North American Chinese Medical Physicists Association

Spring 2022
Volume 7 No. 1

NACMPA NEWSLETTER

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Inside this issue:

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

Editor: Kai Yang, PhD

欢迎大家投稿

Message from President

Brian Wang, PhD
NACMPA President

Welcome to the Spring 2022 Edition of the NACMPA newsletter.

I am writing this message at a quarantine hotel in Xiamen, China. It is a big project to prepare for my trip, from visa application, flight booking, 7-day pre-flight testings, to the current at-least-three-week quarantine. What I learned from this experience is that we can accomplish many seemingly impossible things with a goal or mission in mind. What's the mission of our NACMPA then? I believe it has evolved since the establish of our association. We have not carried out many scientific/clinical exchange activities between North America and other countries due to the pandemics and the international political tension in the last couple of years. On the other hand, the physicist community within the North America has increased communications, especially since the establishment of the WeChat group. Our members help each other on scientific, educational, and clinical questions, thus enhancing our service to patients.

The AAPM annual meeting is in-person this year, how exciting! The RSS and Spring Clinical Meeting already hosted very successful in-person meetings in March. I am sure the annual meeting will have a great turnout after three years! NACMPA will host the traditional annual dinner meeting on July 13th. I encourage you to register for the meeting beforehand, and this will reduce the amount of work by our volun-

teers at the restaurant. If you change your mind, the registration is fully refundable. You can find the meeting program and registration information in this newsletter. I am sorry to miss you all at the meeting as I cannot afford two month-long quarantines within three months. I truly appreciate all my fellow NACMPA officers and many of the volunteers to pick up the extra work.

We will have elections at the annual meeting for two officers this year: president and treasurer. You can find an introduction of the candidates in this newsletter. We strive on equality, diversity and inclusion: three of four candidates are women, one represents diagnostic imaging specialty. Of note, our treasurer candidates are no longer restricted from the great New York area, thanks to Ke Nie's work.

Every year, NACMPA members receive prestigious awards from professional societies. In 2022, Pei-Jan Lin received the Marvin M.D. Williams Professional Achievement Award. Grace Jianan Gang got the John S. Laughlin Young Scientist Award. The following members were elected as an AAPM fellow: John Fan, Baojun Li, Heng Li, Tian Liu, Dan Ruan, Xiangyang Tang, Dandan Zheng, Xiaohong Joe Zhou. In 2021, Jun Deng was inducted as an ASTRO fellow. Please join me to congratulate our colleagues!

We continue soliciting article submissions to our newsletter. The topic does not have to be technical, clinical or professional. We have a new column on life-outside-of-work. Our past NACMPA president, Josh Xu, wrote a great article on Bitcoin and I am sure you will find it very informative.

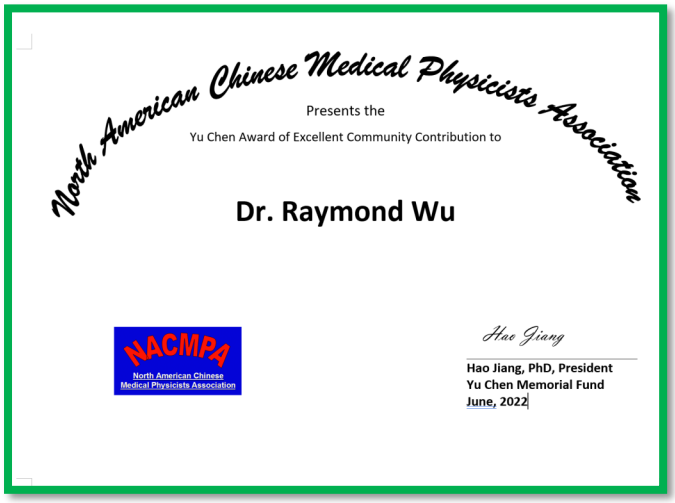
2022 NACMPA Awards

为了感谢和表彰华人物理师志愿者的奉献和鼓励更多医学物理师参与公益活动，NACMPA由陈昱纪念基金会赞助，从2018年起设立一个新的年度奖项-陈昱华人物理师最佳奉献奖。

评议过程主要以网上实名投票的方式进行，由大家投票选出。 2022年度的获奖者是 Dr. Raymond Wu。

陈昱纪念基金会为获奖者准备一个奖状铭牌和美元现金奖励。恭喜胡博士。

陈昱华人物理师最佳奉献奖


North American Chinese Medical Physicists Association

Presents the

Yu Chen Award of Excellent Community Contribution to

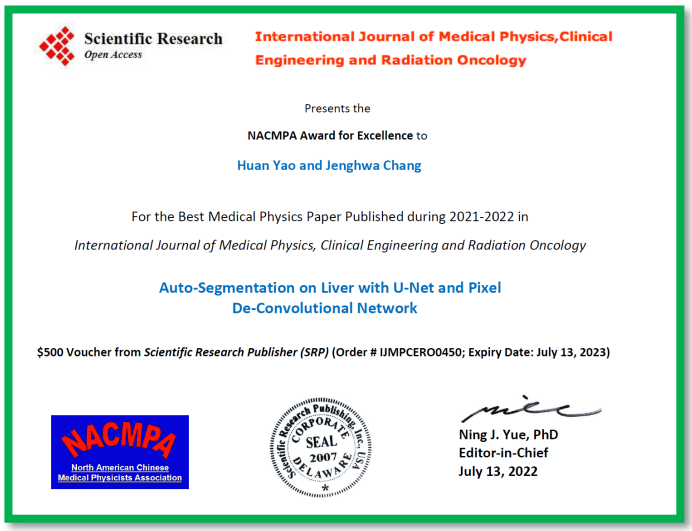
Dr. Raymond Wu

NACMPA North American Chinese Medical Physicists Association

Hao Jiang

Hao Jiang, PhD, President
Yu Chen Memorial Fund
June, 2022

IJMPCERO Best Paper Award


Scientific Research Open Access

International Journal of Medical Physics,Clinical Engineering and Radiation Oncology

Presents the

NACMPA Award for Excellence to

Huan Yao and Jenghwa Chang

For the Best Medical Physics Paper Published during 2021-2022 in

International Journal of Medical Physics, Clinical Engineering and Radiation Oncology

Auto-Segmentation on Liver with U-Net and Pixel De-Convolutional Network

$500 Voucher from *Scientific Research Publisher (SRP)* (Order # IJMPCERO0450; Expiry Date: July 13, 2023)

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Scientific Research Publishing, Inc. CORPORATE SEAL 2007 DELAWARE USA

Ning J. Yue, PhD
Editor-in-Chief
July 13, 2022

The International Journal of Medical Physics, Clinical Engineering, and Radiation Oncology (IJMPCERO) was founded in 2012. The Editor-in-Chiefs have been Lei Xing, PhD (Stanford University), Huan Bosco Giap, MD, PhD (University of Miami), and Ning Jeff Yue, PhD (Rutgers Cancer Institute of New Jersey). The journal has been endorsed by the North American Chinese Medical Physicists Association (NACMPA) since the beginning. It is an Open Access (OA) journal, meaning that the publisher makes all articles and related content available for free on the journal's website. Since it was established, the journal has published over 300 articles with more than 1200 citations. Since it is an OA, there have been over 675,000 and 1,176,000 downloads and views of IJMPCERO articles respectively. For example, the first IJMPCERO best paper has been cited by peer-review journal articles more than 154 times based on Google Scholar Citation Tracking. The Best Paper Award ($500 voucher along with a framed official certificate) has been presented to the first author of the winning paper each year at the annual meeting of NACMPA since 2013. The meeting is held on Wednesday evening at the annual conference of the American Association of Physicists in Medicine (AAPM) except this year will be held virtually due to the pandemic.

The criteria for best paper award selection, set by the NACMPA award committee, are the 1st or senior author must be a member of NACMPA and the paper was published in 2021. This year our award committee of NACMPA has selected the following paper as the Best Paper of IJMPCERO published in 2021 – Huan Yao and Jenghwa Chang: "Auto-Segmentation on Liver with U-Net and Pixel De-Convolutional network ", Vol. 10 No. 2, May 2021 (https://www.scirp.org/journal/paperinformation.aspx?paperid=109449). Congratulations to all the authors!

