Seminar

Department of Biomedical Engineering
香港城市大學
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Development of 3D Ultrasound Imaging System for Scoliosis Assessment

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Abstract

Scoliosis is the most common spinal disease among adolescents, which is a medical condition of sideway-curved spine, either in C or S shape, normally accompanied with 3D deformity of spine, affects about 3.5%-5% of adolescents in Hong Kong and China, and about 20% of them tend to suffer from progressing curvature that requires wearing braces or undergoing surgery. Most patients observe an onset from age 10 to 17, and females are eight times more likely than males to progress to a curvature that needs treatment. As teenagers grow rapidly, regular and continual monitoring of scoliosis are essential, and such check-ups are usually done with X-ray imaging, the current gold standard for scoliosis diagnosis. However, research shows that scoliosis patients receiving an average of 16 radiographs during the treatment period are 5 times more likely to develop cancer 25 years after treatment. Thus, scoliosis patients cannot have X-ray scans too frequently, meaning their conditions cannot be monitored as closely as they should be. Furthermore, X-ray can only reveal the spinal curvature in 2D, while scoliotic deformities are typically 3D in nature.

In light of this, our team has developed Scolioscan, using 3D ultrasound imaging technique for scoliosis assessment. Due to its radiation-free feature, Scolioscan can be used from accurate screening, frequent follow-up, treatment outcome measurement, and real-time visual feedback during non-surgical treatment of scoliosis. In addition, Scolioscan also has potential for predicting scoliosis progression. In addition, the team has successfully a portable version of the system with a palm-sized probe, known as Scolioscan Air, designed to be brought to local communities, such as schools, for mass screening. A typical scan for a spine only takes 30 seconds.

Conventionally, ultrasound imaging has been mainly used for soft tissue assessment, as bone surface will reflect most of ultrasound energy, leading to a shadow after the bone surface in the image, thus imaging bone using medical ultrasound has been treated a forbidden zone. This development innovatively utilizes the artifact, acoustic shadow in B-mode image to form coronal image features for spine, and it has been treated as groundbreaking idea. Multiple studies have been reported to demonstrate the reliability and validity of Scoliosis, in comparison with X-ray results of spinal deformity. In addition, Scolioscan cannot only provide 2D images but 3D images of spine, it can also provide muscle information, which X-ray not, and Scolioscan can also be used to research on the topics that X-ray cannot, due to radiation hazard.

The system has been commercialised by Telefield Medical Imaging Limited, a start-up co-founded by Professor Zheng, and Scolioscan has been registered as a medical device in multiple countries and region, is now being used in the Netherlands, Italy, Germany, Bosnia, Poland, Romania, Australia and China, and a number of countries in Southeast Asia. Over 30,000 scoliosis patients so far have been scanned using Scolioscan, thus reduced X-ray exposure.

Biography

Professor Yongping Zheng, Henry G. Leong Professor in Biomedical Engineering, is currently a Chair Professor of Department of Biomedical Engineering in the Hong Kong Polytechnic University, and he is also the Director of Research Institute for Smart Ageing and Director of Jockey Club Smart Ageing Hub. Professor Yongping Zheng received the BSc and MEng in Electronics and Information Engineering from the University of Science and Technology of China. He received PhD degree in Biomedical Engineering from the Hong Kong Polytechnic University (PolyU) in 1997. After a postdoctoral fellowship at the University of Windsor, Canada, he joined PolyU as an Assistant Professor and was promoted to Professor in 2008 and Chair Professor in 2019 respectively. He was the Associate Director of the Research Institute of Innovative Products in PolyU from 2008 to 2010. He served as the Founding Head of Department of Biomedical Engineering during 2012-2020.

Prof. Zheng's main research interests include biomedical ultrasound and smart aging technologies. Professor Zheng was rated as the top 2% citation scholar in the area of Artificial Intelligence and Image Processing in a survey conducted by Stanford University in 2021-2023. He has trained over 19 PhD and 8 MPhil graduates as Chief Supervisor, and over 15 postdoctoral fellows. He also owned more than 50 patent families (with a total patent number over 120), published over 300 journal papers, and wrote two books "Measurement of Soft Tissue Elasticity In Vivo: Techniques and Applications" and "Sonomyography: Dynamic and Functional Assessment of Muscles", and the third book "3D Ultrasound Imaging for Spine and Scoliosis" is now in processing, a number of technologies invented by his team have been successfully commercialized by startup companies that he co-founded, including Scolioscan (http://scolioscan.com): a 3D ultrasound imaging device to provide radiation-free assessment of scoliosis, and Liverscan (http://eieling.com): ultrasound image guided transient elastography for liver stiffness measurement. His inventions have won many international and local awards, including the prestigious 1st Bank of China Hong Kong Science and Technology Innovation Prize in 2022.

Professor Zheng is a Senior Member of IEEE, a Fellow of Hong Kong Institution of Engineers (HKIE), past Secretary of World Association of Chinese Biomedical Engineers (2017-2019), past Chair of Biomedical Engineering Division of HKIE,and Honorary Advisors of Hong Kong Federation of Senior Citizen Industries and Hong Kong Medical and Healthcare Device Industry Association. He also serves as the President of Guangdong Hong Kong Macau Chapter of the International Society of Gerontechnology. He has served as Associate Editor and Editorial Board Members for some leading journals in the field.