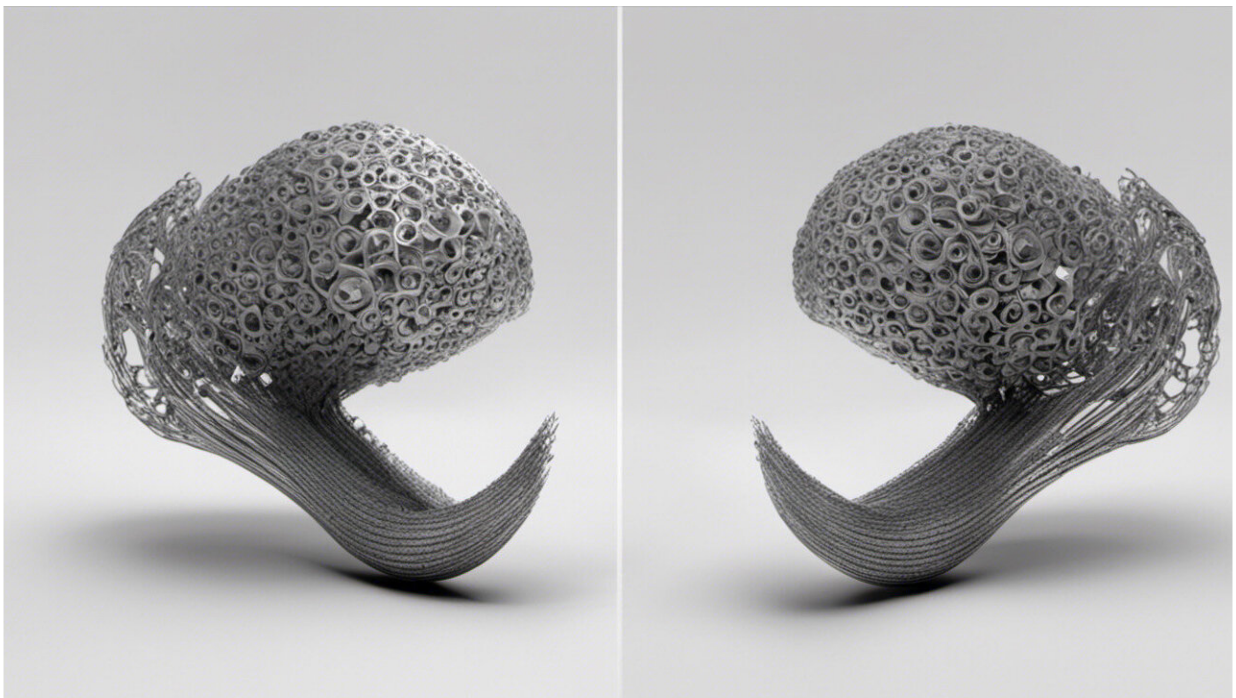
Opinion: A war made me realize that the world needs biomedical engineers

October 6 2017, by Zahra Moussavi



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It was a sunny and pleasant spring day in Dezful, a small city in the south part of Iran. There were not many people on the street but I remember a young teenager pedalling slowly on his bike. I remember him because a moment later he was decapitated by a piece of metal when an Iraqi missile hit the neighbourhood.

His headless body pedalled for a while before falling to the ground. Everything in that moment registered in my brain like a scene in slow motion.

In shock, all I was thinking was: "Wow! How can the body balance without the brain? The body's motion must have also been programmed in the spinal cord!"

It was spring of 1981 and I was 20 at the time, a second year university student with no background in biology or human physiology. A year earlier, I wanted to become a nuclear physicist and work on a Nobel Prize winning project. Then the war between Iran and Iraq started and the universities closed. I went to the Red Cross and to hospitals to learn first aid and then to the fronts to help with the war casualties.

The war scenes—and particularly the teenage cyclist on that particular day—made me decide to become a biomedical engineer.

