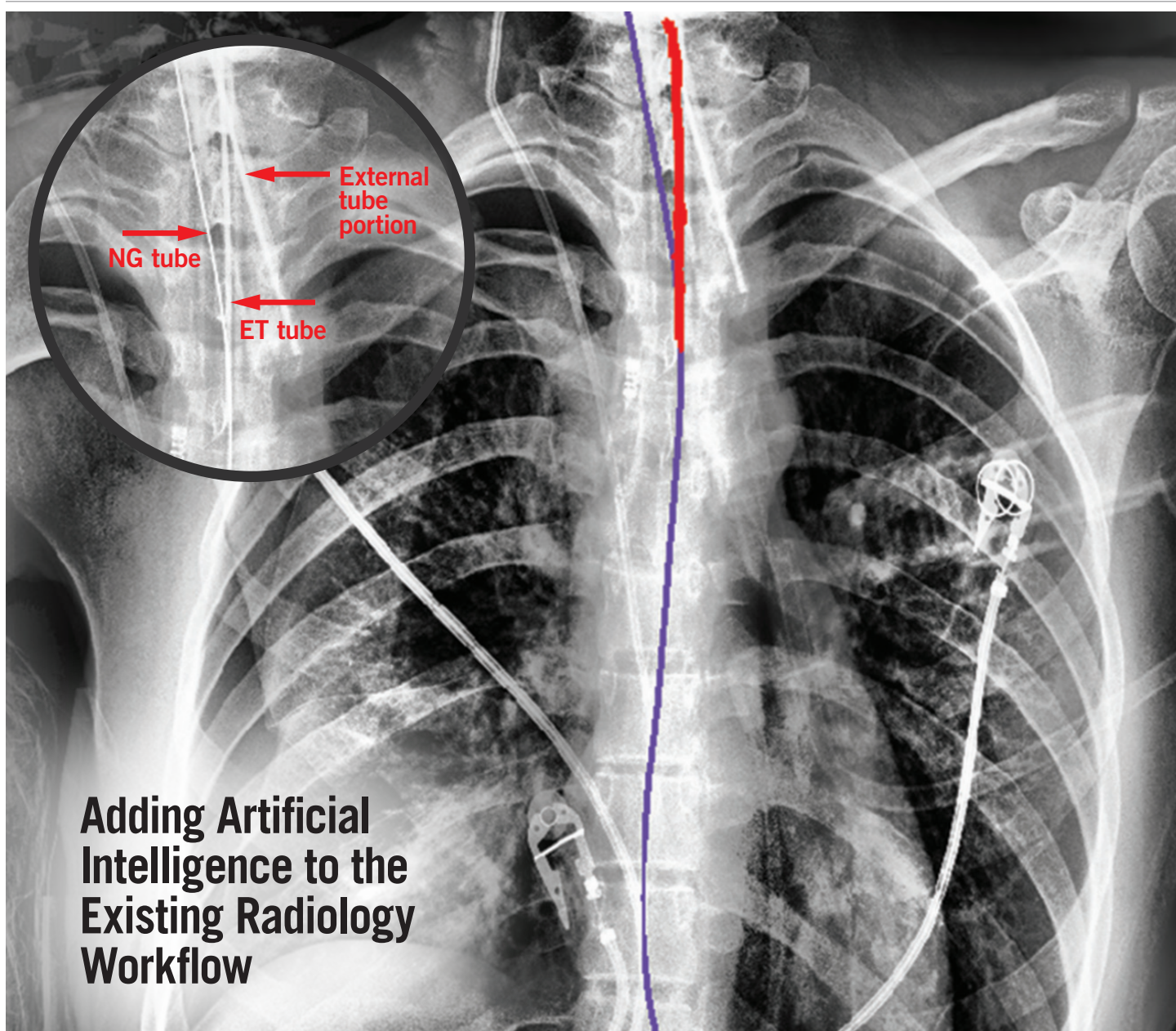


UCLA Radiology

NEWSLETTER OF THE DEPARTMENT OF RADIOLOGICAL SCIENCES

WINTER 2019



Adding Artificial Intelligence to the Existing Radiology Workflow

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Chair's Message




Dieter Enzmann, MD

Professor of Radiology
Leo G. Rigler Chair
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The UCLA Department of Radiological Sciences is actively participating in accelerating the pace of innovation in machine learning and deep learning (ML/DL). The radiology profession having been adroit in adapting to new hardware and software technology, now has the opportunity to expand in the ML/DL era. Previous adaptations often replaced radiological physical tasks, but upcoming adaptations involve replacing cognitive tasks rather than physical tasks. This is a bit more complicated in order to balance simultaneous disruptive and sustaining ML/DL effects.

While some ML/DL cognitive feats appear highly intelligent, they are really just very sophisticated statistical guesses based on past correlations. ML/DL intelligence is bounded by its training on large datasets of past correlations. Current ML/DL's theory of knowledge is based on iteratively feeding prodigious amounts of "big data" into chiliads of logical processors to reach "intelligent decisions." This works well for "pattern reading" cognitive tasks, hence its applicability to radiology. This training process compresses in time the years radiologists dedicated to correlations that become imaging expertise. Radiologists will need to understand ML/DL technology, but more importantly they will need to know when and when not to employ it.

