North American Chinese Medical Physicists Association

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NACMPA NEWSLETTER

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Message from President

Brian Wang, PhD
NACMPA President

Welcome to the 2021 Fall Edition of the NACMPA newsletter.

Time goes by fast, and the pandemics have been with us for almost two years. Many have received their booster shot by now, and the vaccine is open to children as young as age five. Working from home and Zoom meetings are part of our work and life now. With these changes, human being excels at adaptation. We, medical physicists, are at the forefront of adaptation. It is under this environment that our Association hosted the first virtual annual meeting on July 24th, 2021. More than 80 members joined the event on a beautiful summer Saturday evening. After the routine presidential and financial reports, we conducted the online voting for new officers in the Zoom meeting. Dr. Kai Yang from MGH was elected as the board member-at-large, and Dr. Dandan Zheng from the University of Rochester was elected as the secretary. Both have started working with other officers and their official terms are from 2022 to 2023. As I discussed previously, Dr. Kai Yang may be the first NACMPA officer who is specialized in diagnostic imaging specialty. We can already see the benefits. Kai provided valuable information for imaging physics at our first Executive Committee meeting in August. I encourage other imaging colleagues to get more involved with our Association, so we can serve the broad Medical Physics community better. Our annual meeting continued with the traditional Award Ceremony. Congratulations to all the award recipients! The unique agenda for this annual meeting was the last session of Ask the Experts. My deep appreciation goes to the panelists, Drs.

Seeking Contributors

NACMPA NEWSLETTER is published by the North American Chinese Medical Physicists Association on a semiannually schedule. We welcome all readers to send us any suggestions or comments on any of the articles or new features to make this a more effective and engaging publication and to enhance the overall readership experience.

Contact us: nacmpa@yahoo.com 欢迎大家投稿, 并希望大家关注北美华人物理师微信公众号.

Editors: Lu Wang, PhD

Charlie Ma, Ping Xia, Fang-Fang Yin, and Cedric Yu. They shared their insights, from professional wisdom to personal experiences. The session was so well received that I reluctantly closed it after almost one hour. We also thank the participants for their questions and comments. We probably could never have hosted such a session in the live in-person restaurant environment. Again, we adapt and make the most use of the virtual meeting format

I want to thank all the officers, Josh Xu, Allan Li, Yi Rong, Zhicong Huang, Ke Nie, Lu Wang, for their time and effort in preparing for this first virtual meeting. We did mock practice weeks before and also hours before the meeting. I want to especially thank Dr. Ke Nie, who set up the Zoom and was in the background to provide technical support throughout the meeting.

My appreciation goes to the members who contributed to the many discussions in the WeChat group on how to make the virtual meeting enjoyable and the election process rigid. Specifically, our past presidents, Drs. Raymond Wu and Charlie Ma helped us refine the election process according to the bylaws. Many other members also contributed to the discussion, and please excuse me for not mentioning your name here.

Holidays are just around the corner. Have a relaxing winter break, everyone!

From the NACMPA Officers

to all of You!

Starting a Business—创业家的感想和建议

Cedric Yu，Ph.D.

NACMPA past Hall of Fame recipient

Since founding Xcision Meical Systems, LLC to develop the GammaPod system for applying SRS/SBRT principles to the treatment of breast cancer, I have often been asked: "How do I become a successful entrepreneur?" or "How do I start my own business?". When Dr. Lu Wang asked me to write a few words on entrepreneurship for our Newsletter, I welcomed the opportunity to provide some thoughts on these questions and to reflect on my own experiences.

First and foremost, you must have an unwavering conviction that what you want to do means something. If you can't convince yourself, how can you convince someone to partner with you, or to support you with funding? And it's not enough to just have a killer idea, you must also understand the landscape – a full picture of what problem it will solve or what unmet need it will satisfy. As you begin the process, there will be no shortage of naysayers who will call you crazy and provide reasons why your idea won't work. To endure this barrage and continue to venture into the unknown, an entrepreneur must possess a steadfast belief that their vision is something worth suffering for. I saw that breast cancer awareness and screening led to more and more breast cancers being diagnosed at an early stage. Based on breast cancer statistics, 61% of all breast cancers excluding DCIS are T1N0M0 at diagnosis in the US. For such small and localized tumors, I believed that radiosurgery, if safely delivered, could potentially replace surgery and postoperative radiation therapy, or shorten postoperative radiation therapy to only 1 – 2 fractions. It is this belief with which I was able to convince investors to fund our company and to motivate our employees.

Related to the first prerequisite is the question of why you want to start a business. The number one wrong reason is seeing others succeeded in doing something and thinking you can be a stronger competitor. Although copying other's success seems low risk, starting a business to make a competing me-too product that only differentiates from what already exists on the surface is doomed to fail. This is true not only for startups but also for established companies – many of you may still remember Amazon's $170 million Fire phone fiasco.

Equally important, an aspiring entrepreneur must be willing and able to lead. Leading a company is a lot tougher than leading a research group or a team of physicists in an academic or community setting because you are both a leader and an employer. There is no easy formula for strong leadership. However, in my experience I consider strong personal values to be the key. Strong values underlays a strong character, which is the essence of a strong leader. Every person and every company has a set of core values. Each opportunity and decision is looked at through the lens of these core values. At Xcision, loyalty and service to our customers and

Starting a Business—创业家的感想和建议 (cont.)

breast cancer patients is at the top of our values. It leads to our other values of trust and accountability because what we do affects the quality of our product, and thus the quality of breast cancer treatments. Second to your core values is your knowledge in the areas of interest. Over the years, I have been continually enriching my knowledge on breast cancer treatment, not just in the latest radiation therapy clinical trials and publications, but also in the latest systemic therapies. The more you know, the more self-confident you will be, and the more trust you will earn from the people you lead.

