

A Review of Computer-Aided CT and MRI in Literature and the Clinic

For more than 80 years, plain film X-ray radiography dominated as medical imaging modality in the clinic. The status quo changed in the 1970s when the first X-ray computed tomography (CT) was introduced. By the 1990s, after a series of technological improvements, CT developed into a fast-scanning and a high spatial resolution imaging modality. CT images, now a clinical staple, are reconstructed from scanned slices of the human body, using the different X-ray absorption properties of anatomical tissues and structures. CT has a broad set of medical applications besides radiology. It is commonly used in neurology, hepatology, pulmonology, cardiology, and oncology. However, CT suffers from the disadvantages of harmful ionizing radiation exposure and poor soft tissue contrast (e.g., in the brain). Computer-Aided Diagnosis (CAD)—the 3D reconstruction and the computational analysis of the images produced from the complementary modality pair, CT and Magnetic Resonance (MR) imaging—provides more complete patient information, thus aiding the limited-supply of clinicians in the detection, diagnosis, and treatment of disease. Despite the potential advances of integrating CAD into medical diagnostics and therapies, developing these techniques for CT and MR imaging pose challenging computer vision and machine learning problems. Nonetheless, CAD has currently begun clinical translation, which will continue as the computational speed, accuracy, and precision improve in addition to a reduction in the required human interaction. The primary focus of this paper will be current clinical and yet-to-be translated CAD and computational methods. The methods for segmentation—the division of the image into anatomical or structural regions of interest to augment readability and interpretability for clinicians—and, to a lesser-extent, registration (i.e., classification) will be surveyed from technical and clinical literature, with a discussion of clinical applicability.