June 2009

mech + bio

News and stories from Mechanical and Biomedical Engineering in NUI Galway

NUI Galway offers level 8 degree courses in **Mechanical Engineering (GY405)**, **Biomedical Engineering (GY408)** and **Energy Systems Engineering (GY413)**. These degrees are also available through the Undenominated Engineering entry (GY401).

More information is available at www.nuigalway.ie/mechbio. Do contact us at mechbio.eng@nuigalway.ie or (091) 492723 if you'd like to talk to teaching staff or arrange to visit us.

Adrian Doyle

is creating the next generation of wind turbines

In 2000 I graduated from NUI Galway with a degree in Mechanical Engineering, which has been the foundation for my career to date. For my professional experience placement, while I was a student, I worked at Composites Testing Laboratory (CTL) where I gained my first experience of carbon fibre composite materials. CTL tests high-performance carbon fibre composite materials for the aerospace industry. During my placement I was able to start my final year project, investigating how different test equipment for carbon fibre specimens could give varying test result data.

After graduating I spent six months working in Switzerland through a contact gained during my degree at NUI Galway. I worked on projects developing process methods for new composite materials. One project was to manufacture a glass fibre safety roll-bar for a bus. I then returned to Ireland and started working with ÉireComposites in Indreabhán, Co. Galway. Over the years I have worked on many motorsport, transport, marine and aerospace products. Now I work in wind energy. I'm a research and development manager in the team who developed the very first thermoplastic composite wind turbine blade to go into mass production for "micro" turbines (blade length of 5 metres or less). Traditional wind turbine blades are manufactured from polyester resins which create harmful emissions during the manufacturing process. We developed a new manufacturing process using thermoplastic composite materials. The new process produces no emissions, and the blades can be recycled at the end of their life. I was involved at every stage of the project, from the first contact with our customer through to design, process development, quality control and testing. Since the first thermoplastic blade went into production a number of years ago, many other leading turbine manufacturers have approached ÉireComposites to produce blades for their machines.

Following the success of the micro turbine blades, we also have a project to develop the first thermoplastic wind turbine blade for the larger turbines. In 2006 I was involved in an R&D project with Mitsubishi Wind Energy to develop tooling and a manufacturing process to build a 12-metre thermoplastic wind turbine blade. Following the success of this project, we are now looking to scale the technology up to 40-metre turbine blades.

Every summer at ÉireComposites we hire a third year Mechanical Engineering student on placement from NUI Galway to assist us with our R&D projects. Now I sit on the interview board where previously I was the student.

SFI/DELL Scholarship 2009

Young Women in Engineering

Each year, Science Foundation Ireland and Dell award the Young Women in Engineering scholarship to some of the best female students entering engineering degree courses in Ireland. Scholarship holders receive an annual award of €2,000, a Dell notebook, and at least one funded internship in a university or industry research laboratory. For more information, see www.sfi.ie/scholarship. The closing date for applications is 26 June 2009.

An employer's perspective

Paul Gilson

These are depressing times for all sorts of people with the world and national economies in dire straits. In particular, CAO form-fillers have a bewildering choice of careers and courses in front of them. With a number of the Universities advertising in various media that they can offer a fantastic educational experience, choosing the correct course can be difficult. Actually, it should be really easy. If you have the aptitude (which you should actually measure), there is no better career choice than engineering. Let me try to explain.

Engineers actually drive the world's economy. Others play with the money, banking, lending, hedge funding, leveraging and accounting but they would not have anything to count if the economic building block of actually making something that is needed by somebody else and can generate a sale did not happen. Production is the actual core. It could be mining ore to produce a raw material, writing code that makes up gaming software, producing a mobile phone or even as happens so often in Galway, manufacturing a life-saving medical device.

If future job prospects are important to you in choosing a career path, there are few better professions than Engineering. It may sound somewhat corny, but if you are choosing to enter the medical device industry, you will bring direct benefit to people at a time when they are most vulnerable.

Looking at the engineering courses provided by our universities, you will be hard pressed to find others that offer anything like the breadth of subject choice. Engineering is both an educational and vocational degree. Having finished, you will leave university already equipped to take up a huge variety of roles in industry, although you will certainly need to add on "on the job training" for specific elements.

The training provided, in whatever specific discipline you enter, relates to providing an understanding of principles in numerous technology areas. You may take a course for a single semester and then drop it. You will later inevitably find that you have enough of a foundation to build additional expertise on if and when you need it. Both Mechanical and Biomedical engineering degree courses equip students very well to enter the workforce.

In particular, it is the problem-solving and analytical skills and abilities developed in every subject

A self-expanding nickel titanium stent emerging from its delivery catheter. Devices like this are engineered to contract to less than 1 mm in diameter for delivery into a blood vessel and expand to full size when deployed (as in the picture).

throughout the course that make engineering graduates so effective in whatever career role they choose. Manufacturing, Quality Assurance, Product Development, Research, Supervision and Management all need engineers and are proven career tracks for engineers.