One of the first important actions in starting a business is finding a co-founder. Just as in finding a spouse, chemistry and compatibility are very important. The initial few employees are typically the people you know. They are also partners and co-owners of the company, your core team. Not only should they all share your conviction, but they should also be people with whom you have strong mutual respect. There are too many examples where the business fails due to infighting among the core team members. Maintaining mutual respect requires continual demonstration of integrity and strong ethics in all your activities, both in public and private life. This is more than just obeying laws, as you can be perceived as dishonest, unprincipled, untrustworthy, unfair, or uncaring without breaking any law. Christopher Amies was Xcision's first CEO and my first partner in leading Xcision. I flew to California to ask him to join me on this venture in February 2007, before Xcision had any employee. From that moment until he passed away last year, we were truly buddies. It was an honor to partner with someone of Chris's caliber, with such high integrity and immense knowledge.

Leading a business requires you to be confident in making decisions. You should always consult your teammates in decision making and be open and honest with them. However, you must ultimately give your own judgement high priority and not rely on others when making every decision. People around you will recognize your confidence and follow you more willingly.

Starting a business is among the toughest things one can undertake in life. If you have a strong conviction with a business idea that means something, go for it! Through my experiences of founding and leading Xcision, I believe that I learned and improved over the years. I consider this my biggest reward.

关于人工智能的临床实现的一点思考和浅见

Steve Jiang, Ph.D.

NACMPA Member

近几年，人工智能用于医疗方面的研究可谓是如火如荼。在PubMed上顺便搜一下，就可以发现，每年发表的这方面的论文数目在指数式的增长。但是另外一方面，真正用到日常临床实践中的人工智能工作，却屈指可数。显而易见，有关人工智能的科研和临床应用之间有一道鸿沟。那么，这道鸿沟是什么原因造成的呢？怎样才能缩小以至于最终填平这道鸿沟呢？

我们先来看看，目前，一个人工智能的工作是怎么用于临床的。研发人员先建立起深度学习的模型，然后用一个数据集来训练模型，然后是调试和测试，得到一个满意的结果之后，就认为可以用于临床了，然后把训练好的模型交给用户。临床的用户，在把这个模型用于每一个病人的时候，对得到的结果有三个选择：直接接受，修改之后接受，和拒绝。

我们都知道，一个软件，不光是基于人工智能的软件，要在临床应用取得成功，得有非常高的用户接受率。也就是说，一个临床用户，比方说医生，不需要在每次使用这个软件的时候，都要花费大量的时间精力去修改结果。如果老是那样的话，医生就会说，与其每次我都要改来改去，还不如我自己手动从头来做，不需要用你这个所谓的人工智能。如果大多数用户都持这个想法，那么这个人工智能软件的临床应用就失败了。

由此可见，临床应用成功的关键，是用户的接受度。而要让用户接受，这个软件工具给出来的结果，一定要非常精确可靠。所以医疗人工智能研发的一个主要目标，就是提高模型的精度，要超过专家用户的水准，最好能达到100%的精度。这样的话，用户的每次使用的时候，直接接受人工智能结果的几率也是100%，让用户无从挑剔，最终不需要用户的介入，直接把人工智能的结果用于临床诊断和治疗。从长远来看，人工智能可以代替人，能够做好一切人做的工作，—我觉得这是很多人工智能研发者的终极目标。对医疗行业来说，这是不现实，幼稚的，是源于很多人工智能研发者对医疗行业缺乏真正的了解。

也许，对于很多简单的，重复的，标准的工作，人工智能可以代替人。但是，人体是复杂的，医疗是复杂的，有很多复杂和困难的稀有情况。对于这些情况，至少在可以预见的将来，人工智能是没法代替人的。你如果不相信的话，可以做一个实验。下次参加科里的chart round的时候，对每一个病例，你问问自己：人工智能可以做吗？能完全代替医生/物理师/剂量师吗？

除此之外，还有很多其他的因素，比方说法律上的考虑，让人工智能无法替代人，至少在中短期的未来没法代替人。在这里，我们就不做深入讨论了。

回到精度的问题。要让用户容易接受，需要很高的精度。我个人认为，由于种种原因，有很多的临床任务，人工智能还做不到很高的精度。其中一个非常重要的原因，就是模型的普适性(generalizability)。就是说，研发者训练好的模型，在训练数据集上表现的很好，但是拿到一个用户那里，模型的表现可能会差很多。这是因为，训练数据集所代表的情形，跟该用户日常面对的情形，可能会有比较大的差别。

举一个例子，就是Google做的关于糖尿病视网膜病变的工作。他们训练了一个深度学习模型，训练数据集

关于人工智能的临床实现的一点思考和浅见 (cont.）

包含将近13万视网膜图像，由54位眼科医生标记。在两个独立数据集上做了测试，测试的结果非常好，AUC达到0.99。作为医疗人工智能的一个代表性工作，这个工作发表于2016年的JAMA期刊。在2020年4月的一个会议上，Google公布了这个工作在泰国的临床应用情况，结果非常令人失望。一个主要的原因是，模型是用高质量数据训练出来的，而临床使用的时候，常常会遇到图像质量很差的情况，比方说采光条件不好，这种时候，出来的结果就变得很不准确了。