While ML/DL is impressive, without being Luddites we should ponder Daniel Yankelovich's quote (1972): "There is a deeply hubristic arrogance in the reduction of complex processes to statistics."

An important side effect of the ML/DL era is the relative increase in the value of human interaction. Interventional radiology in moving image-guided treatments from mere highly technical procedures to personalized, direct care of individual patients has acquired this human interaction. The Department's thriving clinic-based practice is testimony to that value. In diagnostic radiology, a key human interaction is with referring physicians who represent the best interest of their patients. There is now an increasing trend for patients to want to interact directly with diagnostic radiologists, because superb diagnostic imaging is recognized as being important if not critical to their care. In our Department and in the radiology profession as a whole, more direct contact and expert interaction with our patients will be key to how our services are valued by patients, by other physicians, and by entire healthcare systems. 

There is now an increasing trend for patients to want to interact directly with diagnostic radiologists, because superb diagnostic imaging is recognized as being important if not critical to their care.

Device Placement Confirmation System Aims to Bring AI into Clinical Setting

Matthew Brown, PhD
Professor of Radiology
Director of the UCLA Center for Computer Vision and Imaging Biomarkers
Department of Radiological Sciences
David Geffen School of Medicine at UCLA



Researchers developing artificial intelligence systems at UCLA are giving special priority to projects that can improve patient care in the near term. “While we’re interested in publishing academic papers on the performance of artificial intelligence and recognize the importance of doing so, our primary focus is in getting the technology into clinical practice where it’s helping physicians and it’s helping patients,” explains Matthew Brown, PhD, professor and director of the UCLA Center for Computer Vision & Imaging Biomarkers. Despite the groundswell of interest in medical applications of artificial intelligence, most radiologists do not make use of it in their everyday practice.

Among the current Center for Computer Vision & Imaging Biomarkers efforts that aim to address that focus is a chest X-ray device detection and placement confirmation project. A very large number of chest X-rays are performed each day to check the placement of endotracheal tubes and nasogastric tubes to confirm that they are in the correct position. Physicians need to know immediately when the placement is incorrect because of the significant morbidity and even mortality associated with incorrect placements. The high volume of these X-rays and the challenge of getting busy radiologists to review films quickly makes this application ripe for enhancement with artificial intelligence.

Two artificial intelligence knowledge representations used

The project employs a deep learning technique that applies neural networks to learn through the analysis of large amounts of data. Hundreds of endotracheal and nasogastric tube images have been annotated as training samples to facilitate that learning, and ultimately thousands more will follow to build an algorithm that can analyze new images with a high degree of accuracy. While hundreds of annotated images may suffice to develop the basic functionality of an algorithm, squeezing additional performance out of the model takes progressively larger numbers of training samples. The nearer the model approaches perfect accuracy, the more difficult are the additional gains.

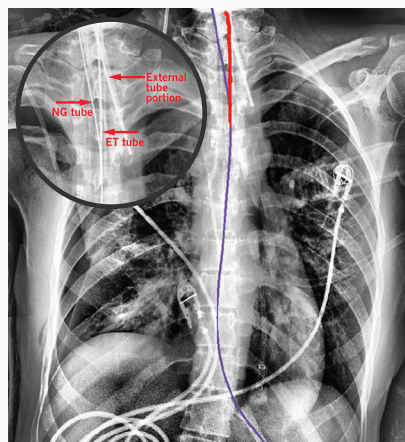
The system must learn to identify the tubes and analyze their relationship to key anatomical landmarks to confirm that their placement is within the targeted area. The neural network builds its model by encoding image features into a large network of nodes, where the weights between nodes are learned from training samples. This type of machine learning is very powerful, but its workings are not visible to the researchers developing the AI tools, making it in some ways difficult to interpret and also to directly enforce known anatomical relationships. The UCLA team countered that weakness using the

novel arrangement of embedding the neural network in a semantic network that can describe anatomic relationships. For example, they used the semantic network to specify target boundaries for correct placement of the tip of the endotracheal or nasogastric tube relative to anatomic landmarks, rather than relying on the neural network to correctly learn these boundaries on its own. In a number of ways, the semantic network layer adds assurance that the analysis will not be derailed by basic errors of interpretation on the part of the neural network.


Adding artificial intelligence to the existing workflow

Dr. Brown and his colleagues plan to introduce their placement confirmation tool directly into the existing X-ray workflow by integrating it into the PACS. “If you run the algorithm on a separate workstation, fewer physicians will make the time to use the tool,” states Dr. Brown. “By integrating it into the PACS, we can run the analysis automatically for every chest X-ray at the time it is archived and make the results immediately available to the physician when they first review the image.” Another advantage of this integration is that the AI algorithm can be implemented simultaneously throughout the health care system, there’s no need to roll out new workstations in each clinic location.

