Physics & Mathematics
Australia's research field leaders

These are the top researchers and institutions in the 21 fields of physics and mathematics

Aaron Nicolson
CSIRO
Field leader in Acoustics & Sound

At first, an academic career was just a sideline to Aaron Nicolson's dream of gaining an overseas scholarship to play American football.

Studies for his computer and electronic engineering degree took a back seat to training and playing football at a national level. But shortly after semester one at Griffith University, Nicolson injured his knee so badly it needed reconstruction surgery – and put his dream out of reach for good.

"It was devastating, I had put all this work into trying to achieve this sporting goal, which was admittedly far-fetched," Nicolson says. "But then all the focus that I had applied to football was then directed to this degree."

That was a decade ago, and since shifting priorities he's gone on to develop AI models that can be used to improve hearing aids, enable better speech-to-text and more recently enhance medical imaging.

Nicolson was introduced to AI in 2016 during a project at the Hong Kong University of Science and Technology, which was part of his honours study on speech recognition.

"It was such a powerful tool that, given some data to learn from, could perform complex tasks such as recognising language from speech," he says. "From there, I was hooked on doing research involving AI."

During his PhD at Griffith University, he shifted focus to speech enhancement, developing AI models to remove the background noise from audio containing speech.

"Speech enhancement has many applications," he says. "It makes it easier for those with hearing aids to hear someone talking in a noisy environment, it enables speech recognition or speech-to-text tools that are used by virtual assistants to better understand your speech, or (make) conference calls clearer."

The core tool to make it all happen is the AI models, which he describes as being an artificial brain of connected neurons. Researchers chop and change the structure of these artificial neural networks, making some parts bigger and others smaller, and tweaking how each neuron fires to get the best results on certain data.

After his PhD, Nicolson wanted to continue developing AI models in areas that could be impactful, such as in health and medicine. He now works for the CSIRO's Australian e-Health Research Centre (AEHRC) on medical imaging, using an AI technology called large language models to read a patient's medical images.

"Large language models are quite astounding and have very powerful reasoning capabilities," he says. "I get to develop large language models in order to make automatic radiology report generation as diagnostically accurate as possible."

Recently, Nicolson and his team beat off tough competitors to win an international competition on automatic radiology reporting. "I have found research to be more of a marathon than a sprint," he says. "You chip away slowly at a problem, and cumulatively, over many years, you can see an impact."

Carmel Sparke

Acoustics & Sound
Field leader: Aaron Nicolson, CSIRO
Lead institution: UNSW

Algebra
Field leader: Aidan Sims, Uni of Wollongong
Lead institution: UNSW

Astronomy & Astrophysics
Field leader: Joss Bland-Hawthorn, Uni of Sydney
Lead institution: ANU

Computational Mathematics
Field leader: Ricardo Ruiz Baier, Monash
Lead institution: UNSW

Condensed Matter Physics & Semiconductors
Field leader: Oleg Tretiakov, UNSW
Lead institution: Monash

Discrete Mathematics
Field leader: David Wood, Monash
Lead institution: Monash

Electromagnetism
Field leader: Amin Abbosh, Uni of Queensland
Lead institution: UTS

Fluid Mechanics
Field leader: Ivan Marusic, Uni of Melb
Lead institution: Uni of Melb

Geometry
Field leader: David Baraglia, Uni of Adelaide
Lead institution: ANU

Geophysics
Field leader: Dietmar Müller, Uni of Sydney
Lead institution: ANU

High Energy & Nuclear Physics
Field leader: Paul Jackson, Uni of Adelaide
Lead institution: Uni of Sydney

Mathematical Analysis
Field leader: Yihong Du, UNE
Lead institution: UNSW

Mathematical Optimization
Field leader: Fred Roosta, Uni of Queensland
Lead institution: Uni of Sydney

Mathematical Physics
Field leader: Ian Marquette, La Trobe
Lead institution: Uni of Melb

Nonlinear Science
Field leader: Tonghua Zhang, Swinburne
Lead institution: RMIT

Optics & Photonics
Field leader: David Moss, Swinburne
Lead institution: ANU

Physics & Mathematics (general)
Field leader: Tony Murphy, CSIRO
Lead institution: Monash

Probability & Statistics with Applications
Field leader: Christopher Drovandi, QUT
Lead institution: Monash

Pure & Applied Mathematics
Field leader: Sever Dragomir, VU
Lead institution: Monash

Spectroscopy & Molecular Physics
Field leader: Lars Goerigk, Uni of Melb
Lead institution: UNSW

Thermal Sciences
Field leader: Chunrong Zhao, Uni of Sydney
Lead institution: Uni of Adelaide