IVE WINTER SCHOOL

ARTIFICIAL INTELLIGENCE FOR EXTENDED REALITY (AI FOR XR)

Mark Billinghurst

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University of South Australia

Artificial Intelligence for eXtended Reality!

Acknowledgment of Country

We acknowledge this land that we meet on today is the traditional lands of the Kaurna people and that we respect their spiritual relationship with their country.

We also acknowledge the Kaurna people as the custodians of the Adelaide region and that their cultural and heritage beliefs are still as important to the living Kaurna people today.

Introductions

- Introduce yourself
  - Who you are
  - Where you're from
  - What you want to get out of the course

Key People

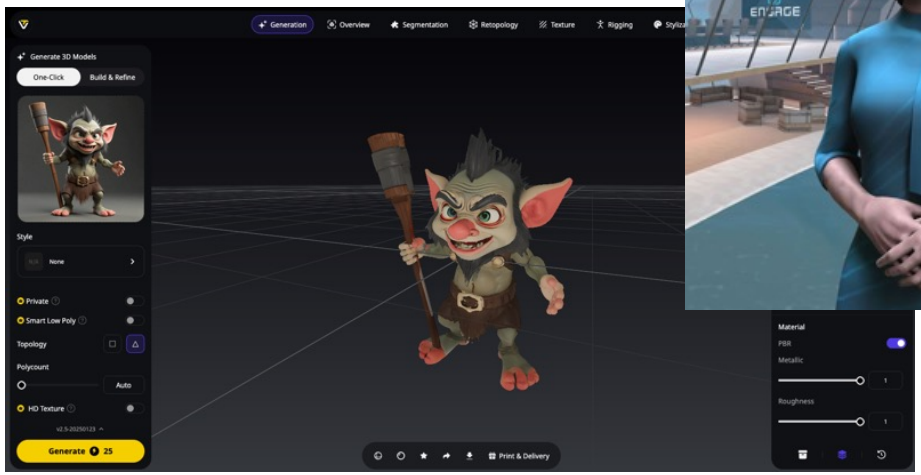
- Mentors
  - Mark Billinghurst (UniSA)
  - Richard Zirui (HKCU)
  - Yun Suen Pai (Auckland)
  - Tamil Gunsasekaran (Auckland)

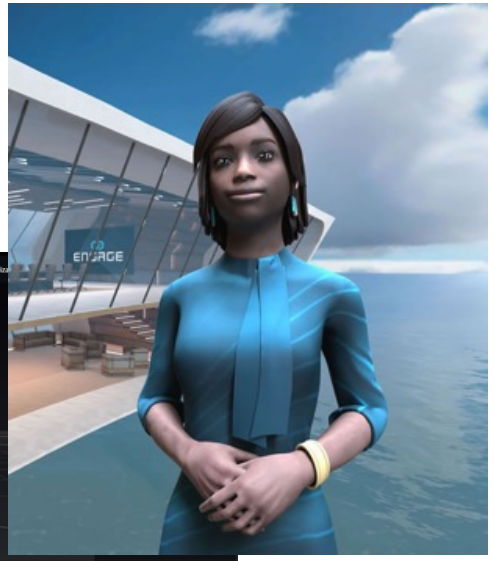
- Logistics
  - Tracy Goodchild
  - Kai Zhang

Course Motivation

- XR becoming widely available
  - Consumer devices
  - Mobile AR/VR
- Rapid rise of AI technologies
  - Intelligent Agents
  - Large Language Models (LLMs)
  - ChatGPT/Google Gemini, etc.
- AI for XR
  - Using XR as front end for AI
  - Spatial Computing/Understanding
- Need for AI skills

Example Applications





- Smart Glasses – AI embedded into wearable AR glasses
- Conversational agents – AI driven avatars in AR/VR
- Generative AI – rapid content creation (audio, video, 2D/3D)
- AI Understanding – Scene understanding, sensor analysis, translation, etc

Course Format

- Guest Lectures (17 hours)
  - Basic and advanced topics
- Group Project Work (18-20+ hours)
  - Create your own AI and XR project
- Friday Demos (2 hours)
  - Working demo to show
- Optional Social Activities (3 events)

