What is Mechatronics Engineering?

- » Want a career where you control the robots?
- » Blend mechanical, electrical and software engineering
- » Mechatronics is the key to a smart and connected future
- » Computer-controlled systems, drones, robots and automotive equipment
- » Apply your skills in maths and programming



Where our mechatronics graduates work

Industries



- » Aerospace
- » Advanced Manufacturing
- » Product Development
- » Computing and Electronics
- » Software Systems
- » Mining
- » Renewable Energy
- » Biomedical Engineering
- » Robotics

Companies



- » Alerte Digital Health
- » Ford
- » IBM
- » KPMG
- » McKinsey & Company
- » Melbourne Metro Rail Authority
- » Thales
- » Telstra
- » Bukalapak
- » Viva Energy

Job roles



- » Mechatronics Engineer
- » Software Engineer
- » Software Consultant
- » Design Engineer
- » Verification Engineer
- » Senior Associate
- » Project Engineer
- » CTO
- » Control Systems Engineer

Our student opportunities

Industries



- » Electronics
- » Automotive
- » Biotechnology
- » Manufacturing

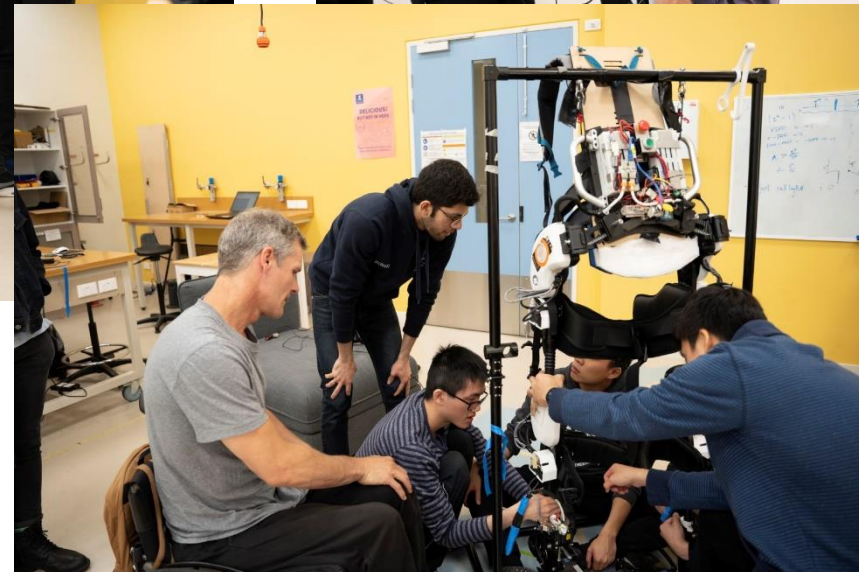
Student experience



- » Read, write and debug programs in high-level programming languages such as C
- » Access world-class facilities; wind tunnels, alternative fuel engines, rehabilitation robots, UAV platforms and large-scale water management systems

Final year (team) projects

ALEX (Advanced Lower Extrimity Exoskeleton)



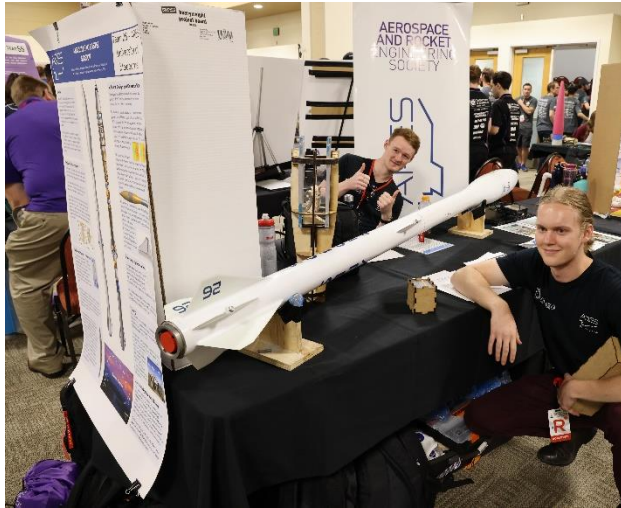
<https://www.alexexoskeleton.org/>



Final year (team) projects

Aerospace and Rocket Engineering Society Rocketry Team

<https://eng.unimelb.edu.au/ares#about>



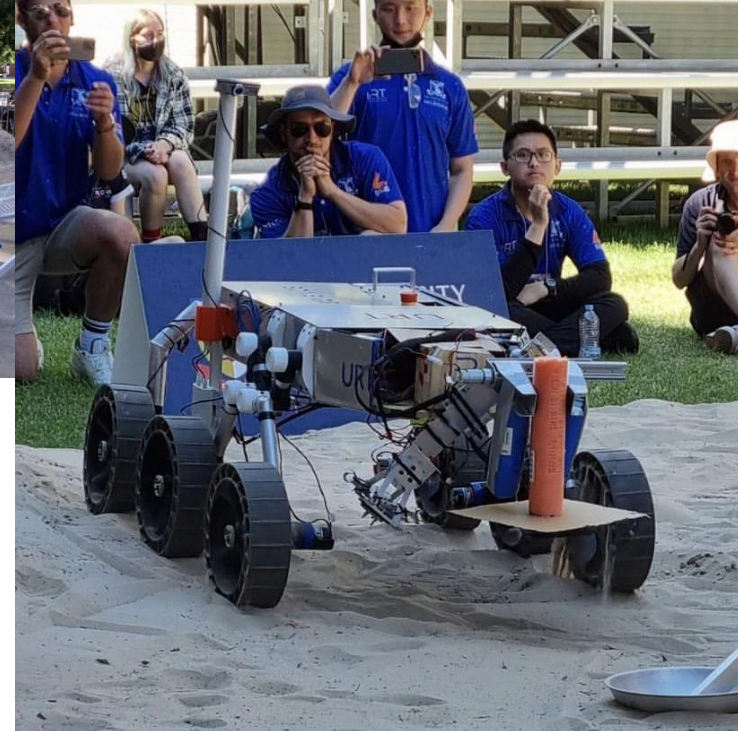
<https://spaceportamericacup.com/>
Technical Excellence at the Spaceport America Cup



