# Computer-Aided Diagnosis in Radiology

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**Abstract**

During the past decades, numerous attempts have been made to develop computerized methods that process, analyze, and display multidimensional medical images in radiology. These computerized methods often automate one of the image-processing tasks and depend on user interaction for the remaining tasks. *Computer-aided diagnosis* (CAD) goes beyond these automated image-processing applications and steps into the area of *medical image understanding or interpretation*. In its most general form, CAD can be defined as a diagnosis made by a radiologist who uses the output of a computerized scheme for automated image analysis as a diagnostic aid. Conventionally, CAD acts as a "second reader," pointing out abnormalities to the radiologist that might otherwise have been missed. This definition emphasizes the intent of CAD to support rather than substitute for the human reader in the detection of polyps–the final diagnosis is made by the radiologists.

The concept of CAD is universal across different modalities and disease types. Although, historically, CAD has been most popular in the diagnosis of breast cancers, such as the detection of microcalcifications and classification of masses in mammograms, CAD have demonstrated its importance and benefit for those examinations that became feasible due to the advancement of such digital imaging technologies as the detection of lung nodules in CT scans of the lung and the detection of polyps in *CT colonography* (CTC), in which many images need to be interpreted rapidly to find a lesion with low incidence.

CTC, also known as *virtual colonoscopy*, is an alternative technique for screening of colon cancers. CAD for CTC typically refers to a computerized scheme for automated detection of polyps and masses in CTC scans. It reveals the locations of suspicious polyps and masses to radiologists. This offers a second opinion that has the potential of improving radiologists' detection performance, and of reducing variability of the diagnostic accuracy among radiologists. CAD for CTC has been successful during the past years for making CTC exams "radiologist friendly."

Currently, the focus of CAD for CTC is to make the CTC exam "patient friendly." Tools for this include pseudo-enhancement correction, virtual tagging, as well as electronic cleansing and detection of colonic polyps for laxative-free bowel preparation. These new tools are substantially redefining the CAD for CTC. This talk reviews the fundamental CAD scheme as well as the current and future challenges in CAD toward patient-friendly CTC exams.

**Biography**

Hiroyuki Yoshida received his B.S. and M.S. degrees in physics, and a Ph.D. degree in information science from the University of Tokyo. He previously held an Assistant Professorships at the University of Chicago. He was a tenured Associate Professor when he left the university and joined the Massachusetts General

Hospital and Harvard Medical School in 2005, where he is currently the Director of 3D Imaging Research and an Associate Professor of Radiology. His research interest is in designing computer-aided diagnosis (CAD) algorithms for detection and diagnosis of cancers in various imaging modalities. For CAD research, he has received various research funding from the NIH/NCI, the American Cancer Society, and other cancer-related agencies, as well as serve for grant review panels for these agencies. For his work on CAD for virtual colonoscopy, he received several awards from the Annual Meetings of Radiological Society of North America, including a Cum Laude Award and an Excellence in Design Award, as well as an Honorable Mention Poster Award from SPIE Medical Imaging.