Maria Chan, PhD
NACMPA Liaison to IJMPCERO
Past President/Chair of Board, NACMPA

NACMPA Best Paper Award

NACMPA best paper award , established in 2018, aside recognizing the outstanding contributions to the medical physics field by the awardee(s), another goal of this award is to promote our society and hopefully draw more participations and contributions to NACMPA. Therefore, the criteria for best paper award selection, set by the NACMPA EXCOM, are


North American Chinese Medical Physicists Association

Presents the

NACMPA Award for Excellence to

Hao Gong, Liqiang Ren, Scott S Hsieh, Cynthia H McCollough, Lifeng Yu

For the Best Medical Physics Paper Published during 2021 in

Med Phys. 2021 Oct;48(10):5712-5726.

Entitled

Deep learning enabled ultra-fast-pitch acquisition in clinical X-ray computed tomography

NACMPA North American Chinese Medical Physicists Association

Zhigang Xu

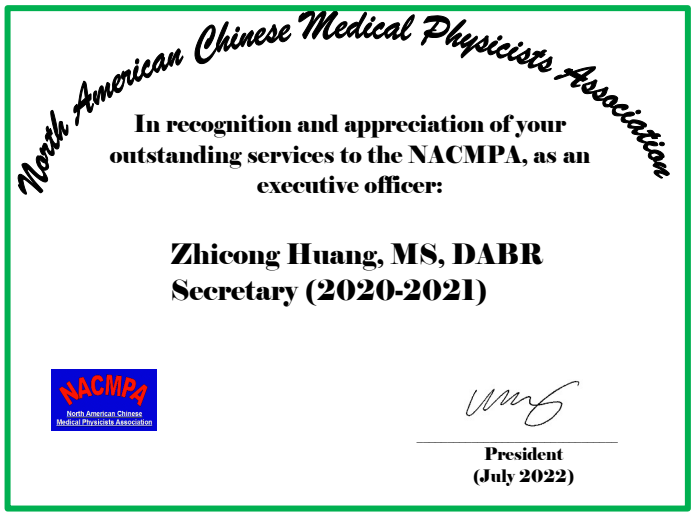
Zhigang Xu, PhD, Chair
NACMPA Best Paper Committee
June, 2022

1. 1st author is a member of NACMPA
2. Publication was in 2021 and in a medical physics related journal.

The 2022 NACMPA best paper award goes to:

Hao Gong, Liqiang Ren, Scott S Hsieh, Cynthia H McCollough, Lifeng Yu: "Deep learning enabled ultra-fast-pitch acquisition in clinical X-ray computed tomography "

NACMPA Service Award

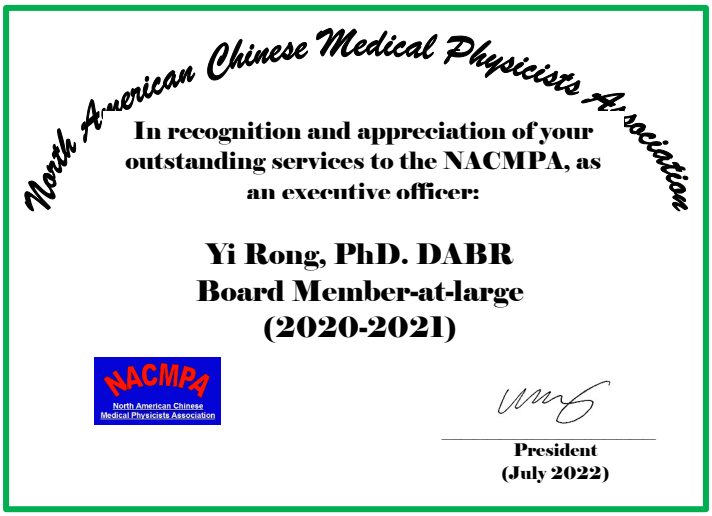

North American Chinese Medical Physicists Association

In recognition and appreciation of your outstanding services to the NACMPA, as an executive officer:

Zhicong Huang, MS, DABR
Secretary (2020-2021)

NACMPA North American Chinese Medical Physicists Association

President
(July 2022)


North American Chinese Medical Physicists Association

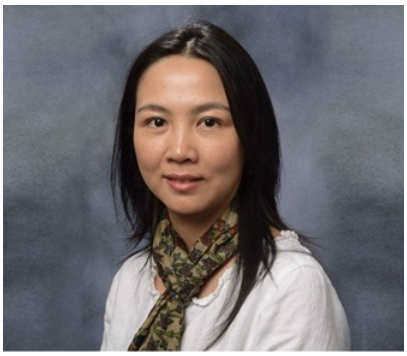
In recognition and appreciation of your outstanding services to the NACMPA, as an executive officer:

Yi Rong, PhD. DABR
Board Member-at-large
(2020-2021)

NACMPA North American Chinese Medical Physicists Association

President
(July 2022)

2022 NACMPA service awards go to Zhicong Huang and Yi Rong who have both completed two extraordinary years of service to NACMPA. Zhicong Huang has completed his term as the Secretary of NACMPA and Yi Rong has concluded her position as the Board Member-at-large of NACMPA for 2020-2021. Their contributions to the organization have been widely recognized.



Maria F. Chan, PhD, FAAPM
NACMPA Member

NACMPA Hall of Fame Award

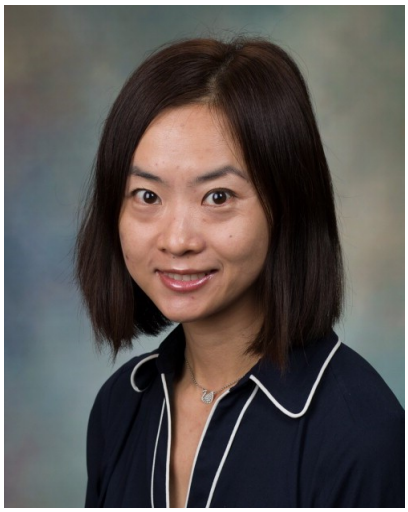
The NACMPA Hall of Fame award is an annual award to acknowledge the individual who made outstanding contribution to the field of medical physics through research or clinical work, or the individual who was outstanding in service in NACMPA. Due to the outstanding accomplishments and the significant contributions to NACMPA, Dr. Maria F. Chan has been selected by NACMPA Awards Committee to receive the 2022 NACMPA Hall of Fame Award, the highest honor of NACMPA. Congratulation!

Maria Chan, PhD, received her BS in Electrical Engineering from the University of Toledo, Toledo, Ohio in 1989. She earned her PhD in Medical Physics from the Medical College of Ohio, Toledo, Ohio in 1995. Dr. Chan was certified by the American Board of Medical Physics in 1998. She then joined the faculty of the Department of Medical Physics at Memorial Sloan Kettering Cancer Center (MSKCC) in 1999, where she currently serves as Attending and Chief Physicist at the MSKCC regional network in Basking Ridge, New Jersey. She served as Chairperson of the Practice Guidelines Subcommittee for 6 years which initiated a series of production of Medical Physics Practice Guidelines (MPPGs). She has been a member of 10 other AAPM committees, workgroups, and task groups. She served as a member of the AAPM Board of Directors and President of the New Jersey Chapter. Dr. Chan currently serves as a member of the Therapy Physics Committee (TPC) of AAPM, as well as the Guidelines Subcommittee and Education Committee of ASTRO. Dr. Chan also serves in several other professional societies, including the American College of Radiology (ACR), the American College of Radiation Oncology (ACRO), the American Board of Radiology (ABR), and the North American Chinese Medical Physicists Association (NACMPA).

Dr. Chan's clinical and research expertise covers wide areas in medical physics, including dosimetry for advanced delivery techniques (IGRT, IMRT/VMAT, SRS/SBRT, HDR), machine-learning in radiotherapy QA, management of implanted devices. Dr. Chan has published over 100 peer-reviewed papers and book chapters, over 60 invited national and international presentations; and has had 3 award-winning papers. She is the sole editor of a multi-author dosimetry book "*Recent Advancements and Applications in Dosimetry*". She has served on 4 Editorial Boards. Most recently she received the "Distinguished Associate Editor 2022" award from the Medical Physics Journal. Dr. Chan has received numerous industrial research grants including $300,000 (100% PI) from Ashland, Inc. for her development of One-Scan film dosimetry across multimodalities including Linac-based multi-lesion SRS, CyberKnife, Protons, MR-Linac, FLASH.

