Medical Bionics can improve health outcomes by replacing, enhancing or monitoring damaged organs using devices that interface with the human body.

**Director’s Message**

The medical bionics industry, primarily centered around the development of implantable neurostimulation devices, is undergoing massive growth in the US, Europe and Asia. Cochlear’s bionic ear remains the most sophisticated medical bionic devices commercially available, although other commercial devices include: spinal cord stimulators for the treatment of chronic neurological pain, vagus nerve stimulators for the suppression of epileptic seizures, and deep brain stimulators (DBS) for the treatment of movement disorders associated with Parkinson’s disease. Collectively, these products form the nucleus of a significant and rapidly growing market. For example, in 2005, the total US market for neurostimulation products (including bionic ears) was estimated at $830 million. This market is expected to grow at a compound annual rate of 17%, reaching more than $1.8 billion in 2010, with the potential to double or triple over the following decade.

The Bionic Ear Institute has become a leader in the practical application of new technologies to the field of medical bionics. Our research and collaborative interests have expanded to include exciting new work such as the development of a bionic eye, therapeutic drug delivery and infection control, brain implants for neurological applications such as epilepsy control as well as our ongoing commitment to bionic ear research.

Our Autumn newsletter highlights some of our talented research staff, covering a broad array of skills and experience. It is a great honour for me to be the Director of an Institute full of such talented and devoted people committed to the development of new health outcomes for a variety of neurological disorders. Enjoy reading our Newsletter!

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**Eminent R & D Scientist joins The Bionic Ear Institute**

The Bionic Ear Institute recently appointed Professor Hugh McDermott as Deputy Director (Research). Hugh has had a highly successful career as a research engineer and scientist with the Department of Otolaryngology at The University of Melbourne. As a key member of the BEI’s Executive team, Hugh will contribute expertise and leadership that are crucial to the Institute achieving its vision to become a world leader in Medical Bionics.

Hugh has devised, developed, and evaluated several commercially successful devices that help restore hearing for deaf and hearing-impaired people. These include the most widely used speech-processing software currently in use by over 150,000 cochlear implant recipients, and a highly successful innovation that improves sound perception for millions of hearing-aid users worldwide.

Hugh will apply his considerable experience in translational research to expand his activities, including:

- stimulation of non-auditory neural structures to develop new devices that may soon help people suffering from epilepsy, blindness, and other disorders;
- design of improved sound processors and implants for auditory stimulation;
- investigation of the response patterns and plasticity of artificially stimulated neural structures to produce new knowledge that will underpin the development of medical bionic devices.

One of Hugh’s particular strengths is in creating and cementing collaborative relationships with research partners. In many instances this has involved collaboration with international companies and academic institutions. Three years ago he spent a year working in Switzerland, where he divided his activities between the University Hospital in Zurich, which is a leader in clinical research with cochlear implants, and Phonak AG, which is a global leader in hearing-instrument technology. One major outcome of the latter work was the commercial release of SoundRecover, an innovative sound-processing scheme that enables this development was carried out previously in Melbourne under contract to Phonak by a small team led by Hugh. SoundRecover is now a feature of almost all hearing instruments manufactured by Phonak, which is one of the world’s largest hearing-aid companies.

In 2009 Hugh was the first winner of the US Callier Prize in Communication Disorders, which recognises individuals whose leadership has fostered scientific advances and significant developments in the diagnosis and treatment of communication disorders.

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**Professor Hugh McDermott**

“My appointment brings an exciting new challenge and the opportunity to broaden my contribution in the rapidly growing field of medical bionics. I look forward to the day that we can build on our highly successful technology developed specifically for hearing devices to help people with other disorders, such as epilepsy and blindness.”
The Bionic Ear Institute has a proud history of multidisciplinary, innovative research focused on the world’s most sophisticated medical bionics device, the Bionic Ear.

We are using this experience and expertise to expand our research scope to medical bionics solutions for other serious medical conditions. These include epilepsy, blindness, infection and nerve damage. Our approach follows the same principles that resulted in the successful development and commercialisation of the bionic ear – we conduct world-class, multidisciplinary research that is always focused on achieving clinical outcomes to improve health in the community. We are delighted and proud to share with you the progress The Bionic Ear Institute is making to achieve these goals.

Therapeutic Drug Delivery

Research over the last four years funded by a Victorian State Government Science and Technology Innovation Infrastructure grant has delivered a breakthrough drug-polymer conjugate technology for infection control. The technology will be further developed and commercialised through a spin-off company, PolyActiva Pty Ltd.

This new technology delivers high levels of therapeutic drugs to targeted sites with low volumes, such as the eye, over an extended period of time up to 90 days.

The high ratio of drug per weight of the polymer materials represents a significant advance on current technology. In addition the system controls the rate of drug release as the polymer erodes, leaving no residue in the body. No existing system will allow drugs to be delivered in a controlled fashion from device components at such high dosage.

The drug polymer conjugate is like a LEGO® set that can be used to build multiple infection control products with different physical properties from similar building blocks, as illustrated in the following diagram.

Blue dots indicate electrodes positioned on the surface of two brains. These electrodes are used to record brain activity in order to detect and suppress epileptic seizures.

Epilepsy Control

Epilepsy is a chronic disease of the brain that affects over 1% of the world’s population. The defining characteristic of epilepsy is recurrent seizures, which may occur from hundreds of times per day to once every few years. Frequent or lengthy uncontrollable seizures carry a risk of irreversible brain damage, and the syndrome of sudden unexpected death is common amongst people with epilepsy.