Week Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00am	Welcome (Mark Billinghurst)	How does AI/ML Work? (Wolfgang Mayer)	Cybernetic Humanity: Exploring the new humanity emerging from the integration of humans and computers (Shunichi Kasahara)	TBC	Designing Intelligent Human Computer Interfaces to extend the limits of our perceptual and cognitive capabilities (Suraga Nanayakkara)
10:00 am	Fundamentals of XR (Mark Billinghurst)	Fundamentals of AI for Robotics Learning (Feras Dayoub)	TBC	Why XR? Bridging Empathy, Assistance, and Augmentation (Yun Suen Pai)	Designing Human-AI Interaction (Misha Sra)
	Morning Tea Break				
11:00am	Application and use cases of AI in XR (Allison Jing)	TBC (Mar Gonzalez Franco)	Mobility-First Telepresence Communication using HMDs (Liwei Chan)	Project Work	Project Work
12:00pm	**Lunch**				
1:00pm	Application and use cases of AI in XR (Allison Jing)	AI in wearable headsets: From Basic LLM Integration to Advanced Agents (XIAO Zirui)	Project Work	Project Work	Project Work
2:00pm	TBC (Lia Song)	Project Work	Project Work	Project Work	Project Work
	Afternoon Tea Break				
3:00pm	AI & XR (Tamil Gunasekaran)	Project Work	Project Work	AI-Enhanced Multimodal Communication: How to Build Rapport between Humans and Agents across Physical and Virtual Platforms (Elisabeth Andre Augsburg)	Project Work
4:00pm	Project Brainstorming	Project Work	Project Work	Project Work	Demo
5:00 pm	Wrap Up / Daily Review (Mark Billinghurst)				

Social Activities (Optional)

- Wednesday
  - Illuminate Adelaide
- Friday
  - Friday drinks
- Saturday
  - Cleland wildlife park

What You Will Learn

- Fundamentals of XR
- Introduction to AI
- Case studies of AI in XR
- AI tools for XR
- Introduction to ML
- LLM integration with XR
- AI driven characters for XR
- Industry examples of applying AI in XR
- Research topics in AI and XR

Monday Schedule

- 9:00am Welcome and Introductions
- 10:00am Fundamentals of XR - Mark)
- 11:00am Application and Use Cases of AI in XR – Part 1 - Allison Jing
- 12:00pm Lunch/Group formation
- 1:00pm Application and Use Cases of AI in XR – Part 2 - Allison Jing
- 2:00pm Case Study – Lia Song
- 3:00pm Tools for AI in XR – Tamil Gunasekaran
- 4:00pm Project Brainstorming
- 5:00pm End

Things to Do Today

- Form a project group
  - 4 people, at least one Engineer (red sticker), one Designer (green sticker)
- Decide on a project topic
  - Should be completed in 15 hours of work
- Sign up on Discord
  - Accept invite
- Access GitHub repository
  - Code, presentations

Australian Research Centre for Interactive and Virtual Environments(IVE)

Positively changing the world through changing people's realities

https://unisa.edu.au/ive/

University of South Australia | Australian Research Centre for Interactive and Virtual Environments

A World Leader in AR & VR

- Leaders in Australia for augmented and virtual reality research
- UniSA has some of the leading AR/VR researchers globally and is in the top 5 in the world for AR publication numbers

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Leadership Team Members

Professor Mark Billinghurst Director

Professor Ning Gu Deputy Director

Professor Bruce Thomas Founding Director

Professor Ian Gwilt

Professor Ina Bornkessel-Schlesewsky

Dr Erik Champion

A/Professor Ross Smith

Dr Peter Schumacher

Dr Joanne Zucco

Dr Gun Lee

Dr Julie Nichols

Dr Deirdre Feeney

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Research Groups

Building and Urban Informatics

Cognitive Neuroscience Lab

Creative Computing Studio

Design for Health and Wellbeing

Empathic Computing

Playful Cultures

Studio for Complex Human Environment Design

Wearable Computing

- Over 140 researchers in eight groups
- Multi-disciplinary alignment of computer science, engineering, psychology, neuroscience, art, architecture, and design

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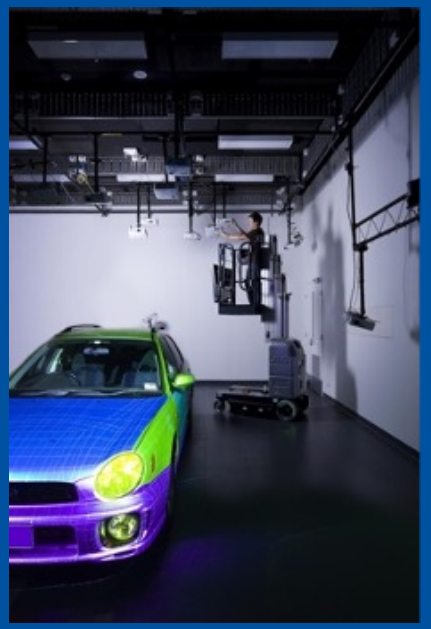
Facilities

A suite of mixed reality visualisation environments enabling up to full scale simulation