另外一个例子是我们MAIA Lab去年做的一个工作，开发一个AI Watchdog，自动的悄悄的检测医院里每一个新出的含肺的CT图像，看看有没有COVID-19肺炎的嫌疑。如果有的话，会自动通知相关人员，做进一步的评估和处理。我们用美国，中国，俄国，和伊朗的数据集来分别训练模型，然后发现，用一个国家的数据训练出来的模型，在本国数据上结果很好，可以到达0.9以上的AUC，但在其他国家的数据上完全不工作，结果几近于盲猜。

这种例子不胜枚举，所以这个模型普适性的问题必须得到解决，否则，人工智能的临床应用会很危险。那么，解决这个问题的办法是什么呢？目前人工智能研发界的主流办法，一个是从模型本身着手，一个是从训练数据着手，让训练出来的模型尽可能的变得普适。终极目标就是一个放之四海而皆准的模型， 不管何时何地何人，都可以用。我个人认为，这个目标是不现实的，也是出于对临床现实的复杂性的不了解。

我们认为一个比较实际的解决方案，是model commissioning。就是说，在研发阶段，要让模型尽量的普适。把研发出来的产品交给用户的时候，要让用户做acceptance test and commissioning，要允许模型参数做微调，以适应用户的数据。这个过程最好做到自动或者半自动，要求用户收集的数据也应该尽量的少。这个过程，非常类似于我们如何对待一个新的治疗计划系统，所以对医学物理师来说，这是很自然的一个解决方案。但是，对主流的人工智能研发界来说，让每家医院有一个自己的模型，还是比较难以接受的。

这里，我想顺便讨论一下，人工智能对医学物理师这个职业的潜在影响。很多人担心，人工智能会抢了物理师的饭碗。就像20年前，IMRT刚刚引入临床的时候，也有不少人担心，inverse planning会不会抢了物理师剂量师的饭碗，因为鼠标一点，一个治疗计划就自动生成了。但实际情况呢？大家都看到了，不但没有抢饭碗，还新增加了很多的饭碗。我对人工智能的预期，也有类似的乐观。就如刚刚说到的acceptance test and commissioning，谁最适合做这个工作呢？谁最适合收集和清理数据呢？最适合做软件的QA和升级呢？等等。我的答案，是医学物理师。所以我认为，物理师应该为之做一点准备，应该学习一点人工智能，懂一点基本的知识，知道模型大概是怎么工作的，知道它的适用范围，等等。

好了，回到主题。如果用户用自己的数据，把一个人工智能模型本地化了，那是不是临床上用起来，就一帆风顺了呢？不是的，还有很多其他的问题要考虑。其中一个很有趣的问题，就是医疗实践的多样性，variability in clinical practice。就是说，同一个病人，不同的医生，有可能给出不同的治疗方案。这个多样性，有可能是医生经验不足导致，他们给出的方案不是最佳的，那么，这种多样性是应该被消除的。但是，在临床实践中，我们也注意到，哪怕在很有经验的医生之间，也经常会给出不用的治疗方案，而又没有什么临床证据表明，谁的方案更好。

我一直认为，医疗实践也是一门艺术。循证医学和临床指南这些东西，给了医生地板而不是天花板，所以医生还有很大的空间发挥自己的判断。而一个治疗的结果，往往涉及到很多因素。医疗实践的多样性，往往淹没于这些因素之中。也即说，我们很难取得证据

来表明，哪一个方案更好。医生采用某一个方案，往往是基于她/他的训练背景，经验，直觉，等等。还有一个重要的原因，让这种多样性在理论上都无法消除。那就是，一个方案，经常是基于多个因素的平衡考量，即Pareto Optimization。比方说，一个方案可能更激进，有更好的肿瘤控制，但也有更大的毒性；而另一个方案比较保守，毒性要小很多，但肿瘤控制也要差一些。不同的病人，会在这两个方案做不同的选取。有的病人想多活几年，哪怕生活质量很糟糕。也有的病人，想保证剩下的时间有较高的质量，可以去看看世界，哪怕总的时间要短一些。同样的，每个医生的观点也不一样，在尊重病人意见的同时，他们也有自己的倾向性。类似的平衡考量，还有很多，比方说治疗效果和费用之间的平衡，等等。在这种情况下，医疗实践的多样性，在理论上都无法消除。

那么，对于这种多样性，我们在把人工智能用于临床的时候，该怎么处理呢？人工智能研发界的主流观点，是把任何的多样性，当成数据噪声，当成一个不好的东西，从数据和模型角度采取多种手法来消除。再一次的，我认为这些观点是错误的，是基于对临床实践的不够深入的了解。这样研发出来的人工智能软件，会让很多用户不愿意使用。

举一个例子，前列腺术后放疗的CTV勾划。我们发现，即便都是用的同一个临床指南，不同的医院，甚至用一家医院的不同医生，勾划出来的CTV都可以不一样。而这种不一样，是系统性的，是可以用深度学习去学习到的，也是很难消除的，因为每一个医生，都认为她/她最清楚怎么治疗自己的病人，不需要别人来指手画脚。那么，如果人工智能软件给出的CTV勾划，是用某个医生或者某几个医生consortium的数据训练出来的，那么其他医生在使用的时候，很可能不满意其结果，最后很可能不想用，导致这个软件临床应用的失败。

