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UCT researcher develops new MRI technology to help fight cardiovascular disease

Biomedical engineering offers fast, non-invasive techniques for diagnosis and treatment

Research by University of Cape Town PhD graduate in biomedical engineering, Dr Daniel Auger, has the potential to improve the diagnosis and treatment of a number of diseases in the human heart.

According to Dr Auger, a new magnetic resonance imaging (MRI) technique is capable of quantifying the three-dimensional (3D) motion and deformation (strain) of the heart in a single scan. This technique is called 3D displacement encoding with stimulated echoes (DENSE). Dr Auger's research focuses on the development of novel software algorithms for the analysis and interpretation of 3D DENSE data. There are three arms to this project:

- Dr Auger presents a method to calculate the strain and quantify motion in the right ventricle, achieving previously unattainable spatial resolutions and providing new insights into the kinetic parameters of the right ventricle, which previously was notoriously difficult to image and analyse.
- He developed and implemented a novel segmentation algorithm for the entire left ventricle by using properties inherent in the DENSE data, reducing by tenfold the time required to delineate a single data set.
- Dr Auger provides strain-mapping algorithms to measure and quantify mechanical dyssynchrony in both ventricles. This can in turn be used to guide pacemaker lead placement in cardiac resynchronisation therapy.

These methods offer a fast and non-invasive technique for identifying the anatomical location and for assessing cardiac dysfunctions, such as those that occur during cardiac dyssynchrony, inflammatory heart diseases and myocardial infarction. The application of 3D DENSE MRI is an exciting extension to the study of cardiovascular disease using MRI. Three-dimensional imaging is required to accurately capture the 3D motion and contraction patterns of the heart. This

allows for 3D strain calculations and representation of the fibre architecture along the heart wall, which can assist with diagnosis of diseases that are patchy in their manifestation, such as Arrythmogenic Right Ventricular Cardiomyopathy.

Dr Auger says the heart is the fastest moving organ in the body and contracts in a complex, three-dimensional manner. However, the understanding of cardiac function and pathology is still limited. "Therefore various imaging techniques have been developed for the effective diagnosis and treatment of cardiovascular disease. The ability to non-invasively image and analyse the function of the heart wall has significant potential to improve our management of heart disease. MRI has been an active platform for the development of several non-invasive techniques used to understand myocardial structure, function and perfusion."

Dr Auger combines his interests in engineering and medicine to help people and improve quality of life. "Biomedical engineering is a reasonably new degree and career path in South Africa," he says.

ENDS

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