Dr. Chan was one of the long-time officers of NACMPA and served as Secretary, President, and Chair of Board since the election in 2007. During the past 15 years, she served as a lecturer for a few universities and hospitals, co-organized meetings, symposia, and workshops, and engaged in educational activities in China. Dr. Chan helped the establishment of the International Journal of Medical Physics, Clinical Engineering, and Radiation Oncology (IJMPCERO) in 2012. The journal has been endorsed by the NACMPA since the beginning and published over 300 articles with more than 1200 citations. Since it is open access, there have been over 675,000 and 1,176,000 downloads and views of IJMPCERO articles. Dr. Chan has been the liaison with the journal to ensure provide the "best paper" award at the annual meeting of NACMPA since 2013.

Candidates for NACMPA President 2022



Yi Rong, PhD, FAAPM

NACMPA Member

Dr. Yi Rong is Professor and Consultant in the Department of Radiation Oncology at Mayo Clinic Arizona. She obtained her PhD from Medical Physics Department at University of Wisconsin Madison in 2008. She is an experienced faculty physicist and researcher in various areas of medical physics and radiotherapy. She has worked on a wide range of cancer radiotherapy related clinical and research projects and applications, with extensive experience in teaching and mentoring graduate students in the field of medical physics and biomedical engineering. She has authored more than 70 papers and 3 book chapters. Her clinical expertise includes external beam photon and electron, brachytherapy, SBRT/SRS, motion management, IGRT, Tomotherapy, etc. Dr. Rong has been serving as Deputy Editor or Associate Editors for multiple journals, including Medical Physics and Journal of Applied Clinical Medical Physics (JACMP). She has also been moderating the Parallel-Opposed debate editorial series for JACMP since 2015. Dr. Rong was awarded the Fellow of American Association of Physicists in Medicine in 2020.

Wei Zou, PhD DABR

NACMPA Member

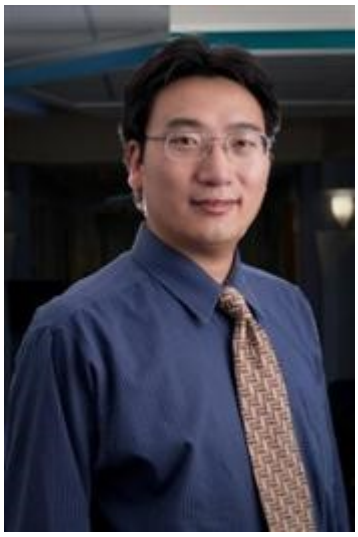
Dr. Jennifer Wei Zou is a faculty member in the Department of Radiation Oncology in the University of Pennsylvania. She obtained her Ph.D. from Cornell University in the Department of Theoretical and Applied Mechanics and completed medical physics master degree and residency at the University of Pennsylvania. Prior to joining the faculty body of UPenn, she worked as an Assistant Professor at the Rutgers University from 2012-2016. She also had several years of experience working as a development scientist in the semiconductor industry. Dr. Zou currently provides clinical service to the proton clinic and the CNS team. She is heavily involved in the didactic and practicum teaching of the medical physics master and residency programs. Her research focuses on motion effect and management, and the radiobiological mechanism and clinical application of proton FLASH radiotherapy. Dr. Zou has published more than 50 peer-reviewed papers, one book chapter and holds 7 US patents. She is currently supported by several NIH and vendor-funded research grants, including a recent funded FLASH P01 grant. Dr. Zou is a member of AAPM and ASTRO. She is an associate editor for the journals of Advances in Radiation Oncology and PLOS One. Dr. Zou has served in the NRG oncology medical physics subcommittee since 2016, and is currently the medical physics chair of an NRG/ECOG clinical trial.

Candidates for NACMPA Treasurer 2022

Qin Lei PhD

NACMPA Member

Dr. Lei Qin is an Assistant Professor of Radiology at Harvard Medical School and the Director of medical physics at the Department of Imaging, Dana-Farber Cancer Institute. Dr. Qin completed her Ph.D. thesis at NIH and received her Ph.D. degree in Bioengineering from University of Maryland, College Park in 2009. She did her post-doc training at Brigham and Women's hospital, an affiliated hospital of Harvard Medical School. Her current job includes overseeing quality control of all imaging modalities and optimizing imaging protocols to improve image quality. Dr. Qin's has authored/co-authored over 50 peer reviewed publications. She is currently a member of AAPM online learning services subcommittee and diagnostic workforce subcommittee.



Dengsong Zhu, MS

NACMPA Member

Dengsong Zhu is currently the Vice President at K&S Associates, a medical, health, and radiation safety physics consulting group and an accredited ADCL calibration laboratory. As an ABR certified medical physicist, his specialties are Stereotactic Radiosurgery, Stereotactic Body Radiation Therapy; High Dose Rate Brachytherapy including SAVI, Tandem and Ovoid, Cylinder, and Endobronchial treatment; Low Dose Rate I-125 Prostate Brachytherapy; I-131 and Xofigo Pharmaceutical treatment; and Radioembolization(Y-90). In addition, he performs shielding design for different clinics.

Dengsong has authored/coauthored about 50 published papers in peer-reviewed journals and conferences. He is a voting member of Maintenance of Certification Subcommittee of AAPM and also serves as Associate Editor for JACMP. During 2018 to 2019 he served as Secretary for NACMPA, successfully facilitating the development of the organization.

28th NACMPA Annual Meeting, Washington DC 2022 -Concurrent with AAPM Annual Meeting

Date/Time: July 13th, 2022, Wednesday, 6PM – 9PM

Place: 龙之味饭店 Chinatown Garden Restaurant, 618 H St NW, Washington, DC 20001

Meeting Agenda

6:15 PM: Members Arrival

6:30 PM: Introduction of Officers – Dr. Lu Wang

Recognition of Local Organizers

Introduction of Sponsors

Financial Report – Dr. Ke Nie

6:40 PM: Award Ceremony – Dr. Lu Wang

Yu Chen Excellent Community Service Award

IJMPCERO Best Paper Award

NACMPA Best Paper Award

NACMPA Service Award

NACMPA Hall of Fame Award

6:50 PM: Keynote Lecture by Hall of Fame Recipient

7:00 PM: Officer Election

President-elect

Treasurer

7:15 PM: Dinner

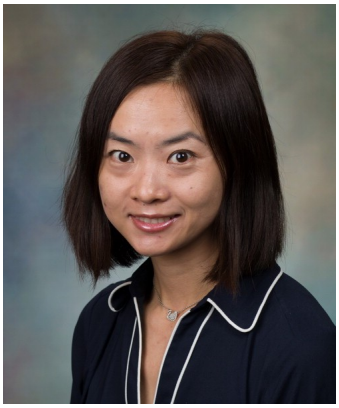
7:30 PM: Sponsor presentation (length depending on level)

8:00 PM: New Business

9:00 PM: Adjourn (Executive Meeting Follows)

Link to purchase ticket: https://www.eventbrite.com/e/the-28th-nacmpa-annual-meeting-tickets-367912796077?utm-campaign=social&utm-content=attendeeshare&utm-medium=discovery&utm-term=listing&utm-source=cp&aff=escb

A brief overview of current proposal on Radiation Oncology Alternative Payment Model



Yi Rong, PhD, FAAPM
NACMPA Member

The radiation oncology alternative payment model (RO-APM) is proposed in mid-2019, as a way to improve quality of care for Radiotherapy (RT), provide a system of episode based bundle payment, and thus reduce overall medical cost. The model has three major changes compared to our current fee-for-service model. It is a prospective episode-based bundled payment based on cancer diagnosis in a 90-day period; it links payment to quality of care by establishing merit-based incentive system and determining performance using quality measures, clinical data reporting, and patient experience. The details rules of the RO-APM have gone through multiple rounds of revisions, and are still pending further revision. Current start date of the RO-APM remains unclear as of May 2022. Model participation is mandatory for those randomly selected participants. AAPM website has a webinar that comprehensively summarized the currently published rules on RO-APM. As of now, five years of performance period (if no further delay), are to begin on January 1, 2023, and end December 31, 2027.