要解决这个问题，需要正视和尊重临床实践的多样性。我们认为，人工智能软件应该能够给出每个医生自己想要的方案，同时也要在医生需要的时候，方便的给出同行专家的意见。这样的话，一方面可以提高工作效率，另一方面，特别是从长远来看，也可以提高临床实践的质量。

最后，我想谈一下人工智能跟用户的关系问题。目前的医疗人工智能，跟用户之间是一种上下游的相对独立的关系。就是说，人工智能给出一个结果，用户怎么用，爱用不用，跟它没啥关系。我们认为，人工智能应该是用户的助手，他们之间是相辅相成的关系。在研发人工智能的时候，不要仅仅盯着深度学习模型和训练数据，而应该采用一个系统性的观点，设计一个临床系统，以用户为中心，临床流程为主线，再来看人工智能放在在系统的哪个部分，可以加快流程和帮助用户。

在这么一个系统里，人工智能首先应该知道，这个病例它能否处理。不能的话，要告诉用户为啥不能，然后让用户自己去处理；能的话，给出结果同时给出原因和可信度，以及哪些地方不是很肯定，需要用户特别关注，等等。用户在这些信息的基础上，决定是采用，修正，还是拒绝。如果是修正的话，人工智能应该帮助用户快速的修正，而不是“ 袖手旁观”。用户采取的这些行动，也应当反馈给人工智能，让人工智能不断的进化。

人工智能大规模的用于临床实践，还有很长的路要走，还有很多的问题要解决，比方说模型的定期QA，模型的鲁棒性，模型和数据中的偏见，等等等等。限于篇幅，我今天只讨论了其中的三个还没引起足够重视的问题，即：模型的普适性，医疗实践的多样性，和人机关系的问题。一点点肤浅的思考，愿做引玉之砖头，让更多人的重视人工智能科研和临床应用之间的鸿沟，让更多的人参与到相关的工作中来，最终让人工智能更好的更早的造福病人。

参考文献：

[1] Nguyen D, Kay F, Tan J, Yan Y, Ng YS, Iyengar P, Peshock R, Jiang S. Deep Learning-Based COVID-19 Pneumonia Classification Using Chest CT Images: Model Generalizability. Front Artif Intell. 2021 Jun 29;4:694875. doi: 10.3389/frai.2021.694875. eCollection 2021.PMID: 34268489

[2] Balagopal A, Nguyen D, Morgan H, Weng Y, Dohopolski M,

关于人工智能的临床实现的一点思考和浅见（cont.）

Lin MH, Barkousaraie AS, Gonzalez Y, Garant A, Desai N, Hannan R, Jiang S. A deep learning-based framework for segmenting invisible clinical target volumes with estimated uncertainties for post-operative prostate cancer radiotherapy. Med Image Anal. 2021 Aug;72:102101. doi: 10.1016/j.media.2021.102101. Epub 2021 May 17.PMID: 34111573

[3] Balagopal A, Morgan H, Dohopolski M, Timmerman R, Shan J, Heitjan DF, Liu W, Nguyen D, Hannan R, Garant A, Desai N, Jiang S. PSA-Net: Deep learning-based physician style-aware segmentation network for postoperative prostate cancer clinical target volumes. Artif Intell Med. 2021 Nov;121:102195. doi: 10.1016/j.artmed.2021.102195. Epub 2021 Oct 18.PMID: 34763810

[4] Bai T, Balagopal A, Dohopolski M, Morgan HE, McBeth R, Tan J, Lin MH, Sher DJ, Nguyen D, Jiang S. A Proof-of-Concept Study of Artificial Intelligence Assisted Contour Revision. arXiv:2107.13465.

North American Chinese Medical Physicists Association

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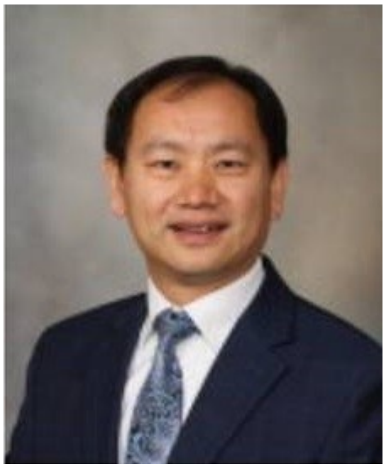
Photon Counting Detector (PCD) CT



Shuai Leng, Ph.D.

NACMPA Member

This year marked the 50th anniversary of Computed Tomography (CT). On October 1, 1971, the very first CT exam of a patient was performed at Atkinson Morley Hospital, United Kingdom. Through the last half century, CT has been widely used as an advanced imaging modality helping various aspects of patient care, ranging from disease diagnosis, staging, prognosis, to therapy monitoring, treatment planning, and image guided intervention and therapy. Each year, millions of patients have benefited from this imaging technology.

The success of CT is associated with tremendous amount of technology advance, both hardware and software. On September 30 this year (2021), FDA cleared the first commercial photon-counting-detector (PCD) CT, NAEOTOM Alpha from Siemens Healthineers. In the press release, FDA stated it was the 'first major new technology for computed tomography imaging in nearly a decade' [1]. This intrigued strong excitement in CT community and the news were reported quickly on various media outlets. Siemens is not alone, other major CT vendors have also showed strong interest in this technology, with studies and investigations performed on prototype systems.