The system’s findings, including alerts if the tube is misplaced, are overlaid on the X-ray image, making it easy for the physician who placed the endotracheal or nasogastric tube



Automated AI detected ET and NG tubes in a complex image with superimposed external leads and tubes.

to preliminarily confirm its placement even before the radiologist reviews the film. The AI tube location overlay is also visible to assist the radiologist in interpreting the image. Should the radiologist discover an error in the algorithm’s analysis, the image is flagged and fed back as a training sample, further refining the algorithm over time. The AI system can also identify images in which the neural network has lower certainty in its output, and can move them to the top of the radiologist’s queue for immediate review. 

Population Data Can Be Applied to Diagnostic Images to Reveal New Information

Noriko Salamon, MD, PhD

Professor of Radiology
Vice Chair of Academic Affairs
Chief of Neuroradiology
Department of Radiological Sciences
David Geffen School of Medicine at UCLA



Success in the surgical treatment of epilepsy relies on accurately locating the focus of seizures, identifying abnormal structures and defining the borders of the area to be treated. To make the most accurate analyses possible, radiologists and other treatment team members employ multiple diagnostic modalities — including MRI, FDG-PET, diffusion tensor imaging and electrophysiology — to inform treatment decisions. Yet in many cases, even multiple layers of diagnostic information fail to identify with a high degree of certainty the patient’s seizure focus.

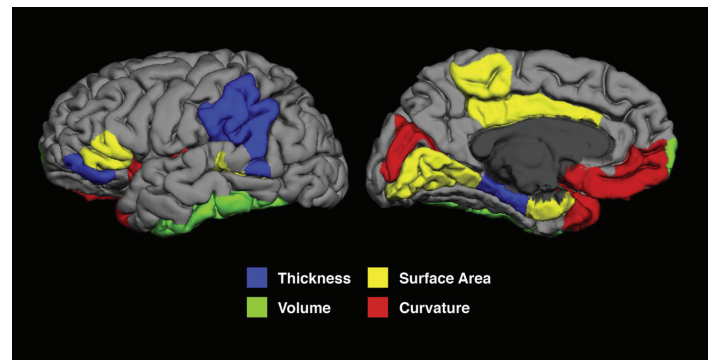
“Technologies that provide precise information to guide treatment have been the great development of the last 25 years in the neuroradiological assessment of epilepsy. But there are still many things that we cannot see,” states Noriko Salamon, MD, PhD, professor of radiology and chief of neuroradiology at the David Geffen School of Medicine at UCLA. “We’re now starting to use artificial intelligence to reveal subtle information in these images that we cannot detect with the naked eye.”

Artificial intelligence used to predict abnormalities not yet visible

Epilepsy surgery aims to eliminate the focus, or origin, of seizures in the brain, which is different from the lesion. While epileptogenic foci are sometimes associated with well-defined lesions — including vascular malformations, traumatic brain damage, tumors and perinatal injuries — foci are often normal-appearing tissue adjacent to the lesion. FDG-PET (fluorodeoxyglucose positron emission tomography) can add a layer of information to MR imaging by showing areas of glucose hypometabolism, revealing epileptogenic foci adjacent to the lesion. Combining imaging information and electrophysiology can help define the boundaries of brain abnormalities to help guide surgery.

But in many cases of congenital focal cortical dysplasia, the lesion is very difficult to detect, as when an area of tissue disorganization is not obvious enough to detect with current diagnostic imaging techniques. Artificial intelligence offers radiologists a powerful tool that can use data from a large group of similar patients to determine the potential for normal-appearing structures to be abnormalities not yet distinguishable using visual inspection. “AI can take information on the volume of each brain structure and perform a population-based computational analysis that can reveal potential abnormalities among structures that are still within normal range for that patient,” says Dr. Salamon.

An example of AI’s usefulness in identifying abnormal brain structures is in distinguishing a unilateral abnormality from an asymmetrical bilateral abnormality. Temporal lobe epilepsy is the most common form of adult epilepsy, with hippocampal sclerosis often being the cause of seizures. “Usually, hippocampal sclerosis is unilateral, and removing the abnormal side — which shows




Surface rendering machine analysis shows top twenty morphological measures that distinguish epilepsy patients with hippocampal sclerosis and epilepsy patients without hippocampal sclerosis.

Epilepsy Research, 2015 Nov; 117:63-9

atrophy and is smaller in volume than the contralateral side — successfully treats the seizures,” explains Dr. Salamon. “But about 30 percent of these patients don’t improve in their seizure symptoms following surgical treatment.” In these cases, the untreated side may also be affected, but still within normal range. UCLA neuroradiologists are using machine learning to perform volumetric analyses based on data from a large population of patients. The machine algorithm assigns a percentile score that allows the team to identify subtle disease in the contralateral side. This enables them to make treatment decisions with greater confidence. “Machine learning is providing information that goes beyond what the human eye can detect,” says Dr. Salamon.

Algorithms able to contribute broadly to treatment decisions

Beyond AI’s usefulness in identifying seizure foci, artificial intelligence can be applied more broadly to help determine when patients can benefit from treatments aimed at mitigating or reversing damage done by epileptic seizures and to prepare patients for the likely outcomes of their epilepsy treatment.

