Medical Imaging in the Framework of Topics Covered by URSI

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Until the 1970s URSI science, segmented into the ten commissions and restricted to the non-ionizing portion of the electromagnetic spectrum (NIEMS) had little, if any, impact on the development of medical imaging. It was the ionizing part of the EM spectrum that drove the first wave of development of radiology: Wilhelm Roentgen in 1895 for 2D radiographs, Ernest Lawrence in 1930 for the first cyclotron and start of nuclear medicine, Godfrey Hounsfield in the 1970s for 3D X-ray CT (Nobel Prize 1979) and in the 1970s 3D nuclear medicine (positron emission tomography and single photon emission tomography). It was not until the 1970s that scientific discoveries from URSI's commissions inspired the utilization of the NIEMS to contribute to the second wave of medical imaging development.

The development of Nuclear Magnetic Resonance Imaging, now called Magnetic Resonance Imaging (MRI) stands as high watermark of the contributions of URSI science to medical imaging. (Discovery of NMR by Felix Block and Edward Purcell in 1946 led to the invention of NMR imaging in the 1970s by Paul Lanterbur (invention of zeugmatography imaging) and Peter Mansfield (invention of echoplanar imaging). More recently URSI science has also inspired the development of microwave breast imaging [1,2], optical imaging [3], near-infrared imaging [4], photoacoustic imaging [5] and Terahertz imaging [6].

The contribution to medical imaging of the URSI commissions have been primarily two-fold: a) the science/discovery of NIEMS field generation and detection and b) the mechanism of interaction of the NIEMS with tissues. Historically, once proof-of-principle of the technology development has been achieved technology engineering is largely driven by medical imaging companies. However, understanding tissue NIEMS interactions continues to be an important contribution of URSI science. This is an important ongoing contribution as this tissue mechanism understanding drives both the important biological information that can be extracted from tissue and the safety parameters that constrain the exposure space.

The presentation will focus on MRI with respect to a) the exposure space, b) current limits of technology, c) future directions and d) future impact on healthcare [7]. As a specific example of future directions, I will focus on simultaneous imaging of MRI with positron emission tomography i.e. hybrid PET/MRI. Hybrid PET/MRI represents an interdisciplinary milestone wherein a bridge is established in medical imaging between the non-ionizing and the ionizing portions of the electromagnetic spectrum. It challenges the hybrid PET/MRI researchers to keep aware of these two very different scientific fields to develop these hybrid medical imaging technologies synergistically [8].

References

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