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Friday, June 27, 2008, 1 pm, Traylor 709



Taking Image Science to Task in Image-Guided Interventions

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Abstract:

Advances in medical imaging are central to addressing the major challenges in 21st medicine, including improved early detection, development of high-precision therapeutics, and understanding the complex morphological and molecular factors of therapy response. Accordingly, image science has been called the “core interdisciplinary science” in fueling discovery and transforming our approach to disease diagnosis and treatment. Such advances rely on the development of novel imaging and interventional technologies beyond the state of the art. In x-ray imaging, for example, the creation of large-area flat-panel detectors has spurred research in advanced imaging techniques such as dual-energy (DE) imaging, tomosynthesis, and cone-beam CT (CBCT). New perspectives on image science provide a foundation for the rigorous optimization of such technologies with respect to the imaging task and have proven a valuable means of rapid translation to clinical trials. In DE imaging, high-performance systems are under development in the investigator’s laboratory that leap-frog conventional limitations to imaging performance and point to DE as a ‘new normal’ means of x-ray examination. Similarly, tomosynthesis and CBCT present imaging platforms that are ideally suited to high-precision guidance of radiation therapy, interventional radiology, and surgery. Such technologies also present a valuable adjuvant to other imaging modalities, with multi-dimensional x-ray images providing high-resolution, geometrically robust contexts for the interpretation of molecular / functional data. This talk addresses several of the challenges and early successes in: i.) the extension of fundamental image science approaches to task-based, multi-dimensional analysis; ii.) the development of advanced x-ray imaging technologies for diagnostic and image-guided procedures; and iii.) the rapid translation of such technologies to clinical trials and the burgeoning scope of future applications.

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