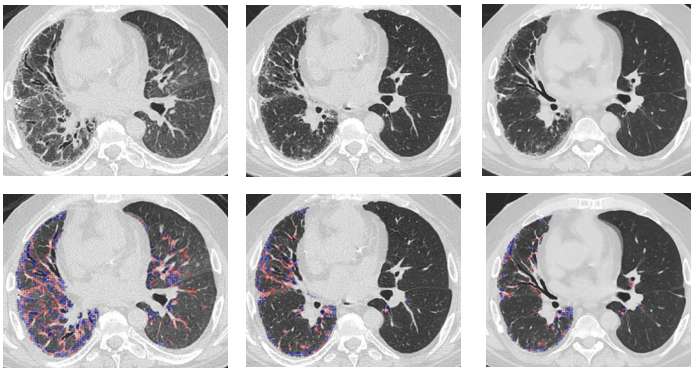
Each seizure can cause global brain atrophy, but the effects can be too subtle to detect using diagnostic imaging. Sophisticated AI analysis using cortical thickness maps can yield information on probable treatment outcomes and suggest when other therapeutic options — such as cognitive training — may be effective in helping to protect the brain. 

AI Quantification of Lung Fibrosis Outperforms Visual Extent Analysis of Images

Grace Hyun J. Kim, PhD
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Researchers at UCLA helped to pioneer an artificial intelligence algorithm over 10 years ago that adds quantitative analysis to the visual image analysis of computed tomography (CT) images at our institution in screening patients for interstitial lung disease (ILD) and for tracking changes to lung tissue over time to help manage treatment. The Quantitative Lung Fibrosis (QLF) score was developed to bring uniformity to the interpretation of CT lung images. A significant goal of the efforts was to make the interpretation of CT images generalizable across different imaging sites and CT equipment. Once the images are normalized, the computer model analyses each voxel to determine the likelihood of fibrosis at every point in the image. A voxel represents a position in three-dimensional space just as a pixel represents a position in a two-dimensional image.



A subject with improvement over time: 62 year old male, QLF (red+blue) score in the whole lung =27% at visit 1; later QLF=7.7% at visit 2; and QLF=6.4% at visit 3. After visit 3, The percent predicted forced vital capacity improved by 22%.

Each voxel is classified using artificial intelligence according to the distinctive visual patterns characteristic of fibrotic tissue in ILD — including ground glass opacities (which indicate inflammation) and honeycomb cysts (which are the final stage of ILD). The voxel score is summed across the entire scan to arrive at the Quantitative Lung Fibrosis score. The QLF score is expressed either as a percentage or volume in milliliters of fibrotic tissue detected. At UCLA, QLF scores have supplanted quartile scores of lung fibrosis assigned by radiologists based on their visual assessment of CT scans. QLF offers advantages in sensitivity, reproducibility and traceability. It can detect smaller increments of change and enables clinicians and researchers to track where changes to tissue have occurred over time.

In clinical investigations of fibrosis treatments for example, QLF enables researchers to track physical changes over time in patients receiving different treatments regimens. Similarly, QLF provides clinicians detailed analysis of lung tissue to help guide their treatment decisions

Development of the QLF score

The QLF score was developed using support vector machine, a supervised learning principle in which experienced radiologists identified patterns of lung fibrosis to teach the model the specific texture features of lung fibrosis. Once the model was trained to characterize each voxel, it was tested to confirm that the score


based on individual voxels corresponded well with evaluations of the overall lung performed by a consensus of expert radiologists. The level of concordance between QLF and the expert consensus is 0.96, with 1.00 being perfect concordance.

Following that confirmation of the model's validity, the algorithm was further assessed by applying it to other, larger populations of patients to ensure that the score was accurate across multiple patient populations and imaging manufactures. The score was compared against both visual image analysis and lung functions test data. Researchers confirmed that changes in the score were associated with other treatment outcome measures and symptom as well. In one example, skin biopsies of patients whose lung fibrosis is associated with scleroderma were evaluated to confirm that changes in scleroderma tissue in response to fibrosis treatment corresponded with changes to the QLF score. Serum biomarkers have also been used to correlate QLF score with measurable biological changes.

QLF scores can predict changes in lung function

An exciting application of QLF is its use in adjusting the medical treatment of patients with idiopathic pulmonary fibrosis (IPF). “We have learned that changes in QLF score — whether a reduction or a worsening of the fibrosis — predict by 18 to 24 months changes of the lung function in IPF patients,” states Dr. Kim. “Patients can be baselined and then tested again after six months. When their scores worsen, it may be a signal to increase medication doses or to switch medication in an attempt to prevent lung function from worsening.” Conversely, when QLF scores improve, pulmonologists can consider reducing doses to minimize unwanted treatment side effects.

QLF scoring is also an important tool for monitoring rheumatoid arthritis patients for the development of interstitial lung disease. An estimated one in 10 rheumatoid arthritis patients will develop ILD over the course of their disease, leading to a significantly higher risk of mortality. It is important to define a threshold for treating lung disease in this population, and QLF scores proved the sensitivity needed to determine such a threshold.

UCLA is currently the only center on the West Coast that offers QLF testing. 