Final year (team) projects

Aerospace and Rocket Engineering Society

Australian Rover Challenge Team





Final year (team) projects

Melbourne University Racing



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How to study Master of Mechanical Engineering

Choose an undergraduate degree:

Bachelor of Design
(Mechanical Engineering
Systems major)

Bachelor of Science
(Mechanical Engineering
Systems Major)

Bachelor of Commerce

Choose your Masters degree:

Master of Mechanical Engineering

Specialisations available in:

Aerospace, Business, Manufacturing, Materials

Or

Master of Industrial Engineering

Exit to employment with professional accreditation



Sample course plan

Bachelor of Science (Mechanical Engineering Systems Major)

Year 1	Semester 1	Engineering Technology and Society	Calculus 2	Physics 1	Today's Science, Tomorrow's World
	Semester 2	Engineering Modelling and Design	Linear Algebra	Physics 2: Physical Science and Technology	Breadth
Year 2	Semester 1	Numerical Methods in Engineering	Engineering Mechanics	Science Elective	Breadth
	Semester 2	Foundations of Electrical Networks	Engineering Mathematics	Science Elective	Breadth
Year 3	Semester 1	Thermodynamics and Fluid Mechanics	Mechanics and Materials	Science Elective	Breadth / Science Elective
	Semester 2	Systems Modelling and Analysis	Mechanical Systems Design	Science Elective	Breadth / Science Elective

■ Core subjects
 ■ Elective subjects
 ■ Breadth subjects



Sample course plan

Step 2: Master of Mechanical Engineering (Example specialisation: Aerospace)

Year 1	Semester 1	Thermodynamics	Dynamics	Materials	Design for Manufacture
	Semester 2	Fluid Dynamics	Solid Mechanics	Control Systems	Critical Communication for Engineers / Creating Innovative Engineering
Year 2	Semester 1	Capstone Project	Advanced Fluid Dynamics	Computational Fluid Dynamics	Aerospace Dynamics and Control
	Semester 2		Vibrations and Aeroelasticity	Aerospace Propulsion	Advanced Elective*

Core subjects
 Elective subject



Master of Mechanical Engineering (Aerospace)

Focus on aerospace engineering, while also developing advanced skills and knowledge in mechanical engineering

- » **Choose your career:** be equipped for positions in the aerospace industry or apply your mechanical engineering skills across diverse industries

- » Aerospace electives:
 - » Advanced Fluid Dynamics
 - » Vibrations and Aeroelasticity
 - » Aerospace Propulsion
 - » Aerospace Dynamics and Control





How to study Master of Mechatronics

Choose an undergraduate degree:

Bachelor of Science
(Mechatronics Systems Major)

Choose your Masters degree:

Master of Mechatronics Engineering
With a specialisation available in: *Manufacturing*
Or
Master of Industrial Engineering

Exit to employment with professional accreditation



Sample course plan

Bachelor of Science (Mechatronics Engineering Systems Major)

Year 1	Semester 1	Engineering Technology and Society	Calculus 2	Physics 1	Today's Science, Tomorrow's World
	Semester 2	Engineering Modelling and Design	Linear Algebra	Physics 2: Physical Science and Technology	Breadth / Science Elective
Year 2	Semester 1	Numerical Methods in Engineering	Engineering Mathematics	Science Elective	Breadth
	Semester 2	Foundations of Electrical Networks	Engineering Mechanics	Science Elective	Breadth
Year 3	Semester 1	Analog and Digital Electronics Concepts	Science Elective	Science Elective	Breadth / Science Elective
	Semester 2	Mechanical Systems Design	Systems Modelling and Analysis	Numerical Programming for Engineers	Breadth

■ Core subjects
 ■ Elective subjects
 ■ Breadth subjects



Sample course plan

Step 2: Master of Mechatronics Engineering

Year 1	Semester 1	Control Systems	Dynamics	Sensor Systems	Mechatronics Systems Design
	Semester 2	Embedded System Design	Programming and Software Development	Introduction to Machine Learning	Critical Communication for Engineers
Year 2	Semester 1	Advanced Elective	Advanced Elective	Advanced Elective	Mechatronics Capstone Project
	Semester 2	Advanced Elective	Advanced Elective	Advanced Elective	

■ Core subjects
 ■ Elective subjects



THE UNIVERSITY OF
MELBOURNE

Thank you

Still have
questions?

SUMMARY:

- **BSc or BDes (Mechanical / Mechatronics)**
 - Master of Mechanical Engineering
 - Master of Mechatronics Engineering
 - Master of Industrial Engineering

CONTACT:

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QUESTIONS?



**Join us for refreshments and networking in the
Old Library/Foyer (Room 137)**