So, what is photon counting detector CT? Detector is a key element in CT imaging. Current commercial CT scanners use scintillator based, energy integrating detector (EID). It involves two stages of conversion: X-ray to visible light, then visible light to electrical signal (Figure 1). The output signal is proportional to the total energy deposited by all photons. Different than EID, PCD is a single stage, direct conversion technique where X-ray interaction with semiconductors directly generates electrical signal (Figure 1). Instead of integrating signals from all photons together, PCD counts individ-

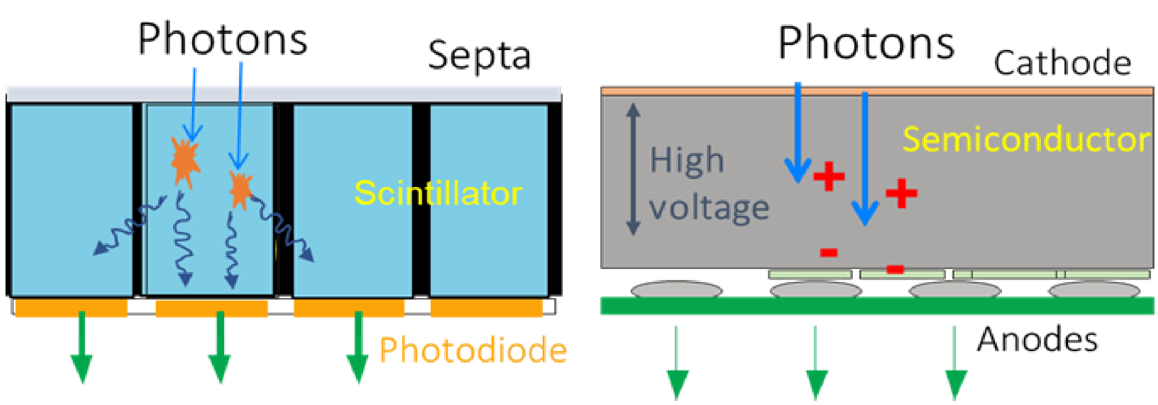


Figure 1. Schematic drawings of energy integrating detector (left) and photon counting detector (right).

Photon Counting Detector (PCD) CT (cont.)

ual photon and uses number of photons as the output signal [2]. In addition, PCD obtains energy information about each photon by setting pre-select energy thresholds. Current commercial dual energy CT acquire data at 2 different beam spectra. With multiple energy bins in PCD (2-8), multi-energy (>2) data sets could be obtained which enables CT going beyond dual energy.

Because of these differences, PCD has several major advantages compared to EID [2]:

1. Reduced or eliminated electronic noise

As electronic noise usually has a lower amplitude compared to true signal, setting energy threshold above the noise amplitude would substantially reduce or eliminate electronic noise without affecting true signals [3].

2. Improved contrast to noise ratio

In EID, the output signal is proportional to the total energy deposited by all photons. Therefore, high energy photons intrinsically have higher weighting. For example, a 100 keV photon generates twice signal as that of a 50 keV photon. However, low energy photons have better contrast than high energy photons. This weighting scheme in EID is therefore suboptimal. PCD, on the other hand, weighs each photon equally, a better weighting scheme than EID. Therefore, PCD generates higher contrast to noise ratio (CNR) than that of EID, especially for scans where iodine contrast is used (Figure 2) [4].

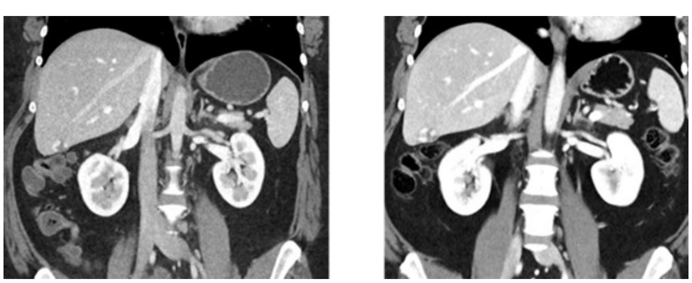


Figure 2. Same patient scanned with EID-CT (left) and PCD-CT (right), with enhanced contrast and CNR using PCD-CT.

3. Higher spatial resolution

To achieve higher spatial resolution, smaller detector pixel is needed. Since septa is required in EID to avoid crosstalk, dose efficiency usually decreases with smaller detector pixels due to reduced fill factor. PCD doesn't require septa, therefore can go higher spatial resolution without losing geometric dose efficiency [5, 6].

4. Radiation dose reduction

Several factors could contribute to dose reduction using PCD. For example, the photon weighting discussed above results in increased CNR at the same radiation dose, which consequently can be used for dose reduction if the same CNR to be maintained. In addition, due to the higher sampling of PCD, stronger filter can be applied to the acquired data while maintaining the same resolution in final images. This results in lower image noise or reduced dose compared to EID. The amount of dose reduction depends on clinical task, resolution, patient size, and dose level [4, 6].

5. Simultaneous high resolution and multi-energy imaging

PCD enables high resolution and multi-energy in a single scan, which is not feasible with current EID-CT systems [7].