Shedding Light on Neural Networks ... as they Shed Light on Indeterminate Lung Nodules

Denise R. Aberle, MD
Professor of Radiology and Bioengineering
Vice Chair for Research
Department of Radiological Sciences
David Geffen School of Medicine at UCLA



“Among the most important questions that radiologists are looking to answer with artificial intelligence is whether a particular lesion — in any organ in the body — is a cancer or is not a cancer,” says Denise Aberle, MD, professor of radiology and bioengineering and vice chair for radiological sciences research at David Geffen School of Medicine at UCLA. “Secondly, if we know that we have a cancer, we’re looking to artificial intelligence (AI) to help distinguish between indolent, slow-growing cancers and those that are aggressive, enabling more individualized management of patients. Various forms of AI, including deep learning with neural networks, are making inroads into these challenges. For example, researchers recently used a deep learning algorithm to distinguish lung cancer in nodules seen on low-dose computed tomography (CT) scans. For those cases where prior CT imaging was not available, the algorithm outperformed a panel of six radiologists, reducing false negative results by 5 percent and false positives by 11 percent.

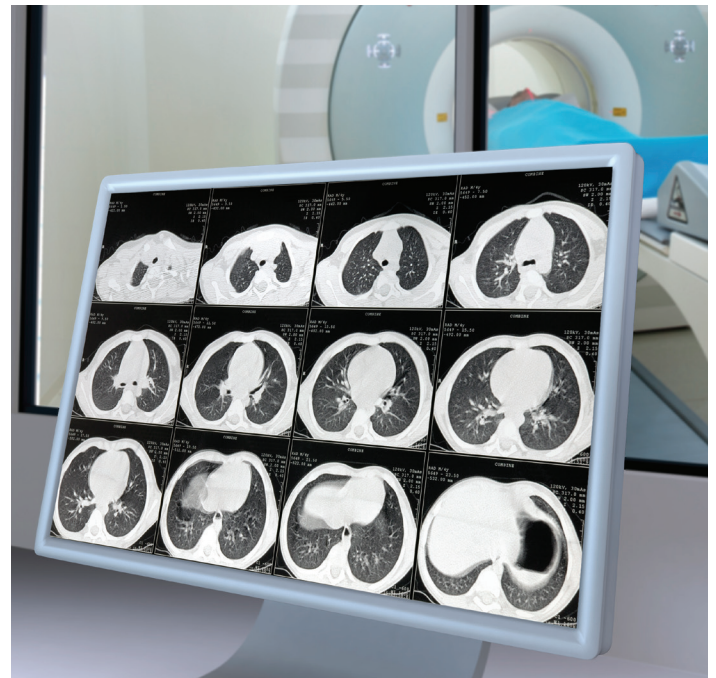
Within AI, there are a number of machine learning approaches, including random forests, support vector machines and deep learning with convolutional neural networks (CNN). “The excitement — actually the frenzy — in imaging today is the use of convolutional neural networks to answer questions for us based on the extraction of information beyond what humans can see in the image, says Dr. Aberle.”

Challenges of developing convolutional neural networks

While convolutional neural networks can be very powerful tools, there are challenges in developing these systems. First, they typically require large data sets in order to be able to perform well. Second, in order for the neural network to learn from the training data, the images must be well annotated to contain all variables relevant to each individual scan. Of critical importance, the training data must be representative of the population to which the model will be applied.

Training the CNN can require data sets sufficiently large that they exceed what is available at a single institution. “In the case of training a neural network to learn what is a lung cancer and what is not, this may involve thousands of images,” says Dr. Aberle.

In addition, annotation of the data set is very labor intensive. A vast amount of human effort is required to annotate the very large data sets required for training convolutional neural networks. The largest annotated data set currently available for lung cancer is from the National Lung Screening Trial (NLST), for which Dr. Aberle was principal investigator. The NLST was a large, multi-center clinical trial that enrolled 53,000 patients, half of



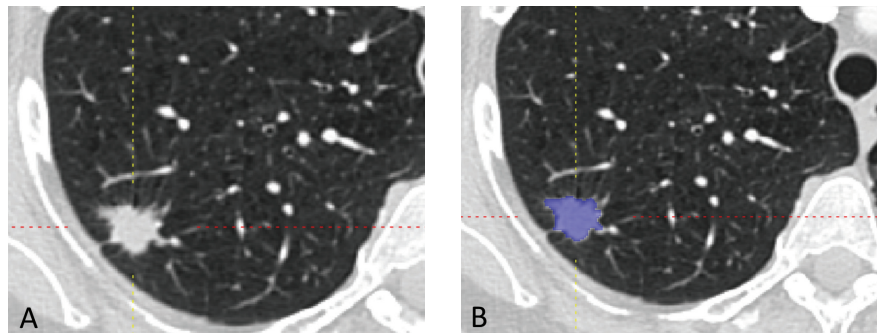
whom had low-dose chest CT scans annually for three years. The NLST data has already been used to train various models approved for clinical use in the European Union.