Where will the jobs be in 4 to 5 years' time? The Medical Devices sector in Galway and Ireland is one that has a number of factors in its favour. It has emerged from being primarily a manufacturing industry fifteen years ago to one that now encompasses indigenous and multi-national research and development. The sector here has international standing, being a world centre of excellence and continues to attract both capital and companies seeking a skilled workforce. In the western world, demographics show an aging population in need of more and more treatment for illnesses. A major driver for the industry is that it provides less invasive and more economical treatment methods for those diseases. So, perversely and counter-intuitively, and particularly in recessionary times, there is a great desire by industry and government to drive out cost from healthcare systems by spending more money on medical device technology. The medical device industry has been called recession-proof. While individual companies see their market share rise and fall at different times, the overall market maintains its inexorable growth.

With engineering training, you should look towards the future with confidence that you are equipped to take on life and career opportunities. Engineers can and do emerge as leaders in society, industry and business.

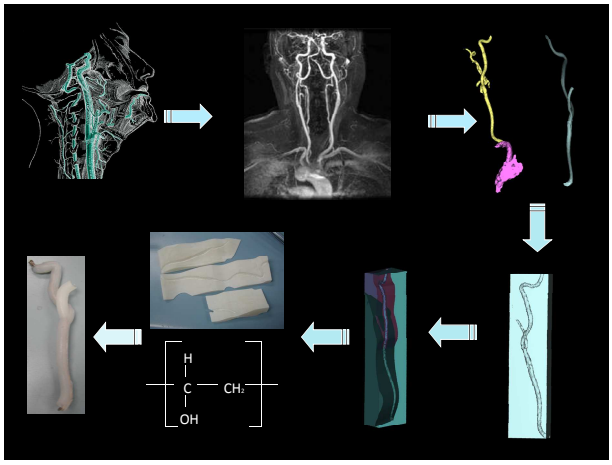
Paul Gilson is currently CEO of Novate Medical and has been a co-founder of a number of start-up medical device and technology companies in the Galway region. He previously was Director of Research and Development for C.R. Bard International. In his various roles he has hired in excess of 100 engineering and science graduates, many of them from NUI Galway. He holds a Bachelors Degree in Engineering.

Ellen Roche — innovating in Ireland and California

During my biomedical engineering degree I worked in Abbott Vascular (then Mednova) in Galway on placement in the research and development team for a next-generation embolic filter (a device to prevent potentially fatal particles in the bloodstream from reaching the brain or lungs). On graduation in 2004, I returned to Abbott in conjunction with the IBEC Export Orientation Programme. This brought me to California, where I stayed until 2008 with Abbott Vascular between Redwood City and Santa Clara (with a six-month stint in Galway in 2005). I worked on design teams for coating of drug-eluting stents, a novel self-expanding coronary stent for treatment of vulnerable plaque, and a needle injection catheter for stem cell delivery to the left ventricle of the heart.

Since finishing with Abbott, I travelled for a few months, and returned to California to join a start-up orthopaedic device company. I'm currently in Dublin doing a Master's degree in Trinity College on the biomechanics of the knee joint. This work is in conjunction with IDAC, a Dublin-based engineering analysis company. This research will result in a useful design tool for total knee replacement devices, and new therapies for the painful condition of osteoarthritis. I plan to return to the USA this summer to complete some kinematic experiments, and to attend classes at the University of California, Berkeley. In September, I plan to study Graduate Entry Medicine with a long-term view to working in university or industry-based research. I hope my background in engineering, and technical mindset and awareness that it's given me, will enable me to identify the primary gaps and areas for improvement in the medical field. While gaining clinical training, I will acquire a thorough understanding of human form and function, and medical and surgical therapies. Equipped with this knowledge and an engineering skill set, I will endeavour to combine the areas of medicine and biomedical engineering into meaningful, interdisciplinary research and development.

I chose engineering because of its analytical, problem-solving nature combined with the fact it allowed a level of creativity as well as technical and mathematical elements. The biomedical discipline suited me, as I always had a keen interest in the medical world. The course content was tailor-made for the daily activities I have become accustomed to for the past five years, however varied they have been. I could not have chosen a better primary degree for working in the medical device industry. My short career to date has been thoroughly enjoyable, and I have had exposure to, and participation in, a wide range of emerging medical device technologies. The decision to study Biomedical Engineering in Galway was undoubtedly one of the best choices I have made, providing me with a solid technical and research foundation in engineering, and opening numerous doors and avenues for the future.



The path from a patient's MRA scan to an accurate physical model of the individual's carotid artery.

In 2004, as part of her biomedical engineering final year project, Ellen Roche developed a technique to make detailed models of healthy and diseased blood vessels, based on magnetic resonance angiography (MRA) scans of real patients. These very accurate models are then used to design and test medical devices such as stents and filters under realistic conditions. The project became a speciality. She used and developed this modelling technique extensively in her job, becoming an expert, and went on to file patents for four inventions in the field. Based on this work, she recently won first prize in the Irish section of "Speak Out For Engineering," a competition for young mechanical engineers. Ellen gave a detailed talk on some of her work to Engineers Ireland. You can watch it at http://tinyurl.com/m87awr.