6. k-edge and multi-contrast imaging

By placing energy threshold around the k-edge of target high z materials, PCD enables k-edge imag-

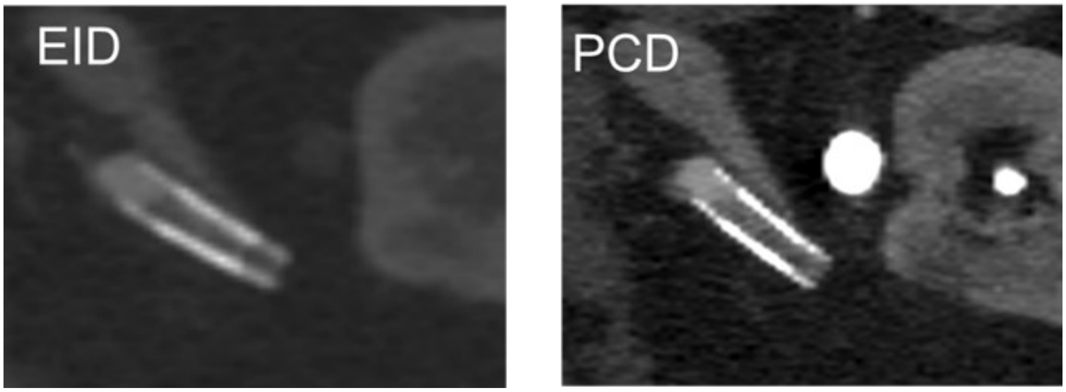


Figure 3. Improved visualization of left renal artery stent using PCD-CT (right) in comparison with EID-CT (left), which has significant in-stent stenosis and left renal infarction.

ing which may open new doors for CT applications. Because of this, imaging multiple contrast agents (e.g. iodine, gadolinium, and gold) in a single scan becomes feasible, given one or more of the contrast agents have detectable k-edge in the diagnostic X-ray energy range [8-10].

7. Artifact reduction

Features of PCD-CT, especially the capability of spectra manipulation, also help artifact reduction, such as streaks, beam hardening and metal artifacts [11].

These benefits have been demonstrated in multiple studies in various clinical areas including neuro, abdomen, vascular, lung, cardiac and musculoskeletal exams. The high spatial resolution enables better visualization of small anatomic and pathological features, such as lung nodules, airways, temporal bone, sinus, bone fractures, and vasculars. It is particularly beneficial on challenging exams such as coronary stents and heavy calcifications, where blooming artifacts make diagnosis of coronary artery disease extremely difficult (Figure 3). The high spatial resolution helps not only visualization, but also quantification and characterization. For example, it increases the accuracy of lung nodule volume estimation in chest CT and the accuracy of coronary calcium score. It can further improve shape differentiation and texture analysis. The increased CNR has been found to be beneficial exams with low contrast structures and lesions, such as brain and liver exams. Using virtual monogenetic images generated through PCD's multi-energy capability, image quality improvement, radiation dose reduction, and contrast media dose reduction have been achieved. Reduced electronic noise especially benefits large patients and low dose exams, such as lung cancer screening or pediatric CT exams.

All these are results of years of research and development. Although PCD has been used in other areas such as nuclear medicine and mammography, CT imposes unique challenges due to its high flux (up to 109/smm2). Substantial progress has been made in recent years from both industry and academia, for both semiconductors and fast electronics (ASIC) used in PCD. Various lab systems and prototypes have been built to investigate technical implementation of this technique and its potential benefits with phantom, specimen, and animal studies. This further led to the first whole-body, high flux PCD-CT system that can perform patient exams using clinical dose and dose rate around 2014. Various imaging algorithms and software have also been investigated, together with the development of hardware. A large body of literature

Photon Counting Detector (PCD) CT (cont.)

have been published for various aspects of PCD-CT in recent years. Many people in the community (myself included) have considered PCD-CT as 'the next big thing in CT'.

Now, with the FDA clearance of the first commercial PCD-CT, it is finally here! With this, the scanners are expected to be more widely available to users at different institutes. More clinical studies with large patient cohorts will be conducted to fully test its benefits. It is also encouraging to see more than one CT vendors investigating this technology. Research PCD-CT systems have been built by Philips, on which patient studies have been performed. Both GE and Canon recently announced starting evaluation of PCD-CT scanners.

With all these advances, we are experiencing the beginning of a new era of CT!

References

1. FDA News Release: https://www.fda.gov/news-events/press-announcements/fda-clears-first-major-imaging-device-advancement-computed-tomography-nearly-decade

2. Leng S, Bruesewitz M, Tao S, Rajendran K, Halaweish AF, Campeau NG, Fletcher JG, McCollough CH. Photon-counting Detector CT: System Design and Clinical Applications of an Emerging Technology. Radiographics 2019;39(3):729-743. doi: 10.1148/rg.2019180115

3. Yu Z, Leng S, Jorgensen SM, et al. Evaluation of conventional imaging performance in a research whole-body CT system with a photon-counting detector array. Physics in medicine and biology 2016; 61:1572-1595.

4. Gutjahr R, Halaweish AF, Yu Z, Leng S, Yu L, Li Z, Jorgensen SM, Ritman EL, Kappler S, McCollough CH. Human Imaging With Photon Counting-Based Computed Tomography at Clinical Dose Levels: Contrast-to-Noise Ratio and Cadaver Studies. Invest Radiol 2016. doi: 10.1097/RLI.0000000000000251

5. Leng S, Yu Z, Halaweish A, et al. Dose-efficient ultrahigh-resolution scan mode using a photon counting detector computed tomography system. J Med Imaging (Bellingham) 2016; 3:043504.

