NZASE scientist profile

Engineer Mahonri Owen

Five of the early hands that Mahonri built; from left, his first, which he called Harper; Sam, made of shaped memory alloy; Handrew; George; and Dr J, named after US professional basketball player Julius Erving, who has huge hands.

Born

Kirikiriroa/Hamilton; he's now 34.

Affiliations

Ngāti Hine and Ngāti Tūwharetoa.

Schools and subjects

Mahonri studied Physics and Maths at the Church College of NZ in Hamilton.

"My grandparents moved from the far north to help build the temple in Hamilton – my grandfather was a bricklayer. They thought it would be two years, but they spent their life there and all my siblings went to the college."

How he got into science

"My mum always encouraged us to pursue education. I really enjoyed taking things apart and putting them back together to see how they worked, their mechanical principles – probably not to Mum's liking. I liked Physics, which I was told is the backbone of engineering."

"Waikato was the closest university, so I did a year of engineering, then two years as a missionary in southern African countries."

While there, "I met a lady who had woken up one morning unable to move her legs. Nobody knew why and I had no ability to help her. From that point, I thought that whatever I do for the rest of my life, as long as it's helping people then I could be happy."

Training and jobs

2014, Bachelor of Engineering (Hons) in Mechanical Engineering; **2015, MEng (Hons)** in brain-controlled prosthetics; **2017, Teaching Fellow**, Hebei University of Science and Technology, China; **2019, PhD** in Engineering. His degrees were all at Te Whare Wānanga o Waikato. **2020-21, Kaihautū Te Urunga Pae**, Pūhoro STEM Academy, Massey University; then **General Manager, Research and Enterprise** in 2022, Pūhoro Trust; From **2022, Senior Lecturer**, Te Whare Wānanga o Waikato.

"Pūhoro was an eye-opening experience; they take tauira Māori who wouldn't usually be in STEM subjects and put a real support structure around them. Two of my Master's students are from Pūhoro."

Fields of science

Prosthetics, autonomous robotics, neurology, mātauranga Māori.

Research topics

A brain-controlled prosthetic hand

This has been Mahonri's project for almost a

Mahonri with his wife Ruby Owen, and their tamariki. Photo by Grant Maiden, Royal Society Te Apārangi.

Mahonri holding an Emotiv Epoc+ EEG headset from his earlier research. Photo: Careers with STEM.

decade. When he returned from southern Africa, he found a Master's project on developing a prosthetic hand; he "thought '*Star Wars*, how cool'. The aim was to help people with nervous system disorders or amputations," he says. "Māori are over-represented in these disorders and in leg amputations from diabetes."

But first he had to learn the complex associated biology and neuroscience in only a year, "so I could understand the structure of hands and how they worked."

His research initially controlled the prosthetic using the standard electro-encephalography (EEG, brain signals) method. "Headset electrodes sense the potential difference (voltage/electricity) produced by the brain and users can control prosthetic devices from what we learn."

"Every time they grip or move their hand a certain way, we can see the signal spike. We can transfer that data into patterns of frequencies. A particular pattern means this person is thinking of grasping an object; it goes through Bluetooth to the prosthetic hand, which grasps after a short delay."

He later changed to using lightmyography (LMG), where light is reflected back from muscles to cameras and an armband sensor, which measures time and distance as the muscle moves. "It's at the forefront of prosthetics now, and is potentially a lot more accurate."

Mahonri is keen to see prosthetic hands become much cheaper and available to a wider range of people. "Commercial prosthetics hands are really expensive – $US20,000-100,000." He estimates the cost of the materials in his prostheses at up to $5,000.

Mātauranga Māori in Construction 4.0

Mahonri developed the first concepts for this project while he was at Pūhoro. It will make Aotearoa/NZ the first country to embed indigenous concepts in the construction industry's adoption of new computer technologies, big datasets, and machine learning.

This will transform the industry, providing a seamless, secure, and decentralised connection between physical building sites and cyberspace. The mātauranga project will produce bilingual articles about the challenges and synergies of the two knowledge systems.