Engineering knowledge, medical problems

Biomedical Engineering (BME) is now one of the fastest growing fields. Molecular Biology advances were the first modern revolution. Genomics was the second. Now the convergence of the life sciences and engineering as Biomedical Engineering is referred to as the third revolution.

But what is BME? And who can be called a biomedical engineer? The simplest and most informative definition is this: BME is the application of engineering knowledge and skills to challenging medical problems.

We can learn from examples. One of my heroes is the late Dr. Paul Bach-y-Rita, a physician and researcher at Wisconsin University. When young Paul had just started his engineering studies, a friend of his father told him he could never become a physician. To prove that friend wrong, Paul quit engineering and went to study medicine. Thus, he became a medical doctor with an engineering mind.

Dr. Bach-y-Rita created two major life-changing technologies: one was for a woman with complete lack of balance; the other was for the blind to see again. In both of his great inventions, he used the tongue as the sensory input.

He used the brain's plasticity to rewire the brain to use tongue nerve signals instead of vestibular (balance) signals and instead of eyes. I encourage you to read about his technologies on vestibular replacement and the "seeing tongue."

Medical devices for sleep apnea

A biomedical engineer must be multilingual, as every field of science has its own lingo. For example, in my team, we develop medical devices for diagnosis and treatment of sleep apnea. It is not enough to have electronics knowledge and skill; one must also have in-depth knowledge of upper airway physiology, sleep apnea pathophysiology and the characteristics of the signals that are being recorded.

That is why I am a firm believer that a biomedical engineer must have experience in the recording and analysis of basic human biological signals—such as those of the muscles, heart, brain and respiration.

Design of medical devices for diagnosis and rehabilitation is only one of many different research fields in which BME is pushing the boundaries. However, advances in science occur in incremental steps.

As an example, electrocardiography (ECG) is now the very first vital signal recorded and monitored in most clinical routines. Yet it took many scientists experimenting over many years, from Galvani's famous electricity experiment on frogs' legs in 1786, until the construction of the first commercialized ECG device in the 20th century by Einthoven (who subsequently received the Nobel Prize in Medicine).

Customised prosthetics and robotic devices

Not every biomedical engineer has to become a researcher. A biomedical engineer may work and serve society in many different ways and the job market is growing rapidly. An analysis from the US Bureau of Labor Statistics projects employment in biomedical engineering to grow 23 per cent from 2014 to 2024 —much faster than other occupations.

Biomedical engineers are also involved in performance testing of new and proposed products. Government positions often involve product-testing and establishing safety standards for devices. In hospitals, biomedical engineers can advise on selection, use and maintenance of medical equipment or life-support systems. They also build customized devices for special health care or research needs including prosthetic and robotic devices to increase quality of life.

In research institutions, biomedical engineers supervise laboratories and equipment. They can direct research activities in collaboration with colleagues in medicine, physiology, pharmaceuticals, nursing and other engineering disciplines.

Some biomedical engineers are technical advisors for marketing departments of companies or in management positions. Others take more advanced training in fields such as medicine to bridge particular deficiencies in the increasingly integrated approach to health care.

One student-centered graduate program

At the University of Manitoba, we designed our graduate BME program as a multidisciplinary initiative involving the faculties of engineering, medicine and science. We accept students with backgrounds in engineering or science and train them to become biomedical engineers.

The main innovation of this program is not its concept nor its content - there are many other similar programs in North America - but its functional interdisciplinary design. Another is its admission's flexibility: the program admits students from a wide variety of backgrounds, and tailors each student's program to their needs.

The main research areas of the program include but are not limited to: medical instrumentation and sensors, biological signal processing, biomedical image processing and reconstruction, gait analysis and rehabilitation, biophotonics, orthopaedic mechanics, neurocognitive science and non-invasive diagnosis of neurological disorders.

Why study in such a program? As I always say to my new graduate students: our research can bring us fame but we do not work for fame; our research can bring us money but that is not our incentive either; we do biomedical engineering because humanity needs it.

This article was originally published on The Conversation. Read the original article.

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