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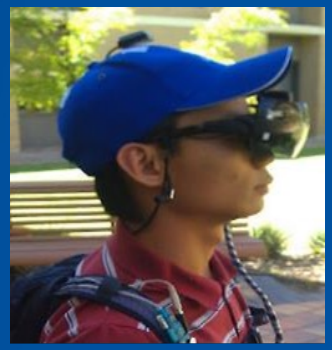
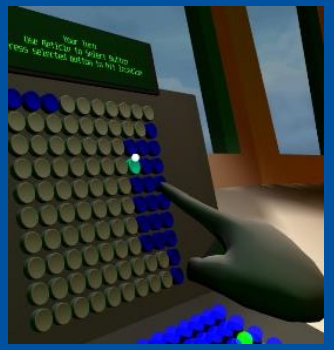
Research Capabilities

AR - VR – MR - XR

Diverse range of disciplines:

- Visualisation
- Virtual Reality
- Augmented Reality
- Immersive Analytics
- Novel User Interfaces
- Human Computer Interaction
- Human Centred Industrial Design
- Neuroscience / Cognitive Psychology
- Remote Collaboration with AR and VR





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Application Areas

- Education
- Defence
- Manufacturing
- Agriculture
- Design
- Health
- Creative
- Urban design

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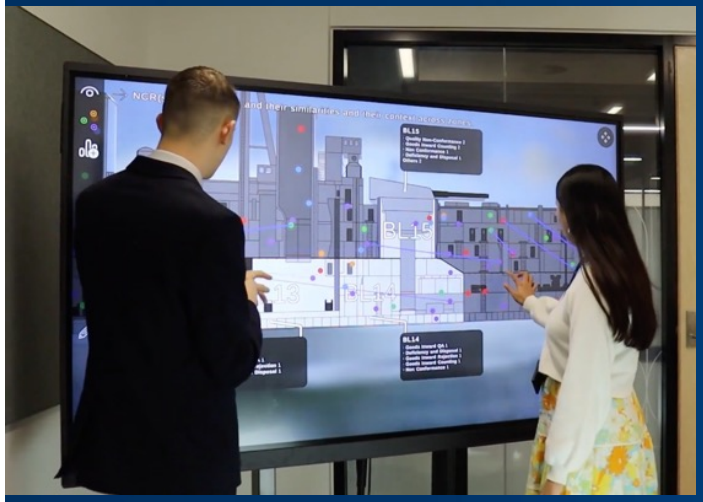
Immersive Digital Twins



Using digital twins for training and assessment in difficult or high-risk environments

- Immersive modelling of complex systems
- One-to-one mapping of CAD models into VR
- Support training and familiarisation
- Assess and predict the state the asset

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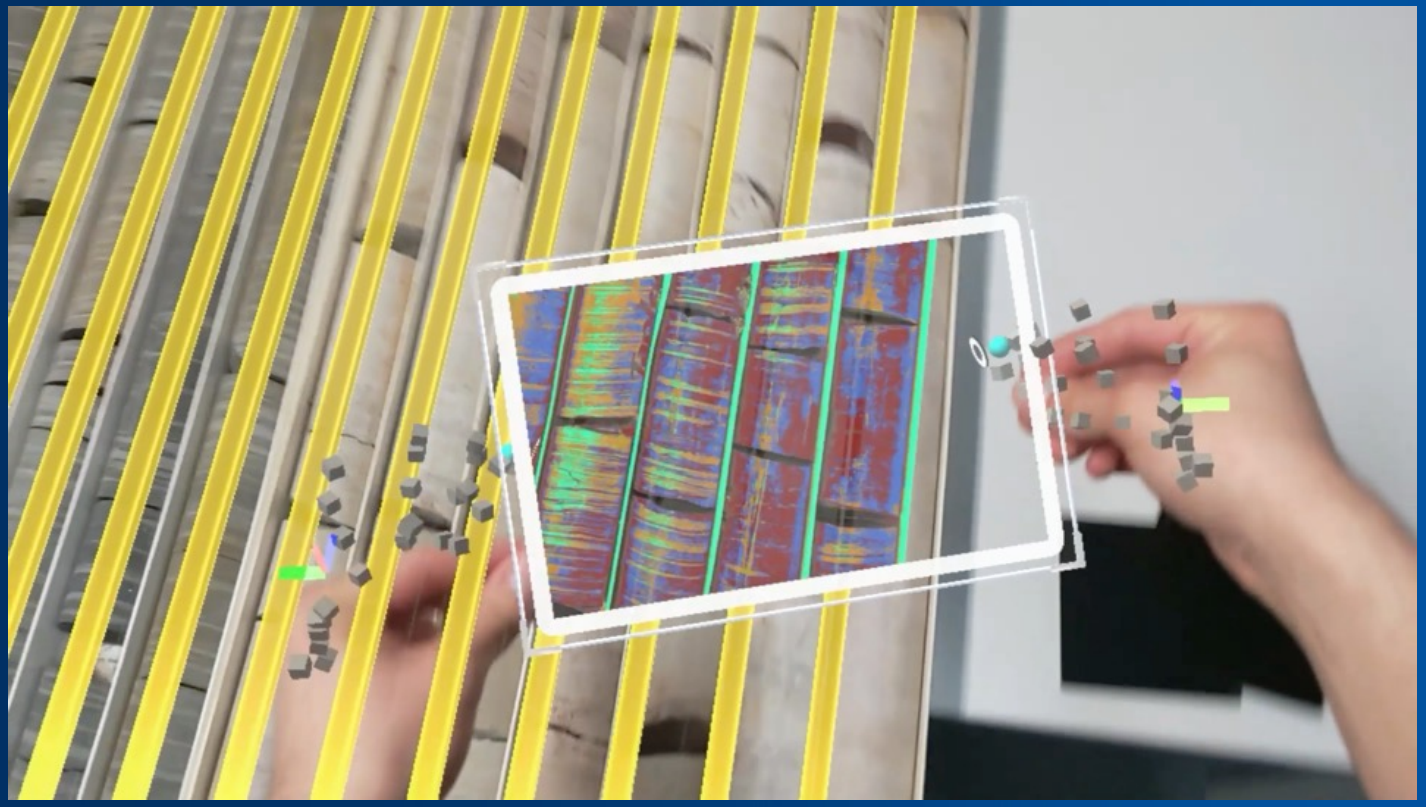
Situated Analytics