To better understand the potential impact of RO-APM, let's look at the Model Pricing Methodology. The reimbursement is based on national base rates, determined from national hospital outpatient rates, between the year of 2017-2019, with a weighted average of 20% for year 1, 30% for year 2 and 50% for year 3. Additional correction factors will be applied to the national based rates, including trend factors, case mix/historical experience adjustments, discount factors and withholds. Trend factor is to correct for differences between RO-APM participance and non-participants, case mix/historical experience factor is to adjust for individual hospital so that the financial impact will be gradually increasing throughout the five performance years. Lastly, the discount factor is for CMS to reduce overall cost, and withholds are for encouraging quality reporting for providers and hospitals to earn back.

This method of reimbursement will impact 15 cancer types (excluding liver and skin) and most common RT modalities Focus on 15 cancer types and include the most common RT modalities, including 3D CRT, IMRT, SRS, SBRT, proton beam therapy (PBT), and IGRT, excluding brachytherapy or IORT. One exception for PBT is for patients who are enrolled in a federally funded, multi-institution, randomized control clinical trial. CMS also pays for additional clinical data reporting (cancer stage, treatment plan info, etc.) for five types of cancer, including prostate, breast, lung, bone metastases, and brain metastases.

CMS estimates savings of $160 million over the RO Model's five-year performance period. RO APM will include approximately 282,000 episodes, 250,000 medicare beneficiaries, and $4.6 billion in total spending over those five years. Average payment to Physician Practice Groups is expected to be increased by 5.5%, while average payment to Hospital Outpatient Departments is expected to be decreased by 9.6%.

Overall, RO-APM has three distinct features that differ from our current payment system: 1. Bundle payment will cover all procedures during the episode of treatment, including treatment Planning,

dose planning, medical physics & dosimetry, treatment devices, special services, treatment delivery, treatment management and etc. Incentives will encourage quality measure reporting, clinical data reporting, and patient experience/satisfactory reporting. Treatments using advanced technology might suffer from lacking of incentives, but there are small factors that can be used as incentives in trend factors and continue reporting of HCPCS/CPT codes for all services. CMS is still collecting public comments on the current rules for RO-APM.

Based on the current design, RO-APM has pros and cons. There are advantages patients, providers, and CMS. Patient can receive any treatment modality as needed, based on the treatment modalities that are offered at the medical center. Medical providers can save time from no longer need to acquire insurance pre-certification, perform plan comparison, or request peer-review for insurance approval. CMS also is expecting to reduce overall cost from payment cut. And we can expect to see increase use of hypo-fractionation and SBRT treatments for those cancer diagnosis with sufficient level 1 evidence showing none-inferiority. Consequently, we will see increase patient volume increase, more work for data reporting, in order maintain good performance for refunding withholds, and less departmental support for new labor-intensive technologies, such as adaptive radiotherapy.

To summarize, the concept of episode-based bundle payment proposed in the RO-APM is promising and should be beneficial to the radiation oncology field in general. However, modifications to the current rules are needed in order to ensure fair payment, incentives for innovation, and reduction in reporting burden.

Washington DC 攻略

自疫情以来，阔别三年之后，AAPM年会终于又在线下开会了。这次的会议在首都 Washington DC召开，开会之余同学们也许有想游玩一下，散散心，透透气。协会excom现总结一份DC游玩攻略如下。

华盛顿身为首都，有很多和联邦政府有关的旅游参观项目，比如
白宫（https://www.whitehouse.gov/about-the-white-house/）、
五角大楼（https://washington.org/DC-faqs-for-visitors/can-i-tour-pentagon）、
首都纪念碑(https://www.visitthecapitol.gov/plan-visit)、
阿林顿公墓（https://www.arlingtoncemetery.mil/Visit）等等。
你可以在外面参观留影，譬如重温一下阿甘和珍妮在首都纪念碑前重见奔跑拥抱的画面。如果想要进内部参观，需要提前预约，可以直接预约，也可以从你所居住的州众议员的网页上预约，他们通常会提供帮助。

DC一系列的Smithsonian博物馆（https://www.si.edu/Visit）都是免费参观，离会议中心也比较方便。有像自然历史博物馆等，里边陈列有从恐龙化石到海洋之心的各种珍宝。

想要走远一点游山玩水的同学也可以考虑附近的风景名胜，比如连接弗吉尼亚北卡蓝岭山脉的Skyline drive，或者马里兰附近的海洋城、野马岛等等。

DC附近的马里兰也有联邦经费机构NIH、NSF等的总部，有想申请经费的同学也许可以提前和你感兴趣的 program director安排会面，联络一下感情，了解一下资讯。

吃的方面，开会的会议中心附近就有中国城。想吃中国食品的，可以就近选择。晚上尽量不要，或者是结伴出行，注意安全。想要吃得更好的可以考虑往北走一点到马里兰著名的石家庄（Rockville）等地。因为是首都华人聚集的地区，有很多很不错的中餐馆、自助火锅等等，不一而足。这个季节吃马里兰蓝蟹也不错。

要想了解更多旅游资讯的同学，除了可以放狗自己搜一搜过往驴友的攻略之外，也可以参见大华府华人资讯网（https://www.dcchinaren.com/），上面有很详细的信息。

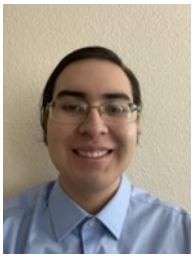
最后excom祝大家这次开会顺利，既有学术临床上的收获，也enjoy久违的老友相聚、旅游探索的快乐。

NACMPA华人年会聚餐，我们期待见到你!

Recent Progress of Cerenkov Luminescence Imaging

Jarrod Cortez,[1] Ignacio Romero,[2] Changqing Li[1,2*]

[1]Quantitative and System Biology, University of California Merced
[2]Department of Bioengineering, University of California Merced
Merced, CA 95343, USA
*Corresponding author: cli32@ucmerced.edu



Jarrod Cortez **Ignacio Romero** **Dr. Changqing Li**

Cerenkov radiation is produced when a charged particle moves faster than the speed of light in media. At a well-defined angle with respect to the particle's trajectory, the particle induces coherent electromagnetic radiation with a continuous spectrum. This radiation then propagates in the media and is detectable at a large distance. The constructive interference of the coherent radiation results in a number of Cerenkov radiation photons that are proportional to the distance traveled by the charged particle and inversely proportional to the square of wavelength.[1] Thus most Cerenkov radiation photons are in the blue region.

In 2009, Robertson et al. have, for the first time, shown that the visible photons from Cerenkov radiation in small animals are detectable with a laboratory camera.[2] These observations were further validated by many laboratories and resulted in a new hybrid imaging modality named Cerenkov Luminescence Imaging (CLI) which has two major advantages.[3–5] One is that CLI provides a low cost alternative to nuclear medicine imaging like positron emission tomography (PET) by low cost optical scanners such as PerkinElmer Caliper IVIS 100.2,[6] The other is direct imaging of β^--emitting radionuclides such as ^{90}Y.[6] Since the emergence of CLI, many scholars have reported different applications such as reporter gene expression imaging,[7] $\alpha_v\beta_6$ integrin tumor imaging [8], and pH values detection.[9] All these applications have demonstrated the popularity and significance of CLI.

Recently, the applications of CLI have expanded into time of flight (TOF) PET detector due to its extremely small or negligible rising and decaying time.[10] We will review this exciting progress later.

