PhD Opening at National University of Ireland Galway

Topic: Dielectric Properties of Bone and the Development of Low-cost Microwave Tomography for Diagnosis and Monitoring of Osteoporosis

Osteoporosis is a condition in which bones become more brittle, causing them to break easily. Worldwide, osteoporosis is responsible for 9 million bone fractures yearly and will affect 1 in 3 women and 1 in 5 men as they age. These numbers are expected to increase significantly in coming years as the world population ages. Fractures regularly occur in important regions such as the hip, spine, and forearm. The risk of re-fracturing is high, thus increasing disability and mortality rates. As an example, one year following a hip fracture, 40% of patients are still unable to walk independently and a full 80% have limited daily independence. It is clear that osteoporosis has a huge personal and societal burden.

In general, bone mineralisation decreases with age; however for those with osteoporosis the decrease is exacerbated. Careful monitoring of these changes in bone density could better equip clinicians to identify and monitor the disease earlier, and prevent related injuries before they occur. Currently, X-ray imaging is the primary method for diagnosis and screening of osteoporosis. However, X-rays are expensive, difficult to obtain quickly, and involve dangerous ionising radiation so they cannot be used for regular monitoring. An ideal osteoporosis monitoring system would be low-cost, non-invasive, non-ionising and available at local clinics.

Microwave tomography has the potential to satisfy this demand. Early research has hypothesized that the change in bone mineralization levels will change the dielectric properties of the bone. These changes could be monitored by creating microwave tomographic images of the heel (and the bone therein) and tracking the dielectric properties of the bone over time. A detailed knowledge of the dielectric properties of healthy bone and bone affected by osteoporosis will provide the foundation for the development of a low-cost osteoporosis screening device. Further, such a bone-health monitoring device would have a strong positive societal and economic impact in the context of an ageing demographic in the EU.

This project (funded by the European Research Council, under the BioElecPro project grant (2015-2020)) will examine the dielectric (electromagnetic) properties of healthy bone and changes due to normal ageing and osteoporosis, and apply this knowledge to the development of a low-cost microwave tomography device for bone monitoring. The PhD student will be based at the National University of Ireland Galway. The salary is €18000/year and university fees will be covered by the project funding. Potential candidates should have a strong background in electromagnetics and/or electronics, and have an affinity for experimental work. The position is available immediately.

Interested candidates should send copies of their CVs to martin.ohalloran@nuigalway.ie.