Special Section Guest Editorial: Computed tomography (CT) at 50 years

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Fifty years ago this month, the first clinical computed tomography image was obtained by Godfrey Hounsfield of EMI and his clinical collaborator James Ambrose at Atkinson Morley hospital in London. While the image is crude by today's technological standards, it clearly visualized a brain tumor and quickly captured the attention of physicians worldwide for the promise it held. It is unquestionably the most significant radiological image since the very first: the famous image of Frau Roentgen's hand acquired 76 years earlier. This special section of the *Journal of Medical Imaging* marks this anniversary with a collection of five invited review articles as well as nine proffered research papers that represent a cross-section of current investigations in CT.

The five invited historical reviews survey the past 50 years from a variety of technological, computational, and clinical perspectives. In "How CT happened: the early development of medical computed tomography," Schulz and co-authors give a compelling account of the development of the 1971 scanner and the first generations of scanners that followed, recounting stories both familiar and unfamiliar.[1] Hsieh and Flohr carry the story to the present day in "Computed tomography recent history and future perspectives," ending with a look forward to emerging technologies like photon counting CT.[2] In "From EMI to AI: a brief history of commercial CT reconstruction algorithms," Crawford and La Rivière survey the computational side of CT over the last fifty years, focusing on four key eras: the algorithmic developments around the 1971 scanner, the optimization and rise to dominance of filtered backprojection (FBP) algorithm, the need for modified FBP to accommodate spiral and cone-beam scanners, and finally the rise of iterative and artificial intelligence (AI) algorithms in recent years.[3] Fahrig and co-authors consider application-specific CT scanners built around wide, 2D digital detectors mounted on C-arms and other novel cone-beam geometries that have brought CT technologies into operating and procedure rooms.[4] Finally, on the clinical side, Dillon guides the reader through key moments in CT neuroimaging.[5]

The nine research papers offer a snapshot of current technical CT research interests and span a wide and representative range of topics. In the realm of emerging hardware and techniques, we see work on system design for a head scanner using a novel x-ray source,[6] a study of phase contrast CT of the breast,[7] as well as image reconstruction for photon counting CT.[8] In a case of one form of CT helping another, we see microCT used to help characterize the performance of an emerging dedicated breast CT scanner.[9] Spectral CT is studied for both stand-alone CT[10] and as a potential source of improved attenuation correction maps for SPECT.[11] Finally, image quality and radiation dose are considered from a variety of standpoints, as part of a survey of image quality and dose in 97 different facilities,[12] as a potential source of noise and metal artifacts to be addressed by novel machine learning techniques,[13] and finally as a research topic in its own right, requiring novel tools to measure noise texture directly from real images.[14]

The interest in CT, both in the clinical and research settings, has grown steadily in the last 50 years. Nonetheless, CT's decline or demise has been predicted at various points, first with the advent of MRI in the 1980s, then with concerns about radiation dose in the 2000s, but the modality has always rebounded. While MRI certainly proved superior for certain soft-tissue studies, the incredible gains in volumetric speed by CT in the 1990s and 2000s along with its reliable

image quality performance and relatively low contraindications have made it the workhorse of the modern radiology department. Meanwhile, concerns about dose have been addressed with improved protocols, system optimization through tube current modulation, and the latest generation of iterative and AI-based reconstruction algorithms. While we cannot predict the future, it seems unwise to bet against CT remaining a source of clinical impact, research innovation, and technical progress.

We expect that readers of this paper may have their own stories and memories they would like to share. Readers interested in doing so can submit their contributions in an email to spiejournals@spie.org with "CT@50" in the subject line. They will be collected and published in this journal in a subsequent editorial.

References

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