The major weakness of CLI is its low photon number which is easily overwhelmed by ambient lights. A small LED light generates much more optical photons than the Cerenkov luminescence photons from any in vivo CLI studies. However, this weakness can be overcome by using the high energy external X-ray beam in radiotherapy. The high energy secondary electrons ionized by the X-ray beam generate a high number of Cerenkov photons to be measured for radiation dose monitoring and tissue oxygenation sensing.[11,12] Furthermore, the high number of Cerenkov photons in radiotherapy can be used as the excitation source for FDA-approved photosensitizers of photodynamic therapy (PDT), which could be used to enhance the radiotherapy.[13]

Another weakness of CLI is short wavelengths in the blue region. Thus, most Cerenkov photons are absorbed before they reach the body surface for measurement acquisition. One way to overcome this weakness is to use an endoscopic system to detect the emitted Cerenkov photons closer to targets.[14,15] Another way is to shift the wavelengths by embedding nanoparticles or quantum dots into the subject.[16,17] However, due to the toxicity concerns of the nanoparticles and quantum dots, most applications of this approach are only for preclinical imaging.

In the following sections of this letter, we will review the aforementioned topics and their recent research progress.

Cerenkov Luminescence Tomography

CLI is a two-dimensional (2D) imaging modality and its applications are limited by photon intensity uncertainty which depends on the target depth. If CLI would like to be an alternative imaging approach of PET, three dimensional CLI is highly desired. In early

2010, Li et al. demonstrated for the first time a new imaging method called Cerenkov Luminescence Tomography (CLT), in which the biodistribution of nuclear radioactivity inside a small animal is traced back from the surface measurements of optical photon intensity from Cerenkov radiation with an inverse algorithm.[18] Later, using a similar approach, Hu et al. also validated CLT's feasibility with SPECT imaging.[19]

Recently, CLT has been investigated with many novel reconstruction approaches such as stacked denoising autoencoder, multilayer fully connected neural network, non-negative iterative convex refinement, and total variation constrained graph manifold learning strategy. However, the qualities of reported CLT images are not good enough to make CLT an acceptable modality in research labs due to the following reasons. Firstly, the reconstructed CLT targets are very sparse, which is not always the case for preclinical models. Secondly, the spatial resolution of CLT is still limited by very strong optical scattering, which is difficult to be overcome with reconstruction methods. Lastly, CLT reconstruction is based on finite element mesh for solving the diffusion equation. It is not trivial to construct the finite element mesh automatically.

Endoscopic CLI

CLI is a kind of optical imaging in which the emitted optical photons are strongly scattered and most photons are absorbed in tissues before they propagate to body surface for measurements. Thus, a catheter based endoscopic CLI is one way to overcome the limitations of imaging depth to reach the deep organs or tissues directly. In 2012, Liu et al. proposed this idea and demonstrated its feasibility with both phantom and mice imaging [14,15]. The same group has also shown that the beta emitting radiotracers like ^{90}Y could be imaged by Cerenkov luminescence endoscopy with much better sensitivity compared with the gamma emitter radiotracer ^{18}F. In 2014, Cao et al. built a CLI endoscopic system and evaluated its performance with phantom and pseudotumor studies.[20] This approach was first applied to human subjects by Hu et al., in which they performed a pilot clinical study in imaging the cancer after administration of FDG. Their study was cross validated with CT-PET imaging [21]. Recently, the performance of an endoscopic CLI system was optimized and indicated that the system can detect radioactivity as low as 0.83 μCi with an imaging time of 1 minute for the radiotracer of ^{68}Ga, which is very impressive.

Intraoperative surgery guidance

Like PET and SPECT, CLI can be used to guide surgeons during a tumor resection. In 2011, Holland et al. deployed CLI with a Zirconium radiotracer and compared images across two cancer types. This study showed that it was possible to track expression of prostate specific membrane antigen (PSMA) in prostate cancer grafts, as well as breast cancer positive tumors BT-474. They compared their CLI images with PET images of the same samples.[22] Soon after it was demonstrated that the CLI of ^{18}F-FDG radiotracer could also provide a suitable method for imaging the internal structure of lymph nodes.

During intraoperative surgery, it is critical that there is a method to determine the cancer margin. Efforts have been made to improve the accuracy of CLI to avoid patients from developing metastases in the future. The blood vessels in tumors was successfully visualized in CLI images with the use of negative contrast.

Recently, with the light proof chamber and the CLI fiberscopic device, Pratt et al. showed that the fiberscopic CLI could serve as a method for superficial disease surveillance and provided a unifying molecular imaging method for nearly all radionuclides currently used in clinic.[23] Figure 1 shows a schematic of the imaging system, in which the patient is in a dark, light-tight chamber and the Cerenkov photons on the patient's body surface are acquired by a sensitive fiberscopic based camera.

Therapy Monitoring and Enhancement

Immunotherapy: Immunotherapy employs therapeutic drugs to activate the immune system to fight malignant diseases. The applications of CLI also extend to the monitoring of these specialized drugs. In 2012, Xu et al. investigated this application to the immunotherapy treatment of lung and prostate cancer. Using mouse models, they investigated the signal of commonly used radiotracers from treatment and control groups.[24] They concluded PET and CLI results correlated very well, suggesting that CLI can be used as a method for cancer drug monitoring. Additionally, CLI has been implemented as a method to track diseases such as lymphoma which

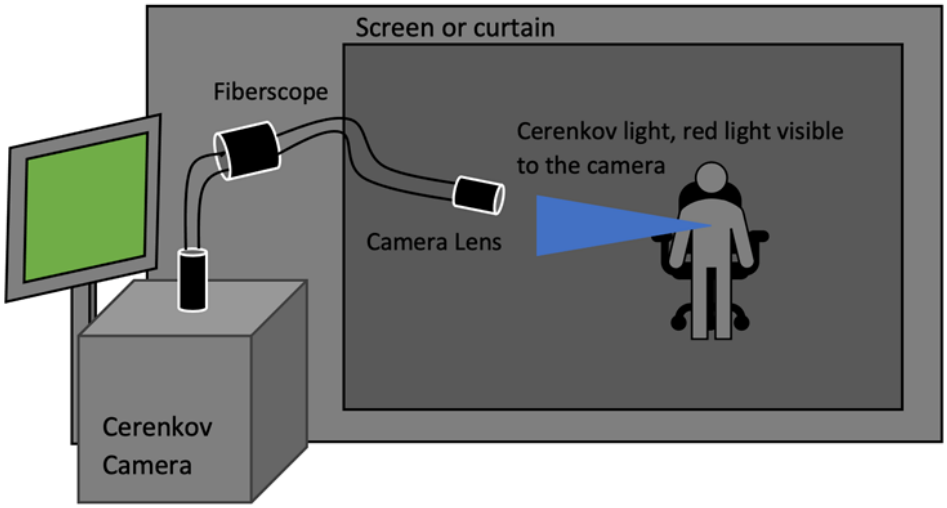


Figure 1 A schematic of a clinical Cerenkov setup using a fiberscope with a dark enclosure to prevent outside light from interfering with patient imaging.

affects the B cells in the model organism. This was done on transgenic mice containing human protein CD20 in the cell membrane of B cells. A Zirconium radiotracer, paired to a biomolecule that tracked the presence of the CD20 membrane protein, was used for generating CLI signals which indicates the expression of CD20. Significant agreement between CLI and PET suggesting was found, which indicates that CLI can be used as an alternative to monitor immunotherapy. The concept of Cerenkov radiation based photoimmunotherapy was reported and its efficacy was compared with near-infrared (NIR) photoimmunotherapy on breast cancer cells. While the Cerenkov radiation photoimmunotherapy was successful in suppressing the tumor size, it was less effective than the NIR photoimmunotherapy with some inconsistencies in producing bioluminescence.

Chemotherapy: Patients with cancers require constant monitoring for their chemotherapeutic treatments. CLI can be used to track the chemotherapeutic treatments of such patients.[25] Such efforts have been made, although the study was applied to small animal models only. In this study, Hu et al. were able to use CLI to quantify tumor uptake of ^{131}I-NGR in tumor bearing mice. This allowed them to get a quantitative measurement of the tumor activity since ^{131}I-NGR was bound to CD13 in a soft tissue cancer, HT1080. However, they did note that CLI has limited penetration depth.

