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How AI Is Used in Computed Tomography

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How AI is Used in Computed Tomography (CT)

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What is Computed Tomography?

- Computed Tomography (CT) is the process of creating a cross-sectional tomographic plane of any part of the body.
- A cross-sectional image (axial slice) is obtained by a tightly collimated x ray beam that is directed through the patient from multiple different angles.
- CT exams include interventional radiography biopsies, cardiac studies, and exams that include contrast, which is used to identify soft tissue structures (kidneys, bladder, etc).
- Post process image reconstruction is used to reconstruct three different acquisitions: axial, which splits body in upper and lower; coronal, which splits the body from front and back; and sagittal, which splits body from left and right.

(Rollins et al., 2023)

What is Artificial Intelligence (AI)

- AI has multiple algorithms that with appropriate training, can complete complex tasks at a rapid speed.
- At the center of AI lies machine learning (ML) and deep learning (DL).

ML

- AI algorithms that identify relationships between datapoints to optimize predictions based on data not yet seen.

1. Supervised learning: The algorithm's focus is to learn and detect patterns from labeled data and compare outputs.
2. Unsupervised learning: Relies on itself to discover new patterns and hypotheses that have not yet been discovered.
3. Reinforcement: Occurs by trial and error, this algorithm is provided with input data and asks for a specific outcome.

DL

-Humans configure networks of nodes that are in layers.

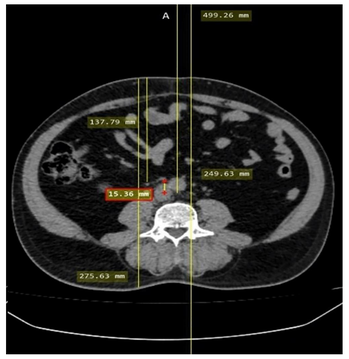
2 types: Convolutional neural networks (CNN) and recurrent neural networks.

-Difference is their layered nodes designs, each having unique strengths.

(Jaltotage et al., 2023)

Patient Positioning

- At the heart of proper patient positioning lies high image quality with optimized patient dose.
- If the patient is not placed close to the gantry isocenter (table is too low or high), the localizer image will be enlarged or reduced in width, causing reduced image quality and increased patient dose.
- Solution: AI based positioning camera
- CT scans have an AI algorithm that detects patient's body using a 3D camera.
- Camera automatically positions patient (adjusts height of table so patient is in isocenter of gantry) according to the selected CT protocol.



- This image displays how a patient can be off-center from the isocenter. (Kundu et al., 2024, Methods section)

- A study was conducted of 286 patients, half were positioned by a technologist manual positioning (MP) and half were positioned by automatic positioning (AP).
- Off-center distance: AP group had 44% less off-center distance than MP group.
- Radiation dose: AP group displayed 8.38%, 12.32%, 10.32%, & 12.42% reductions in various radiation doses, which indicates patient received lower doses.
- The results show AI can be more effective in-patient positioning than technologists. There was less off-center distance and shorter scan times, which ultimately improves image quality and reduces patient dose.

(Kundu et al., 2024)

Example of AI in Lung Screening

- Low dose computed tomography (LDCT) scans are one of the traditional and go-to screening methods for annual detection of lung cancer.
- AI is starting to be used alongside of LDCT scans to enhance the accuracy, efficiency, and accessibility of lung cancer screening.
- A study showed that 120 CT images were evaluated and compared the radiologist diagnostic approach with deep learning. (Liu et al. 2024; as cited in Duranti et al., 2025)
- Result: Small pulmonary nodules on LDCT scans can be detected by deep learning models with improvement in sensitivity from 80%-90%.
- The 10% increase indicates the ability of earlier detection in lung cancer, mostly in cases with smaller or less visible lesions.
- This study shows that the use of deep learning algorithms can be used to work alongside radiologists to be able to detect lung cancer earlier.

(Duranti et al., 2025)

AI 3D in CT

- 3D analysis in CT is used to identify arteries, nodules, and tumors.
- 3D analysis provides accurate characterization of the tumor's overall morphology and spatial resolution.
- In the Synapse Vincent System, AI software calculates component volume and extracts 22 imaging features from 3D reconstruction (these cannot be obtained from 2D-CT).

(Nagese et al., 2025)

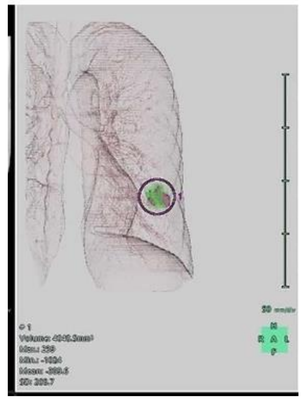


Image of AI software computing a 3D pulmonary nodule. (Nagese et al., 2025, Pathological Evaluation section)

Advantages of AI

- Improved efficiency and productivity
- AI can do tasks that might be able to free up the technologist such as positioning the patient. While AI is positioning the table the technologist can be doing other tasks relating to the study.
- Early detection and prevention
- With AI being able to detect certain diseases earlier such as cancer, improved patient outcomes can result.

Disadvantages of AI

- Bias and discrimination
- Most AI algorithms are focused on a specific task or modality which narrows their general applicability. If the datasets are biased, because of errors in the interpretation in source, then AI may keep using those biases.
- Lack of transparency
- Oftentimes, it is difficult to understand how AI produced the result or conclusion and this can limit the accountability of AI systems.
- Human expertise is still crucial
- It is important to know that AI should not replace human expertise, it is simply a tool to help.

(Resuhr & Garnett, 2025)

CT image showing coronary artery disease. X and Y represent coronary artery disease. (Jaltotage et al., 2023, Utility of AI to Enhance CCTA Risk Stratification)

Conclusion

AI is still in its early stages in medical imaging, but the possibilities it can provide are extremely helpful. The more that is learned and understood of AI and the role it can play in CT, the more it can help the technologist, radiologist, and the patient.

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