6. Leng S, Rajendran K, Gong H, Zhou W, Halaweish AF, Henning A, Kappler S, Baer M, Fletcher JG, McCollough CH. 150-μm Spatial Resolution Using Photon-Counting Detector Computed Tomography Technology: Technical Performance and First Patient Images. Invest Radiol 2018.

7. Leng S, Zhou W, Yu Z, Halaweish A, Krauss B, Schmidt B, Yu L, Kappler S, McCollough C. Spectral performance of a whole-body research photon counting detector CT: quantitative accuracy in derived image sets. Phys Med Biol 2017;62(17):7216-7232. doi: 10.1088/1361-6560/aa8103

8. Symons R, Cork TE, Lakshmanan MN, et al. Dual-contrast agent photon-counting computed tomography of the heart: initial experience. Int J Cardiovasc Imaging 2017; 33:1253-1261.

9. Ren, Liqiang; Huber, Natha; et al. Dual-contrast Biphasic Liver Imaging with Iodine and Gadolinium using Photon-counting-detector CT: An Exploratory Animal Study. Inv. Rad. 2021

10. S Tao, K Rajendran, CH McCollough, S Leng. Feasibility of multi-contrast imaging on dual-source photon counting detector (PCD) CT: An initial phantom study. Med. Phys. 2019

11. Zhou W, Abdurakhimova D, Rajendran K, McCollough C, Leng S. Metal Artifact Reduction and Dose Efficiency Improvement On Photon Counting CT Using An Additional Tin Filter. Medical Physics 2017; 44:3235-3235.

Season's Greetings from NACMPA!

Our Initial Experiences with SUN CHECK QA Program

Zhicong(Zion) Huang, MS.

NACMPA Secretary

Currently there are more than 900 sites worldwide using SunCHECK platform made by the SUN NUCLEAR corporation. Scripps MDAnderson Cancer Center started implementing SunCHECK software since 2021 September.

The SunCHECK software centralized and integrated many popular sun nuclear QA tools. Multiple modules are offered. We acquired the following modules SUN CHECK 3.2.0 ; SNC Routine 1.4.0 ;DOSE CHECK 1.6.0 ;Perfraction 2.10.0 ;SNC Machine 1.8.0 ;Plan check 1.1.1 The software has an interface called PDI host which direct connect the device measurement to the QA template. We have Sun nuclear QA hardware including three ArcCHECK, eight DailyQA3, three SRS map checks and Three IC profiler. We have Varian Eclipse and BrianLab Element planning systems. We configured all our eight Varian LINACS including one 2100c three Clinac IX four TrueBeam into the system at four physical locations in San Diego county. CT and HDR system will be commissioned into the system.

SunCHECK platform server is hosted at corporation data center. All team member can get access to the sun check platform web interface through hospital intranet or remotely from home using CITRIX Workspace.

Sun check Patient module consists Plan check; dose check; pre-treatment QA and In-vivo Monitoring, these modules have automated workflow for treatment plan validation and rule based checks. After dosimetrist finishes planning they will export the treatment plan to the Sun check software. The software will recognize and using preconfigured template to do dose verification in 3D clinical analysis and MU/Dose comparisons. Any warning sign will be verified and checked by physicist after.

For independent pre-treatment patient QA, We did initial comparison between the ArcCHECK/SRS MAPCHECK versus Log file-based Pre-Treatment QA. We found good agreement between two methods. For example after evaluating 20 SBRT lung cases we found ~3% differences for PTV mean dose at 3% 2mm gamma. More data will be collected and shared. Team members will evaluate and to decide if only using Log file-based Pre-Treatment QA.

PerFraction module will pull the machine log and verify each patient's setup and delivered dose compared to the planning at every fraction. We uses Log file and did not choose EPID option.

Sun check machines module including comprehensive Daily Monthly Annual QA. TG51 and TG142 template can be preconfigured and eliminate the need of spreadsheets. Auto-populate your Daily, Monthly and Annual QA results with direct connectivity to Daily QA 3 and IC PROFILER devices. Many imaging MLC and VMAT QA became automated. All Machine QA data became centralized. The QA reports and specific data trend can also be customized.

From the initial experiences, I feel the platform is very well integrated, eliminated many import/export tasks which greatly improve the physics efficiency. After Tolerance table be set, The system will flag out of tolerance items in yellow or red warning sign for physics to review, comments and approve. The server will monitor all the machines in real time, newly generated or retrieved files will be tasked for calculation in Queue. The calculation is happening at background usually take a couple minutes to be ready for review.

We had no server downtime at this moment. We've encountered some glitches for example 1. the field names cannot be the same from previous courses. 2. The field name shall not include some special characters. "underscore" for field names, setup fields and plan name gives a lot of issues. 3. The active QA session shall be closed before template changing taking effects. 4. The old version internet explorer does not compatible with the platform.