Photodynamic Therapy: The activation of photosensitizer molecules is necessary for photodynamic therapy, and the use of a Cerenkov radiation radiotracer as a light source for this process has been investigated. It has been demonstrated that in cells and mice the 18F-fluorodeoxyglucose (^{18}F-FDG) could cause uncaging of the drugs from the Cerenkov luminescence for the treatment to the tumor. Because optical photons at NIR region have larger penetration depth than the photons at blue color, the wavelength shifting of Cerenkov luminescence from blue color toward NIR region has been explored for better PDT efficacy. The main advantage of Cerenkov radiation excited PDT is that the radiotracers can target deep cancer directly so that there is no depth limitation of light penetration. The limitation of this approach is the small photon number emitted per decay. Thus, Cerenkov radiation induced PDT may be a supplemental therapy along with other cancer therapy.

Emerging Applications of CLI

Time of flight measurement in PET detector

The Cerenkov photons are generated promptly in crystals or transparent semiconductors when a 511 keV gamma ray interacts with it. These promptly generated Cerenkov photons could be used to obtain the high TOF resolution in PET imaging. This idea was first demonstrated by Sun II Kwon et al. in 2016, in which they achieved the coincidence resolving time of 560 picoseconds (ps) using a pair of 3x3x20 mm^3 BGO crystals [10]. The same group also demonstrated this application using Thallium bromide (TlBr) detectors with a coincidence time reso-

lution of 330 ps. It is very impressive that Ota et al. developed a Cherenkov-radiator-integrated microchannel plate photomultiplier tube, with which they achieved a coincidence time resolution of 30.1 ps [26].

Radiation dose estimation and quality assurance

The emitted Cerenkov radiation from the object surface due to external beam radiotherapy can serve as a real time metric for absorbed dose. Current external beam radiotherapy treatments use MV electronic portal imaging (EPID) to monitor the radiation beam that passes the patient. However, the EPID does not provide good soft tissue contrast and the anatomical reference points for treatment verification and safe repeatability are limited to patient bone structures or implanted fiducial markers. Other methods exist which employ film, ionization chambers, TLDs, etc. which require additional time for processing and suffer from small FOV.

Cerenkov superficial dose monitoring concept through Monte Carlo simulations was studied, in which flat and cylindrical phantoms were irradiated with megavoltage (MV) X-ray beams and it was found the Cerenkov emission was proportional to the dose. Later, Jarvis et al. clinically demonstrated the use of Cerenkov emission as a method to visualize real time surface dose from breasts with radiation treatment by MV X-ray beams.[27]

To overcome limitations with patient specific breast tissue optical absorption and scattering properties, the tissue properties acquired from CT imaging was used to compensate for the tissue property limitations by adding a correction factor in the Cherenkov luminescence image. Cerenkov emission as a quality assurance tool in electron radiotherapy was also explored. The Cerenkov emission from a water phantom excited by electron beams was recorded with a standard commercial camera. After comparison of dose measurements from ionization chamber measurements, it was found that the Cerenkov method was linear with dose and independent of dose rate.

The Cerenkov radiation arising from the nuclear decay of therapeutic radionuclides can serve as a radiation dose monitoring tool. It was reported that the Cerenkov emissions induced by a therapeutic administration of 131-Iodide was used to monitor the dose distribution of the drug in the patient thyroid. The application of Cerenkov luminescence imaging to monitor the radiation dose from ^{90}Y-labeled gastrin releasing-peptide receptor in nude mice models was also explored.

External beam radiotherapy monitoring using CLI

External beam radiotherapy employs fast charged particles or high energy X-ray beams to treat deep malignant tissues in the patient. As a result, Cerenkov radiation emission occurs if the charged particles (or ionized charged particles) travel faster than the Cerenkov threshold in tissues. As an example of the phenomena, Axelsson et al. reported that a fluorophore, protoprphyrin IX, embedded in a biological phantom, can be excited by the Cerenkov radiation photons generated with external high energy X-ray beams.[11] Axelsson et al also assessed tissue oxygenation in phantoms and mice in real time with CLI induced by external beams as a method to monitor the efficacy of the radiation therapy.[12]

Unlike other external beam therapy, proton therapy deposits most of the radiation dose at the end of their path and subsequently exhibit a high dose gradient fall off known as the Bragg Peak. The proton stopping powers estimated from CT images result in millimeter uncertainties of the proton range. Yamamoto et al. explored CLI as a range estimation method during proton therapy in water phantoms.[28]

Radiotherapy enhancement with Cerenkov luminescence induced PDT:

As reported before, there are plenty of Cerenkov photons emitting from radiotherapy using high energy external X-ray photons. Thus, it is possible to use these emitted Cerenkov photons to excite photosensitizers for PDT. With the cultured cancer cell models, Guo et. al. demonstrate the efficacy of the Cerenkov radiation induced PDT.[13] Considering the fact that there are many clinically available PDT photosensitizers and plenty of Cerenkov photons near the tumor, the PDT enhanced radiotherapy might be worth more studies in the future.

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INTContour: Customizable AI in OAR Segmentation for Clinic and Research

Xue Feng, Quan Chen, Carina AI

摘要

器官勾画是放疗流程中非常重要的一步，准确的勾画能够确保在放疗规划中准确计算各个器官的剂量，以降低治疗副作用，达到理想的治疗结果。目前的临床流程中仍以手动勾画为主，不仅费时费力，更会有准确性、不同操作人员之间的差异性的问题。人工智能技术（AI）的发展给自动化勾画带来了良好的前景，然而在临床实践中仍面临诸多挑战，例如AI算法在不同数据集的表现的差异以及AI产品对临床流程的适应性。就器官勾画而言，不同的临床机构经常还会有不同的需求，甚至采用了不同的器官勾画标准，因而很难保证预训练好的模型能够适应各自的临床需求。

INTContour产品在基于多项创新的AI算法基础上，提供了充分的个性化功能，可以支持用户用本地数据训练需要的模型并用在随后的研究以及临床应用上，并且自定义不同的运行协议以组合不同的模型以及对器官做多种形态学变换。**INTContour**采用了基于网页的UI设计，支持一键部署到本地服务器上，并通过DICOM协议和TPS脚本与内网内其它机器进行交互。

INTContour is a software product developed by Carina AI to support and streamline the radiation therapy treatment planning process through automatic organ segmentation. INTContour uses patented, award-winning AI-based automatic segmentation algorithms that support more than 60 structures, including organs at risk (OAR) and targets from multiple anatomical sites. INTContour has received FDA clearance to market the product.

Accurate delineation of organs is a crucial step in the radiation therapy treatment planning process to optimize the benefit of radiation therapy and allow for the delivery of the maximum dose to the tumor volume while sparing healthy tissues. In current clinical practice, manual segmentation is the most common approach; however, this process is tedious, time consuming, and suffers from intra- and inter-observer variability. Automatic segmentation allows for fast, accurate, and reproducible contouring and eliminates common setbacks associated with manual segmentation.

Quan Chen, PhD,

NACMPA Member

In addition to concerns of the accuracy of automatic segmentation algorithms, other hurdles exist on the road to clinical adoption, such as workflow incorporation and variability in clinic practices. To overcome these hurdles, INTContour provides multiple avenues for workflow incorporation, including web-based access, fully automated workflow, and integration with vendor APIs, to allow seamless integration of the software to existing clinical workflows. To address the challenges that different clinical sites may adopt different contouring criteria, organ definitions and/or morphological operations, INTContour provides functionalities that allows for on-site training and deployment of custom models using local data, as well as customized protocols to define organ combinations and morphological op-

erations. Clinical sites also have the option to share their trained models to other sites.

1. Algorithm and Performance

INTContour's award winning segmentation algorithms support more than 60 structures from four anatomical regions, including head and neck, thorax, abdomen, and male pelvis. The team has won the 2017 AAPM Thoracic Organ Segmentation Challenge (2nd place in live phase and 1st place in ongoing phase) and 2019 AAPM RT-MRI Head and Neck Segmentation Challenge (1st places in all phases). Multiple papers or book chapters are published including technical innovations and clinical validations of the AI algorithms [1-6]. Each organ segmentation model is built using convolutional neural networks (CNNs), which use a 3D UNet model architecture that has five encoding and five decoding blocks. A deep supervision technique is used during training, where the loss function is computed at each decoding block after the first. This allows for the injection of the gradients deeper into the network and facilitates training at each layer. Validation studies were performed to test the performance of INTContour's models on a held-out validation dataset. The metrics used to evaluate the performance included the Dice similarity coefficient (DSC). Table 1 below shows the results for the DSC as mean ± standard deviation, where the mean and standard deviation were obtained using the validation set.

