WHITEPAPER

AI in medical imaging: Leading the way to better patient care

One of the most promising AI applications in healthcare

NetApp | NVIDIA

The use of artificial intelligence in healthcare is transforming key areas of the industry–and for good reason. It's helping save lives and reduce costs across the medical ecosystem. One of the most promising is medical imaging. And it makes sense. Radiologists have always been at the forefront of the digital era in medicine, embracing technology ahead of their peers. As a result, according to the U.S. National Institute of Health, the use of AI in medical imaging over the last 10 years has grown faster than in other specialties. AI is now used frequently in magnetic resonance imaging and computed tomography. Other uses include interventional radiology, triage, aided reporting, follow-up planning, infrastructure planning and prediction, and many others.

Challenge

Medical imaging is under significant pressure to increase efficiency. Patient populations are aging, which means the volume, complexity, and resolution of images are increasing, but the size of the radiology workforce is flat or shrinking. Even in the first world, many countries have shortages of radiologists, particularly in rural areas. In the third world, the lack of radiology expertise is widespread.[1]

Therefore, radiology departments need to carry out more exams with fewer personnel. AI can serve as a valuable aid, enabling departments to make better use of limited resources. By providing pre-screening or pre-analysis, AI will be able to operate as a co-pilot, helping radiologists be more efficient by surfacing critical results—or exceptions—and enabling radiology teams to focus attention on urgent care patients first.

Over 10 years, publications from the National Institutes of Health (NIH) on AI in radiology have increased from **100–150 per year** to **700–800 per year**[2]

According to the NIH, **magnetic resonance imaging** and **computed tomography** are the most involved AI techniques[3]

Solution

Machine learning methods are being applied in all areas of the medical imaging workflow—from image acquisition to analysis to reporting. For example, a medical startup company is developing a suite of medical imaging applications that can enable contrast reduction, up to 4x faster scans, or both. This improves patient comfort and safety while increasing the productivity of a radiology department.

Deep learning models are being developed for a wide range of conditions, promising to increase the speed and accuracy of analysis and enable earlier disease detection. High-profile areas under study include detection of lung nodules, brain cancer, multiple sclerosis (MS), breast cancer, and prostate cancer.

Some AI-powered diagnostic techniques are even moving beyond the clinic. The University of Michigan Kellogg Eye Center is combining a smartphone-mounted device for retinal imaging with a proprietary AI software platform called EyeArt.[4] This solution can determine in real time whether a diabetes patient should see an ophthalmologist for follow-up.

Regardless of the application, usually the first step is collecting a data set with examples of both diseased/damaged and healthy tissue for the target condition. The data set must be prepared and, in most cases, clearly annotated. Today, annotation is still usually a time-consuming manual process.

Much of the significant AI work to date has been accelerated through the use of publicly available, annotated data sets. For example, for lung nodule studies, the Lung Image Database Consortium image collection (LIDC-IDRI) provides a set of computed tomography (CT) scans with annotated lesions. This data set was used for the Lung Nodule Analysis 2016 (LUNA16) challenge contest which concluded in early 2018 with significant results.[5]

Also, the use of federated learning (or collaborative learning) enables multiple institutions or researchers to build a common, robust machine learning model without sharing data. In other words, the datasets don't have to leave the hospital, bypassing issues around data privacy and security.

Most involved imaging subspecialties, as determined by total number of papers published by the NIH[6]:

#1 Neuroradiology*
#2 Musculoskeletal**
#3 Cardiovascular**
#4 Breast**
#5 Urogenital**
#6 Lung/thorax**
#7 Abdominal radiology**

* Accounts for ~33% papers
** Each representing 6-9% of papers

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Benefits

Accenture estimates that AI applications in healthcare could save up to $150 billion annually by 2026.7 In cash-strapped community hospitals, those kinds of savings can help keep the doors open. In addition, AI has the potential to replace many of the menial tasks currently performed by radiologists, as well as integrating data mining into the electronic medical records process.

The potential time savings alone is substantial. The exponential growth of radiology studies—and the number of images in each study—is exacerbating the shortage of radiologists who are able to read these studies. Leveraging AI, the radiologists can now prioritize which studies to read first, and in some cases, they are freed from the mundane, and are able to concentrate on more challenging tasks.

The positive, immediate impacts of AI in medical imaging can be numerous:

- Faster reporting with AI prepopulated reports that radiologists can edit for accuracy.
- Easier cohorting of studies for image or patient similarity.
- Better identification of studies with no significant findings. Many people assume AI is only good at finding abnormalities but what is proving more useful is the faster classification of normal or negative studies. This leaves the radiologist more time to review the abnormal ones.
- Better processing of electronic medical records, presenting the radiologists with timely, relevant clinical information about their patients.
- Built-in mechanisms for quality control and communication between radiologists and technologists.

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Conclusion

AI is already impacting radiology, and more quickly than other medical fields. Any uneasiness among radiologists to embrace AI is somewhat analogous to how airline pilots were reluctant to embrace autopilot technology in the early days of automated aircraft aviation. Obviously, AI is not going to replace radiologists. Instead, AI is going to help radiologists and the healthcare system in general.

Radiologists should be aware of the basic principles of how AI observations are obtained and how they should be interpreted. Datasets used to train AI models do have limitations and can potentially include bias. In this new paradigm, radiologists will need to know how to interact with AI solutions, how to flag studies that provided incorrect results or failed AI processing, and how to interact with the data scientists and IT supporting these solutions.

To this end, NetApp and NVIDIA are partnering to deliver the right AI solutions for the healthcare industry.8 Both companies are laser-focused on eliminating AI bottlenecks and advancing the realm of the possible at a rapid pace. NetApp's attention to the data pipeline amplifies NVIDIA's efforts to accelerate compute.

By combining technologies from both companies, NetApp's ONTAP AI accelerates all facets of AI training and inference, to deliver better outcomes more quickly. The solution brings together NVIDIA DGX supercomputers, NetApp cloud-connected all-flash storage, and Cisco Nexus switches. This proven architecture simplifies, integrates, and accelerates both machine learning and deep learning algorithms, and allows you to start small and grow as needed without disruption. The ONTAP AI Toolkit offers an array of tools and functions to simplify setup and operation, delivering immediate productivity.

Learn more about NetApp AI solutions for healthcare.
Take the next step.

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As a cloud-led, data-centric software company, only NetApp can help build your unique data fabric, simplify and connect your cloud, and securely deliver the right data, services and applications to the right people—anytime, anywhere. www.netapp.com

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