聚力谋发展，视讯话共赢：

首届国际医学物理教育研讨会在线上成功举办

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香港理工大学医疗科技与资讯学系

为了加强医学物理教育的国际交流与合作，把握世界医学物理教育发展脉搏，以全球视角应对中国医学物理教育面临的机遇与挑战，首届国际医学物理教育研讨会于香港时间2021年8月14日晚至15日上午以线上直播的形式顺利召开。本次会议由香港理工大学医疗科技与资讯学系医学物理项目主任蔡璟教授发起，香港理工大学医疗科技与资讯学系和医疗与社会学院共同主办，并获得了国际医学物理组织、中国医学物理协会、北美华人医学物理协会、香港医学物理学会、香港医学物理学院和全球抗癌协作组的联合支持和协助。

香港理工大学医疗科技及资讯学系主任叶社平教授、医疗与社会学院院长岑浩强教授、美国医学物理师协会主席James T. Dobbins

分别向大会致开幕辞，发言中反复强调了医学物理师在患者诊疗和科技创新等环节发挥了不可或缺的关键作用，分析了国际和区域性的医学物理发展现状、人才需求和教育挑战，赞赏了本次大会对于促进国内外医学物理教育和交流的重要意义，并预祝活动取得圆满成功。

作为国内外医学物理教育领军人物的代表，来自全球40余家大型医疗、教育和科研机构的医学物理项目负责人参与了会议讨论和经验分享。嘉宾们从各

自机构的医学物理教育历史、现状和发展等角度，深度分析了中国医学物理教育取得的成绩和面临的困境，也围绕国内外交流合作的主题，对未来的工作提出了愿景规划。作为国内代表，来自中国医学科学院肿瘤医院、北京协和医院、中山大学肿瘤中心、北京大学、清华大学、中国科学院深圳先进技术研究院等20多家中国医院、高校和科研院所的医学物理教育工作者展示了中国医学物理专业在教育、临床和科研等方面的快速发展。作为国外代表，来自哈佛大学，杜克大学，加州大学洛杉矶分校，宾夕法尼亚大学、德克萨斯大学西南医学中心等10多家全球知名高校和医学院的医学物理教育负责人分享了美国医学物理师从研究生教育、住院规范化培训、到职业认证的流程和经验。

在讨论环节，30多位国内外嘉宾积极分享了他们对医学物理教育的见解，并结合大会报告内容和本单位经验，深入探讨了当前中国医学物理教育困境的解决方案。与会者一致认为，中国的医学物理专业进入了更高标准发展的新阶段，但是目前依旧存在人才数量和质量欠缺，学科身份不明确，职业化发展不规范、不健全等问题。同时，随着人口老龄化加速和对高端医疗服务需求的快速增长，中国医学物理行业迎来了前所未有的历史发展契机。因此，本次会议召开得很及时、很必要，从教育培训的角度，促进了国内外医学物理人才的培养和学科的发展，有利于先进经验的分享和借鉴。来自全球的约300名观众线上参加了本次会议。

会后，中国生物医学工程学会医学物理分会主任委员，中国医学科学院肿瘤医院戴建荣教授向本次大会的成功举办表示祝贺。他说：“会议全面展示了中国医学物理教育和培训现状，让大家看到了希望，有了信心，同时也暴露了问题，探讨了解决办法”。中华医学会放射肿瘤学分会常委，中山大学肿瘤防治中心邓小武教授也充分肯定了本次大会的历史意义，他说：“ 医学物理学专业，在学科身份还不是很明确，职业化发展还在路上的时候，就这个专业的定义，范畴和规范化教育培训，和以及职业发展方向进行讨论，既是非常及时和起到很好的推动意义，也是一件挺不容易的基础性工作。”其他同行也都纷纷祝贺会议的成功，称赞本次会议是一场精心安排，高质量的国际学术会议，并呼吁大家积极行动，将医学物理的教育和就业进行规范化统一，以为患者提供规范、稳定、可及和高质量的诊疗为最终目标，促进医、教、研、产协同创新发展。

香港理工大学, 蔡璟教授

香港理工大学医疗科技及资讯学系主任，叶社平教授

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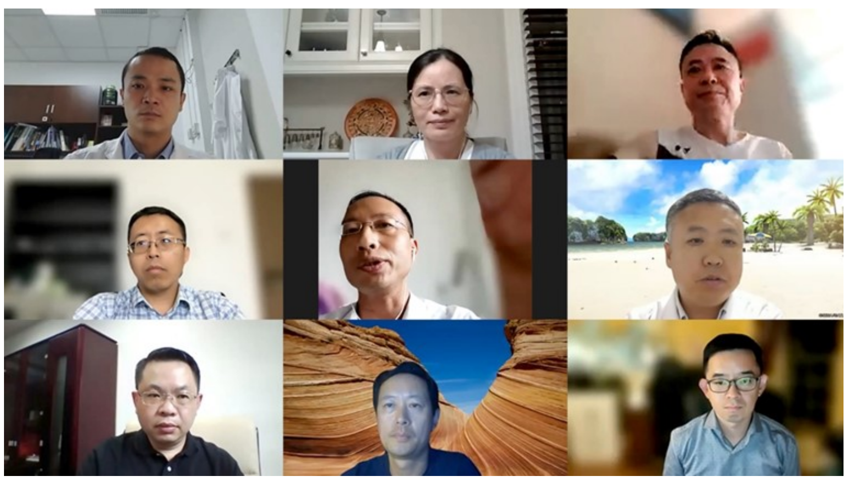
AAPM President, Dr. James T. Dobbins.

IOMP President, Dr. Madan M Rehani

主题一讨论嘉宾

主题二讨论嘉宾



主题三讨论嘉宾

NACMPA thanks to the Vendors who had sponsored us over the years