Table 1. Results for all supported structures2. Clinical Workflow Incorporation

Anatomical Site	ROI	Dice	Anatomical Site	ROI	Dice
Head & Neck	Brainstem	0.893 ± 0.033	Thorax	SpinalCanal	0.860 ± 0.061
	OpticChiasm	0.587 ± 0.192		Lung_R	0.970 ± 0.014
	Bone_Mandible	0.923 ± 0.024		Lung_L	0.968 ± 0.016
	OpticNrv_L	0.572 ± 0.193		Heart	0.926 ± 0.022
	OpticNrv_R	0.583 ± 0.217		Esophagus	0.747 ± 0.073
	Parotid_L	0.885 ± 0.032		Trachea	0.829 ± 0.082
	Parotid_R	0.883 ± 0.037		BronchialTree	0.731 ± 0.103
	Glnd_Submand_L	0.808 ± 0.067		SpinalCord	0.844 ± 0.062
	Glnd_Submand_R	0.816 ± 0.065	Abdomen	Spleen	0.945 ± 0.054
	Eye_L	0.924 ± 0.024		Kidney_R	0.927 ± 0.098
	Eye_R	0.936 ± 0.014		Kidney_L	0.935 ± 0.029
	MidEar_L	0.804 ± 0.058		GallBladder	0.780 ± 0.090
	MidEar_R	0.811 ± 0.047		Esophagus	0.710 ± 0.083
	Joint_TM_L	0.771 ± 0.079		Liver	0.958 ± 0.017
	Joint_TM_R	0.764 ± 0.089		Stomach	0.866 ± 0.071
	Pituitary	0.557 ± 0.213		A_Aorta	0.898 ± 0.044
	InnerEar_L	0.822 ± 0.053		V_Venacava_I	0.769 ± 0.103
	InnerEar_R	0.826 ± 0.034		PortalVein	0.449 ± 0.238
	Lens_L	0.771 ± 0.074		Pancreas	0.677 ± 0.123
	Lens_R	0.719 ± 0.080		AdrenalGland_R	0.671 ± 0.055
	Lobe_Temporal_L	0.864 ± 0.029		AdrenalGland_L	0.602 ± 0.222
	Lobe_Temporal_R	0.863 ± 0.023		SplenicVein	0.318 ± 0.271
	Larynx	0.868 ± 0.049	Male Pelvis	Bladder	0.942 ± 0.057
	Cavity_Oral	0.860 ± 0.033		Femur_Head_L	0.949 ± 0.020
	BrachialPlex_L	0.526 ± 0.080		Femur_Head_R	0.949 ± 0.025
	BrachialPlex_R	0.529 ± 0.077		PenileBulb	0.620 ± 0.182
	Pharynx	0.625 ± 0.099		Prostate	0.853 ± 0.050
	Brain	0.984 ± 0.006		SeminalVesicle	0.779 ± 0.106
	Cochlea_L	0.617 ± 0.217		Rectum	0.814 ± 0.092
	Cochlea_R	0.612 ± 0.209			
	Glnd_Lacrimal_L	0.596 ± 0.183			
	Glnd_Lacrimal_R	0.643 ± 0.117			

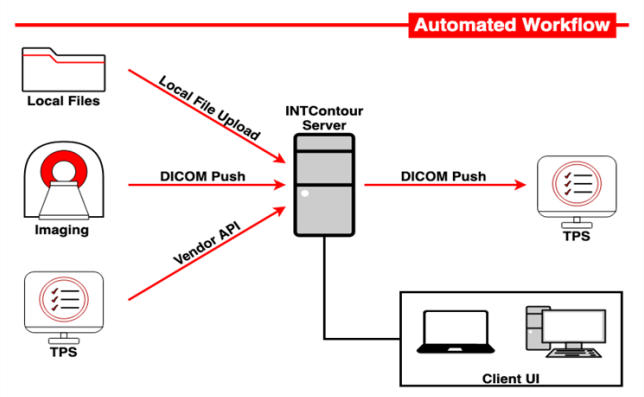

Figure 1. INTContour Workflow

2. Clinical Workflow Incorporation

INTContour is designed to integrate seamlessly with clinical workflows and includes multiple avenues for workflow incorporation, as illustrated in Fig. 1. INTContour is installed locally on a workstation that is equipped with GPU as a web service, which can be accessed by any other clients. All data and communications are limited to the local network. The software can be used using the web-based interface and DICOM tools (DICOM push or direct upload from disk). Additionally, INTContour can be called using Varian or Raystation APIs. The installation, updates, and maintenance of INTContour are managed using the Docker platform, which provides a one-click install and deployment.

A study can be segmented by simply selecting from a list of imported studies, and then pressing the "Segment" button on the study detail page. The user-friendly interface (Fig. 2) gives users the ability to segment, inspect, and export results all from a single page.

Figure 2. Study detail page

In addition, INTContour provides functionality to perform image segmentation automatically as new studies are added. The automatic task execution workflow, as illustrated in Fig. 3, is configured to check continuously for new studies at a user-specified time interval. Once a new study is found, the workflow automatically detects the anatomical regions covered by the study and segments the structures within. The resulting DICOM structure set files will then be automatically pushed to a user specified DICOM node.

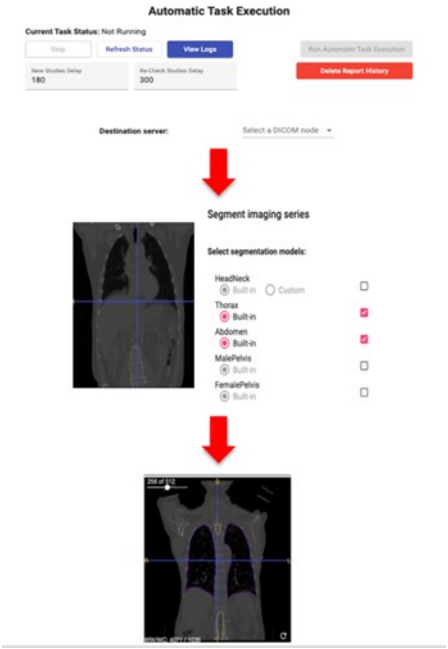

Figure 3. Automatic task execution

3. Customization

INTContour supports customization on multiple aspects to fit to different clinical needs, as shown in

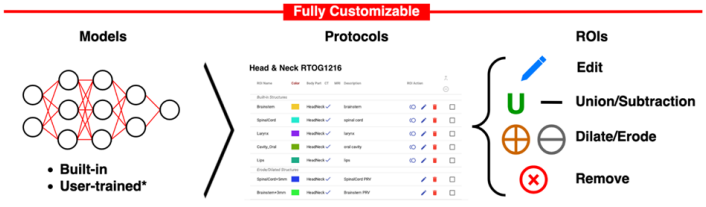

Figure 4. Customization options

Fig. 4. The models refer to each trained CNNs, which has a pre-defined output (organs) and often limit to one anatomical region. For regions that include many organs (e.g. head and neck), there may be multiple models. Protocols are defined as a set of rules that can combine different models, specify different organ names and colors in the output DICOMRT file, and apply morphological operations.

a. Custom Model via Incremental Learning

INTContour provides a unique and advanced feature where users can expand built-in models to generate custom models using incremental learning module. Institutional variability is common in contouring, where different sites adopt distinct contouring atlases and labeling criteria. Incremental learning allows users to train their own models using on-site data to meet different users' needs such as supporting additional organs and/or custom labeling. In the model update process, users have the option to choose the structures on which models will be trained. The incremental learning workflow is highly adaptable and supports the addition of new data and the changing of OAR definitions at any time along the development cycle. As custom models are trained, they will be added to the list of models that the users can choose in running subsequent segmentations.