Embedding data visualisation into the environment



PROJECTLIVE
Learning Through Immersive
Virtual Environments

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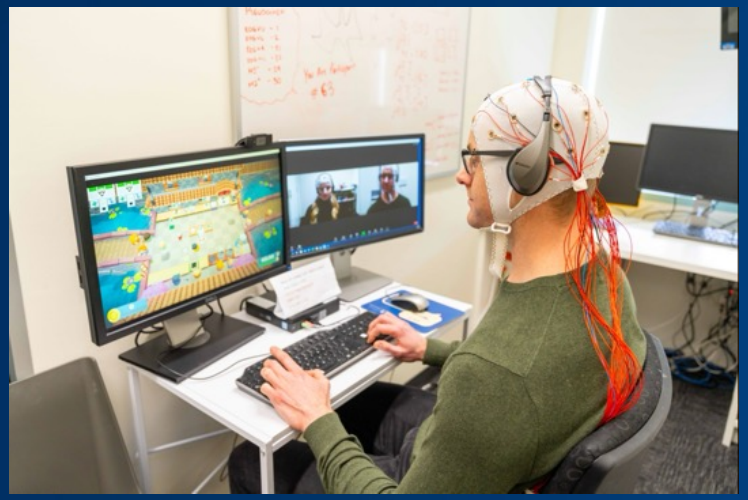
Cognition and Human Performance



Understanding how the brain gives rise to human cognitive abilities and performance in complex environments

- Investigating the biological underpinnings of performing complex tasks,
- Focus on understanding brain function in the "real world"
- Understanding individual differences and improve human performance.

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Empathic Computing

Using AR/VR/MR technology to develop systems that support real-time understanding

- Sharing empathy in VR with physiological sensors
- Collaboration and Shared Experience
- AR First-Person View Video Instructions
- EEG Hyper-scanning for MR Collaboration

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International Collaborations

Academia

KAIST

東京大学 THE UNIVERSITY OF TOKYO

Université de Montréal

TU Graz

ETRI

THE UNIVERSITY OF AUCKLAND NEW ZEALAND

IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom

Keio University
1858
CALAMVS GLADIO FORTIOR

TUM

Nara Institute of Science and Technology NAIST

UC UNIVERSITY OF CANTERBURY

北京理工大学 BEIJING INSTITUTE OF TECHNOLOGY 1940

Industry

oculus

Google

SIEMENS

Microsoft

amazon

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SAAB

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ARIVE Network

Australasian **R**esearchers in **I**nteractive and **V**irtual **E**nvironments

Collecting together all the best AR/VR researchers in Australia and NZ

- 9 institutions, 260 researchers, > 30 million USD in funding

Looking for Industry Partners for research consortium

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Timor Sea
NORTHERN TERRITORY
Coral Sea
QUEENSLAND
Australia
WESTERN AUSTRALIA
Brisbane
SOUTH AUSTRALIA
Perth
NEW SOUTH WALES
Newcastle
Adelaide
Sydney
Great Australian Bight
ACT
Auckland
VICTORIA
Melbourne
Tasman Sea
TASMANIA
New Zealand

Thank You

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