Building the cultural capacity of engineering students

One of Mahonri's Master's students wanted to improve the cultural competency of engineers. She studied Mahonri's teaching about mātauranga Māori, which aims to develop student understandings about Māori.

Her goals were to understand how students responded to Māori perspectives in engineering, and to evaluate the effectiveness of the course. The project "provided ideas about how I could do things better," says Mahonri, "and analysed factors limiting Māori from being involved in sciences."

How he finds things out

"First I read all the research on prosthetic hands. From my engineering degree I used computer-aided design (CAD), applying my knowledge of mechanical principles and the human body."

3-D printing took about 12 hours for each hand. "I figured out many ways ***not*** to build a hand; I probably made 65 hands that work, and lots that didn't."

"The devices can be quite specific depending on who you're making them for: where their amputation is – a finger, a hand and forearm – or what people want to be able to do. For example, one amputee wanted to be able to cut a pineapple."

Mahonri tested each prosthetic on its response time and how well it performed simple gestures, like gripping a key or a ball, pinching and grasping strongly.

"The equations I use change really complex data into manageable chunks, and allow me to recognise patterns within brain frequency data that otherwise would not be seen."

"My supervisor helped with complex equations for machine learning and artificial intelligence, and I asked an orthopaedic surgeon friend at Waikato ADHB about anatomy."

Most valuable results

Mahonri's response to this question is quick: "None of the technical stuff. I still question the impact writing a journal paper has on the lives of Māori. Papers are the currency for academic reputation and promotion, but I want to help people, and don't think articles are the best way to help Māori."

He values "having younger student generations come through, opening doors for them so they can flourish. I'm where I am now because of people who gave me scholarships and opportunities; people are the most important thing."

Science and mātauranga Māori

"Pūrākau is one element of mātauranga; when I'm talking with younger Māori, in the history of our people coming to the South Pacific, I point out the many scientific and engineering principles in our vessels and navigation."

"You can see that switch in their thinking – their pūrākau from the marae is science and engineering. It normalises a place for te ao Māori in our science system. Having these knowledge systems co-existing is a great strength for Aotearoa/New Zealand."

"And when you look at disability from a Māori perspective, Māori tend to focus on people's strengths."

"For example, people who lose limbs or function can develop a heightened sense in other aspects of their life, like heightened hearing for a blind person."

Mahonri has advocated and negotiated the protection of Maori intellectual property (IP) from his time at Pūhoro. "This protection is not reflected well in government contracts and deters Māori from engaging in meaningful work."

He believes that engineers tend to think that making a machine will solve everyone's problem. "But there are too many other factors, including family and the wider environment."

Mahonri with later hand versions. Photo, Royal Society Te Apārangi.

What he likes about science

"Being able to make things, creating a physical mechanism that helps people. When we take our hands into schools, students are beyond excited to see that they can control them with their minds."

Links

Mahonri Owen, 2019, A helping hand; 3-Minute Thesis Doctoral finals, 3m video and transcript.
Mahonri Owen, 2021, Challenging the status quo: mātauranga Māori is science! Part 1, 33m podcast.
Mahonri Owen, 2023, A semi-autonomous neural interface for anthropomorphic prosthetic hand control, presentation at Global Young Scientists Summit, Singapore, 28m, (low-volume) video.
Mahonri Owen, Brain-controlled prosthetic hands, TechTalk NZ, 18m video.
Mahonri Owen, Giving a hand to those with disabilities TEDx Ruakura, 17m video.
Dr Mahonri Owen, undated, Royal Society Te Āparangi.

Ngā Kupu

Hoahoa ā-rorohiko – Computer-assisted design (CAD)
Mātai karehiko – Robotics
Mātai pūhanga – Engineering
Paerongo tāhiko – Electronic sensor
Pororere – Amputated; amputation
Pupuru – Grip, clasp, hold onto
Pūrere – Mechanical device, machine
Ringaringa – Hand, arm
Roro – Brain
Tuhinga kura wānanga – Academic text
Uaua – Muscle, sinew.

From Paekupu and Te Aka Māori Dictionary