Another challenge of training neural networks is that models perform their best when data acquisition and reconstruction parameters for the training images match those of the clinical images to which the model will be applied. Current CT imaging practices are highly variable in terms of parameters like slice thickness, beam energy, dose and image convolution kernel.

“The excitement — actually the frenzy — in imaging today is the use of convolutional neural networks to answer questions for us based on the extraction of information beyond what humans can see in the image”
— Denise Aberle, MD

A current concern in using convolutional neural networks in patient care is that the reasoning of the network classification is often not known; the analytical queues that inform the classification task remain hidden within many layers of the computer model.

Example of a lung nodule on computed tomography (A) with automated segmentation of the nodule (B). This segmented region of interest can then be analyzed for features associated with a lung cancer.



Computer models are most reliable when asked to interpret data that is similar to the data used in their training.

Artificial intelligence algorithms developed for clinical practice must be carefully tested and validated to ensure their soundness as decision-support tools. Testing and validation should each employ an independent data set that was not previously fed through the model. “These are the types of vigorous validation and performance assessments we need before we begin to use these AI tools in clinical practice,” states Dr. Aberle. “We’re not far off, but we’re currently still a ways away.”

Augmenting the performance of neural networks


While convolutional neural networks rely on very large sets of well annotated data to learn to interpret image data, some of the other artificial intelligence approaches, such as random forests and support vector machines, can develop good functionality with smaller training data sets. Moreover, we are increasingly seeing ensemble approaches in which analysis pipelines combine multiple strategies to exploit the efficiencies, or the unique advantages, of different approaches in a single system.

Similarly, a model’s performance can be improved when more than one kind of data is used to train the system. “If I’m training a CNN using image data from CT scans, it may reach a certain level of performance and begin to plateau unless I’m able to feed it many more hundreds or thousands of annotated images,” explains Dr. Aberle. “An alternative approach is to introduce other variables — non-imaging variables — that also influence the classification task.” These other variables, if they represent orthogonal data (meaning that there is little or no overlap with imaging data), provide a different form of training that is complementary to the imaging data. One example might be demographic variables — such as race, sex, age or region of the country — that have been shown to be associated with the clinical condition being investigated.

Artificial intelligence and lung nodules

Under multiple NIH grants, Dr. Aberle is applying CNN to the diagnosis of indeterminate lung nodules. While the majority of lung nodules detected on CT scans are benign — the result of scarring, inflammation or infection — nodules can also be early cancers or cancers that have metastasized from elsewhere in the body. In collaboration with colleagues in the fields of computer science, medical informatics and molecular biology, Dr. Aberle is applying CNN to CT images to help diagnose when indeterminate lung nodules are cancer and to help distinguish indolent growths from those that are more aggressive.

The team is hoping to enhance their ability to diagnose these indeterminate nodules by adding molecular biomarker data to the CT image data. By collecting readily accessible biospecimens — either blood specimens, saliva, or cells easily collected from inside the nose or mouth — they are working to identify useful biomarkers. “Our hope is that the combination of molecular and imaging data will be able to tell us that an individual has lung cancer much earlier so we can intercept the cancer early on and maximize the likelihood of long-term cure,” explains Dr. Aberle.

In other research related to neural networks, Dr. Aberle hopes to shed light on how deep learning algorithms derive their conclusions. A current concern in using convolutional neural networks in patient care is that the reasoning of the network classification is often not known; the analytical queues that inform the classification task remain hidden within many layers of the computer model. “We think being able to follow the process will be important to the ultimate implementation of these machine learning approaches,” says Dr. Aberle. “If the system is not understandable to humans, we are less comfortable implementing them into direct patient management.” she says. 

Artificial Intelligence for Prostate Cancer Radiology and Pathology — and Perhaps the Two Combined

Corey Arnold, PhD
Associate Professor of Radiology,
Pathology & Bioengineering
Department of Radiological Sciences
David Geffen School of Medicine at UCLA



Artificial intelligence algorithms can contribute to prostate cancer care on both the radiology side — by assessing cancer risk and identifying suspicious structures for targeted biopsy — and on the pathology side by analyzing histology data to detect and grade prostate cancer. Researchers at UCLA are currently working on an artificial intelligence system that would fuse radiology and pathology data to create a diagnostic tool that could function as an “imaging biopsy.”

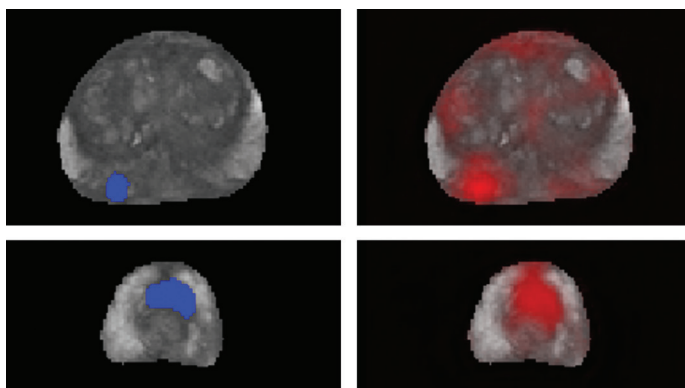
Radiology AI can apply elite expertise to every scan

Radiologists express their suspicion of prostate cancer using the PI-RADS scale, assigning a numerical score of 1 through 5, with higher scores indicating increased cancer suspicion. Low PI-RADS scores express lower confidence that a region of interest (ROI) visible on mpMRI (multi-parametric magnetic resonance imaging) is cancerous.