The Epilepsy Control Program has made significant progress towards the development of an implantable device capable of detecting and controlling epileptic seizures. Promising results have seen this work expand to include preliminary investigations in human patients. The Bionic Ear Institute and its partner, St Vincent’s Hospital, are actively continuing this research, with collaboration from the University of Melbourne.

Bionic Eye

The Bionic Ear Institute is a core member of the Bionic Vision Australia (BVA) joint venture. BVA is a partnership of world-leading Australian research institutions collaborating to develop an advanced Bionic Eye. Other core members are the Centre for Eye Research Australia (CERA); National Information and Communication Technologies Australia (NICTA); The University of Melbourne; and The University of NSW.

In December 2009 the Australian Government awarded $42 million of funding to BVA for the development of a Bionic Eye capable of restoring vision to the blind. The Institute, in collaboration with surgeons at CERA, has already achieved significant progress with the development of a new electrode array and new surgical approaches for implanting the array at the back of the eye. New research staff and post-graduate students have joined the team. We are working extremely hard to achieve ambitious milestones for implant manufacture and for the first clinical trial in 2012.
In addition to this, with the use of an external microphone placed near the listener’s head the software is able to automatically control the sound level. This will reduce the amount of equipment needed in the sound-proof booth, improve the efficiency of the process for both the listener and the Audiologist and allow the software to be used in a variety of settings.

Kyle Slater joined the Bionic Ear Institute in February 2009 as part of the Undergraduate Research Opportunities Program (UROP) while completing his final year of a Bachelor of Engineering in Electrical and Electronic Engineering and Science (Physics) at the University of Melbourne. Supervised by Dr David Grayden and Dr Jeremy Marozeau, Kyle spent last year developing speech perception testing software in a trial phase with the Centre for Audiology and Hearing Research.

Currently, speech perception testing is performed by manually playing a word or sentence list from a CD player, and then noting down the listener’s response. Once the test has been completed, the results must be manually compiled and analysed. Using Kyle’s software, discoLingua, developed at the Institute, the entire process is controlled at a computer by the Audiologist. In addition to this, with the use of an external microphone placed near the listener’s head the software is able to automatically control the sound level. This will reduce the amount of equipment needed in the sound-proof booth, improve the efficiency of the process for both the listener and the Audiologist and store the results on a computer enabling fast statistical analysis of the results.

Kyle’s undergraduate research work was jointly funded by the Department of Electrical and Electronic Engineering at the University of Melbourne, the Bionic Ear Institute, and the Cochlear Implant Clinic at the Royal Victorian Eye and Ear Hospital.

Prior to his experience in 2009, Kyle was planning to enter industry upon completion of his undergraduate studies. However, having had a very positive experience working in research at the Bionic Ear Institute Kyle chose to pursue a PhD and was talented enough to receive an Australian Postgraduate Award (APA) to support this work. Kyle is now part of the Music and Pitch Team at the Bionic Ear Institute where his research will focus on a novel approach to improving music perception and appreciation for people with impaired hearing. Kyle will be developing a device that will convey music information through the tactile sensory system providing an additional mode of interaction with sound.
Our volunteer ambassadors love to share their stories of how the Bionic Ear has changed their lives, or their children’s lives. The Bionic Ear Institute has fifteen ambassadors in Victoria and one in Sydney who are available to speak at your community club or group meeting.

To book a speaker please contact the Public Relations and Fundraising Manager on 03 9667 7500.

Ambassadors Love to Share their Stories.

Our volunteer ambassadors love to share their stories of how the Bionic Ear has changed their lives, or their children’s lives.

From Nanotechnology to Outer Space

In November 2009 the Federal Government announced the establishment of the Space Industry Innovation Council as part of the Government’s Super Science initiative for creating innovation culture in Australia. The Council will examine Australia’s current civil space activities, risks and strategic priorities with a focus on Earth observation, satellite communications and navigation.

Dr David Nayagam, one of the Bionic Ear Institute’s inspiring young researchers, with a passion for space technology, has been invited to be a member of the Council. David was an astronaut candidate with the European Space Agency in 2008/2009 and, after completing a year of selection and screening tests, was one of 22 finalists interviewed for the position of European Astronaut from a pool of 8,413 qualified applicants.

Dr Nayagam says, “I am honoured to be a member of the Council. We have an opportunity to increase Australia’s profile in the global space industry, co-ordinate our space-related activities and collaborations as well as develop a national space policy. It is exciting to be part of this process during its formative period.”

For more information, please visit www.space.gov.au

Biomedical engineering plays an important role in our research

Biomedical engineering is the fastest growing and one of the most challenging areas of engineering today. Biomedical engineering combines principles of several sciences including biology, physics and engineering and applies these to benefit people with medical conditions. Our researchers are at the forefront of this 21st century revolution in medicine and treatment of disease.

One of the leaders of the next generation of biomedical researchers at the Bionic Ear Institute is Research Fellow and Biomedical Engineer, Dr Mohit Shivdasani.

Dr Shivdasani’s research during his PhD years focused on an Auditory Brainstem Implant, a device that electrically stimulates the auditory parts of the brain to restore hearing to some deaf people who cannot benefit from a cochlear implant (Bionic Ear).

During his PhD, Dr Shivdasani published two research papers in prestigious international scientific journals and won five awards including the 2006 Young Biomedical Award presented by Engineers Australia – College of Biomedical Engineers.

Dr Shivdasani is now part of the multi-disciplinary team at the Institute, using his acquired skills to help develop a Bionic Eye. This device aims to restore vision to people suffering from diseases such as retinitis pigmentosa and macular degeneration.

David Nayagam at his final European Space Agency interview in Noordwijk, Netherlands in March 2009.