New degree course in Energy Systems Engineering

Energy Systems Engineering is a new multidisciplinary programme covering fundamental engineering knowledge and skills in such areas as energy conversion, electrical power systems and energy management (in buildings, transport, industry), along with modules on energy sources, energy policy and economics and associated environmental issues. The course (GY413) is open for applications through the CAO change-of-mind procedure up to 1 July.

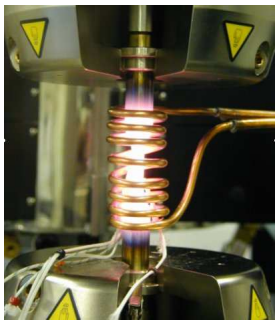
In the past year the academic team in Mechanical and Biomedical Engineering grew to 14 with the appointment of four new staff members. Two are returning Galway natives, but all four have an international track record in research and teaching.

New staff members

Dr. Wenxin Wang

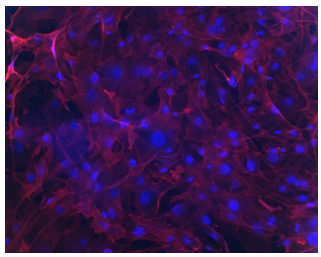
In 1999, I got my Ph.D. at Shanghai Jiao Tong University (China) and then undertook a research position in University of Liège (Belgium) for a year. Before coming to Ireland I spent a few years as a senior researcher in the University of Nottingham (UK, 2001-2008). Through all the years of my research, my passion was focused on the development of novel materials for real applications, especially for medical purposes. I have recently been appointed as a lecturer in Functional Biomaterials in the Department of Mechanical and Biomedical Engineering. I endeavour to convey my expertise on polymer science and technology into biomedical applications. One of my research projects is to develop 'intelligent' polymer systems to mimic biological process for controlled drug/gene delivery and wound healing. The successes in this research will significantly improve the quality of people's life. I teach three courses to mechanical and biomedical engineering students in third and fourth year – Polymer Technology, Tissue Engineering and Biomedical Production.

Prof. Sean Leen



My choice of a career in mechanical engineering, starting with my decision to study Mechanical Engineering at NUIG, was inevitably somewhat intuitive. There was nonetheless an expectation that this was a career which had significant potential for creativity, problem-solving, graphical and visual expression and technical detail, as well as a combination of mathematical and physical sciences. This expectation was borne out by my experience. Mechanical engineering has taken me all over the world, working in consultancy, research and development, and education, before returning to NUI Galway as Professor of Mechanical Engineering. My work has covered a range of industries, including offshore engineering, aerospace, manufacturing and power generation. The picture shows a material specimen under test at 900°C. In electrical power stations, to minimise CO_2 emissions and achieve maximum efficiency but at the same time ensure safe operation of plant, engineers need to design pressurised boilers and steam pipes, including welded connections, for extremely high pressure and temperatures approaching 750°C. Another example is the design of turbine blades for aircraft engines, where the blades must be designed to withstand temperatures of 1000°C and cyclic stresses of 1000 MPa without cracking, which could lead to loss of life. Experiments like the one in the photograph allow engineers to test and improve new materials and designs at these extreme conditions in the safety of the laboratory.

Dr. Laoise McNamara



I began my career by studying mechanical engineering here at NUI Galway. My interest in biomedical engineering prompted me to do a PhD in Bioengineering at Trinity College Dublin. I then worked as a researcher at Mount Sinai School of Medicine in New York and later a lecturer in the University of Southampton (UK). I was recruited as a Lecturer in NUI Galway under a Science Foundation Ireland programme. I teach Medical Device Design and Biomechanics course for the Biomedical Engineering program. I also engage in research which combines engineering and biology to advance treatment of bone diseases. I'm particularly interested in how cells experience mechanical forces (such as loads on our bones when we walk, or on our arteries when the heart pumps blood through them). Certain diseases, such as osteoporosis, arthritis and diabetes may occur when these cells lose their ability to respond to force. My research has achieved international awards and been published in scientific journals. I also work with the medical device industry (Stryker, Medtronic), by providing training and collaborating in research to advance the design and performance of their implants.

Dr. Dimitrios Zeugolis

I studied at TEI Epirus in Greece and the Universities of Lincoln and Northampton in Britain before working in the National University of Singapore, and finally moving to Ireland. Now I'm a lecturer in biomaterials and a researcher in the Network of Excellence for Functional Biomaterials (NFB) at NUI Galway. In my research I'm using recent advancements in engineering, biology, biochemistry and medicine to fabricate implantable medical devices that closely match the properties of native human tissues and ultimately improve quality of life.