“Because PI-RADS scores rely on the judgement and experience of the radiologist, there can be inter-rater disagreement in assigning these scores,” states Corey Arnold, PhD, Associate Professor of Radiological Sciences, Pathology & Laboratory Medicine and Bioengineering, and Director of UCLA’s Computational Diagnostics Lab. “One of the goals in applying artificial intelligence to prostate cancer imaging is to bring greater consistency to these scores.” Using AI algorithms trained on data sets that were annotated by radiologists who are among the leading specialists in prostate cancer, the level of analysis performed by general radiologists might be elevated to match the expertise available at major academic medical centers. Using artificial intelligence, all radiologists — generalists and specialists — can benefit from a system able to add an overlay to the image indicating suspicious ROIs (Figure).

AI applied to pathology to ease and speed a time-consuming process

Pathologists perform histological analysis of biopsied tissue to establish a definitive diagnosis of prostate cancer, assigning Gleason scores to characterize cancer grade. At UCLA, template




Radiologist drawn regions of interest for cancer suspicion (left column) with corresponding AI predictions (right column).

plus targeted biopsies are frequently performed using MR images fused with ultrasound guidance to direct the biopsy. Each core is examined microscopically to establish cancer presence and grade. It is a time-consuming process that could be made considerably less burdensome by using AI algorithms that have been trained to process digitized histology data and automatically detect and grade cancer.

Pathology results from each needle location can be mapped back onto the mpMRI image to place histology data within the MR space. “We can use this information to train algorithms to predict Gleason scores from mpMRI alone,” says Dr. Arnold. “Furthermore, as each biopsy reveals the underlying pathology at a location within the prostate, we are also developing algorithms that apply pathology data from all the areas sampled to analyze the mpMRI pixels between biopsy locations, potentially allowing for more accurate diagnosis of the entire gland.” If successful, these techniques could allow low-risk men to avoid or delay unnecessary biopsies. While less invasive than surgery, prostate biopsies are unpleasant procedures that are not without risk, facts that are particularly relevant to men with low-grade cancer in active surveillance programs, which typically specify a biopsy every six to 12 months.

Beyond diagnosis: predicting aggressive prostate cancer

Many men with low-risk disease do not require treatment; however, a subset of these cancers have the potential to become lethal. There is currently a lack of robust methods to distinguish these two cohorts, leading many men to undergo unnecessary definitive treatments (e.g., surgery), which include the risk of adverse outcomes. Dr. Arnold’s team is investigating fusion techniques that employ artificial intelligence to combine all relevant patient data to better predict cancers that will transition from indolent to aggressive. “We’re looking at ways to combine clinical, radiology, pathology, and genetic data into a single multi-scale, multi-modal model that can predict cancer aggressiveness,” says Dr. Arnold. Such a technique could help better inform patients regarding treatment decisions. “Some men diagnosed with low-grade prostate cancer are not comfortable living with the disease and elect for treatment over active surveillance,” he explains. “A more precise model could offer patients another data point to reassure them that their individual risk for disease progression is low.” 

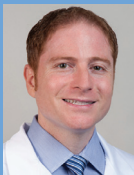


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DEPARTMENT HIGHLIGHTS

Westlake Village Women's Imaging Center



UCLA Westlake Village Women's Imaging Center
30700 Russell Ranch Road, Suite #110, Westlake Village, CA 91362
Central scheduling: 310-301-6800

Early detection and improved treatment have led to decreased mortality rates for those diagnosed with breast cancer, and screening reduces mortality by more than 40% in women 40 and older, says Dr. Doepke, the medical director of the new UCLA Westlake Village Women's Imaging Center that recently opened its doors to provide local women with potentially life-saving imaging services.

Visit UCLAHealth.org/Radiology/WLVVIC to learn more.

Breast Imaging at UCLA provides a full range of high quality and innovative breast imaging studies, treatments and procedures to the greater Los Angeles area, with locations in Westwood, Santa Monica, Santa Clarita, Manhattan Beach, Palos Verdes and Westlake Village.

UCLA Radiology Alumni Connections

Faculty Spotlight Matthew Brown, PhD



Originally from Sydney Australia, Matt grew up in the small town of Bomaderry in New South Wales. His early and steadfast fascination with computers has led him to a successful career in imaging where he serves as director of the Center for

Computer Vision and Imaging Biomarkers (CVIB) and co-director of the Thoracic Imaging Research Group at UCLA. Research interests focus on computer vision and computer-aided diagnosis in medical imaging with current applications including multi-modality tumor detection and feature analysis, and image-based classification of diffuse lung disease.

Some of his current research projects include: computer-aided lung nodule detection and characterization, computer-aided treatment targeting in COPD, quantitative bone scan biomarker for clinical trial outcome assessment in metastatic prostate cancer, automated tube detection in chest X-rays, quantitative fibrosis scoring biomarker and predictive diffusion MRI biomarker for glioblastoma multiformae brain tumors.

Matt is the recipient of numerous awards and honors, including; the University of California Cancer Research Coordination Committee Research Grant, UC Discovery Grant, Certificate of Merit from Radiological Society of North America on his exhibit on imaging-based clinical trials, and the SPIE Cum Laude Award for Best Poster: *The Influence of CT Dose and Reconstruction Parameters on Automated Detection of Small Pulmonary Nodules.*

In his free time Matt enjoys all sports, including *real* ones like rugby, cricket and surfing, and more recently, kids activities and Disney movies.

Research interests focus on computer vision and computer-aided diagnosis in medical imaging with current applications including multi-modality tumor detection and feature analysis, and image-based classification of diffuse lung disease.

Radiology Graduation 2019 Riviera Country Club



Faculty, fellows and staff taking a photo opportunity overlooking the country club golf course.



Stay in Touch!

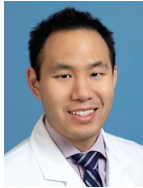
If your contact information has changed recently, let us know so we can keep in touch! Are you the recipient of a recent award or distinction? We would like to know about it and announce it in our newsletter and alumni web page. Visit us at: www.uclahealth.org/radiology/alumni

Welcome New Faculty



Cameron Hassani, MD – Thoracic Imaging, Diagnostic Cardiovascular Imaging

Residency: Diagnostic Radiology, SUNY Downstate Medical Center
Fellowship: Cardiothoracic Imaging and Intervention, Massachusetts General Hospital



Jerry Loo, MD – Pediatric Imaging

Residency: Diagnostic Radiology, LAC & USC Medical Center
Fellowship: Pediatric Radiology, David Geffen School of Medicine at UCLA



Hannah Milch, MD – Breast Imaging

Residency: Radiology, Montefiore Albert Einstein College of Medicine
Fellowship: Breast Imaging, Memorial Sloan-Kettering Cancer Center



Avishkar Tyagi, MD – Acute Care Imaging

Residency: University of South Florida College of Medicine
Fellowship: University of California, San Diego

2nd Annual UCLA-ACR Fellows Career Symposium



The Second Annual UCLA ACR Fellows Career Symposium, with the help of UCLA and external faculty, again highlighted the tremendous network that we at UCLA enjoy across California and the country, and the power of that network in connecting our future leaders with our past and present leaders. The Career Symposium again functioned as an educational event to teach trainees about the radiology landscape, negotiation, contracts and interviews. It was also a networking portal that gave face and personality to key leaders in various organizations and trainees from around Southern California. We hope to build on these relationships for our strategy to connect alumni and new-found friends alike to strengthen our leadership brand and network across California. Last year at least 10 fellows secured jobs in the most desirable practices at this event and some of them came back to share their experiences at this year's event. The event was much larger this year with afternoon sessions devoted to negotiation and salary, women in radiology and academic radiology. Local and national practices from across the country again participated.

A number of corollary benefits were again recognized at this second annual event. We welcomed a number of new and returning faces into our network and helped monitor the emerging opportunities and threats with the recent entry of multi-billion-dollar private equity firms into radiology nationally. We learned how both groups of 1,000 radiologists and four-person boutique practices compete against each other and saw the innovation offered by even small groups. Finally it was a unique opportunity to understand where our small and large competitors are investing for the short and long term. Two big themes emerged from this gathering: the tremendous surplus of radiology jobs in the United States and the rapidly growing interest in harnessing artificial intelligence to become more efficient in interpretation and operations.

We hope to again partner with the ACR to expand this event and bolster recognition among fellows and residents across California of our leadership in becoming an established, unique national forum in years to come.

Steven S. Raman, MD
Robert Suh, MD

2nd Annual UCLA ACR Fellows Career Symposium Hosts

PGY-2 Class of 2023:

Diagnostic Radiology PGY-2 Residents:

- Natalie Cain, MD** – University of Miami, Miller School of Medicine
- Randy Chang, MD** – Washington University School of Medicine in St. Louis
- Iris Chen, MD** – Icahn School of Medicine at Mount Sinai
- Jonathan Lin, MD** – University of California, San Diego
- Claire Lis, MD** – Boston University School of Medicine
- Ziang Lu, MD** – Case Western Reserve University School of Medicine
- Mikhail Roubakha, MD** – Washington University School of Medicine in St. Louis
- Puja Shahrouki, MD** – Sahlgrenska Academy at the University of Gothenburg
- Tiffany Yu, MD** – University of Maryland School of Medicine
- Bill Zhou, MD** – David Geffen School of Medicine at UCLA

Integrated Interventional Radiology PGY-2 Residents:

- Tyler Callese, MD** – Wake Forest University School of Medicine
- Savannah Fletcher, MD** – University of Arkansas for Medical Sciences, College of Medicine
- Shamaita Majumdar, MD** – Washington University School of Medicine in St. Louis

UCLA Health

Department of Radiological Sciences

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WINTER 2019

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A Publication of

UCLA Department of Radiological Sciences

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