Multiple research studies have been performed using INTContour to explore different topics such as segmentation of new structures or from multiple modalities including magnetic resonance imaging (MRI). The algorithm training module is fully embedded into INTContour so that no hyper parameter tuning is needed to achieve a good model. The module also handles tedious data cleaning and preparation tasks with support for specifying different names for the same organ and is robust against using missing data in training. For example, in practice, if the number of trained organs is large, it is very often to have some organs unlabeled in some cases; the training module uses a novel training loss function to ignore unlabeled organs to avoid bias to the final model [7]. Empirically 30-40 training cases can yield a decent segmentation model and the training takes 40-48 hours on a typical Nvidia GPU (e.g. GeForce 2080 Ti).

** Model customization is provided as a research-only feature. INTContour does not perform any actions to validate the accuracy and performance of the new models. Currently it is not a FDA approved feature.

b. Custom Protocols

A built-in protocol exists for each of the supported anatomical regions that consists of a set of rules for related segmentation tasks. These built-in protocols contain the names for each structure and assign each a color that will be used to show the segmentation results. Accompanying the built-in protocols, INTContour also allows users to create custom protocols. Customization options, as illustrated in Fig. 4, include removing unused structures, renaming structures, combining structures, and performing morphological operations such as dilation and erosion. For example, if a user doesn't need the "OpticNrv_L" and "OpticNrv_R" structures, they can remove each from their protocol. Similarly, users may wish to combine the left and right lungs into a single structure by creating a union. Further, users may wish to perform morphological operations to add margins to an existing structure and create planning organ at risk volume (PRV), clinical target volume (CTV), or planning target volume (PTV) structures. This allows users to de-clutter their segmentation results so that they can easily focus on relevant structures. The built-in naming convention follows the most recent Radiation Therapy Oncology Group's recommendations; however, users may wish to adapt a naming convention used in their clinical workflows and will be able to customize INTContour to match the practices at their respective institutions. In the automated workflow, INTContour will parse from the series description or image comments to choose different custom protocols for different images.

About

Carina AI is a startup that spun out of multiple labs at the University of Virginia and the University of Kentucky and is dedicated to the transfer of academic research into clinical products using cutting-edge AI technology to improve cancer treatment. Carina is a receipt of NCI SBIR Phase I and Phase II [8] awards to support the development of INTContour.

We at Carina AI are pushing the boundaries of current healthcare practice to lead to affordable and better care for patients. If you are interested in demoing our products, or potential collaborations, please feel free to reach out to us at:

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145 Graham Ave, A168,

Lexington, KY, 40506

info@carinaai.com

https://www.carinaai.com

We will exhibit at AAPM 2022 (Start-up Space, Booth 16) and hope to see you there.

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life outside of work

加密货币投资初学指南

Zhigang Xu, PHD

NACMPA Past President

Abstract

Digital assets, including cryptocurrencies, have experienced explosive growth in recent years, with a market cap of more than $3 trillion last November, up from $14 billion five years ago. According to the survey, about 16 percent of U.S. adults (roughly 40 million people) have invested, traded, or used cryptocurrencies. The skyrocketing price of Bitcoin (Bitcoin) and other cryptocurrencies has caught the attention of a large number of investors, financial firms, regulators and the media. While many people are interested in Bitcoin and other cryptocurrencies, understanding the basic concepts about Bitcoin and other cryptocurrencies can be slightly challenging for the average person. By my estimate, the likelihood that medical physicists have traded cryptocurrencies is well below 16%.

This article will give you a brief introduction to the basics of Bitcoin and cryptocurrencies, how to buy, store, send and receive cryptocurrencies, I hope it will help you. Remember, there is nothing wrong with waiting until the cryptocurrency market becomes more mature. Don't let the fear of missing out drive you to take too much risk or make emotional investment decisions. Given the uniqueness of these new currencies, it is best to do a lot of research beforehand.

近年来，包括加密货币在内的数字资产经历了爆炸性增长，去年11月的市值超过3万亿美元，高于五年前的140亿美元。调查显示，大约16%的美国成年人(大约4000万人)投资、交易或使用过加密货币。比特币(Bitcoin)和其他加密货币价格的疯涨引起了大量投资者、金融公司、监管机构和媒体的注意。虽然很多人都对比特币和其他加密货币兴趣颇丰，但要理解有关比特币和其他加密货币的基础概念对普通人来说可能稍具挑战性。据我估计，医学物理师有投资交易过加密货币的可能远低于16%。

本文将简单介绍比特币和加密货币的基础知识，如何购买，储存，发送和接受加密货币，并对未来值的关注的加密货币做一些预测，希望对你有所帮助。记住，在加密货币市场变得更加成熟之前，静观其变并没什么不对。不要让错过的恐惧驱使你承担过多的风险，或者做出情绪化的投资决策。鉴于这些新的货币的独特之处，事先进行大量研究是上上之策。

1. 比特币和加密货币101

加密货币(cryptocurrency)是一种通过密码学来保证交易安全的数字货币。许多加密货币都是依赖于区块链技术(blockchain)， 一种记录了所有交易，非中心化分布式的账本。在大多数情况下，只要没有人控制网络上超过50%的计算能力，这种账本就无法被篡改。

与传统货币(fiat currency)不同，加密货币不受任何中央政府或权威机构的控制。对于某些加密货币来说(例如比特币)， 新货币的供应是由一个需要消耗极大算力,被称之为 “挖矿(mining)”的过

程。 在这个过程中，计算机(挖矿节点node)会互相竞争来解决一个数学方程，从而确保了网络的安全。第一个创建新的有效区块的矿工会获得比特币作为奖励，然后将其发布到网络中的其他节点，并添加到区块链中。

其他加密货币则采用了预挖矿的形式，即在货币公开发行之前先进行开采。人们有时会对预挖矿的加密货币持负面看法，因为这些项目经常通过大力宣传来增加需求，推高价格，让开发人员套现。

不同的加密货币的特点和用途各不相同。其中一些是开发者们为了解决某些加密货币的缺陷或提供其他加密货币没有的额外功能而创造出来的。例如，比特币并非完全匿名。任何人都可以查看比特币分类账，其网络中资金的流向也可以被追溯到不同的比特币地址，尽管没有私人信息可以将你与你的比特币地址联系起来。因此，其他类型的加密货币被开发了出来，其目的是为了给用户提供完全的匿名性。还有其他加密货币则有着更具体的用途，并被用于支付特定网络上的服务。例如，以太坊 (Ethereum)是用于在以太坊网络上部署智能合约的数字货币。

2. 如何购买比特币和其他加密货币

据我了解CoinBase 和Gemini 两个加密货币交易平台也许是进入加密货币投资最安全和容易的途径之一。纽约州颁发的BitLicense牌照，堪称是主流交易所最青睐的牌照，Coinbase和Gemini交易所都拥有该牌照，进而获得在全球金融体系最发达的纽约州经营加密货币交易业务的权利。

注册CoinBase 可按连接：

https://coinbase.com/join/mlcinc?src=ios-link

注册Gemini 可按连接：

https://www.gemini.com

在你开始和购买任何加密货币之前，你首先需要验证你的身份。双重身份验证(Two-factor authentication), 即通过你手动验证你确实是登录者，为你的账户提供额外的安全层。有两种方法可以在你的账户上应用双重身份验证(当然取决于网站允许的选项)。

方法一是通过Authenticator应用程序。 一些交易所和应用程序允许 "Authy"，但绝大多数都使用"Google Authenticator"。它们的功能是一样的，都是你手机上的应用程序。请务必写下安装密码，以防你的手机丢失。你也需要这个来验证设置一个新的手机。(这种方法最安全的)

方法二是通过短信。 当你尝试登录或进行交易时，你会收到发送到你手机号码的短信。(简单但不太安全)。

当一切都被核实后，你可以登陆网页， 选择买/卖，点击购买领域来选择你想购买的资产，输入你想购买的金额，以加密货币或你的本地货币计价。然后选择你的付款方式，点击预先购买来确认你的购买。如果细节正确，点击购买来完成你的购买。

3. 如何安全地保存加密货币？

无论是短线投资者还是有长期持有的加密货币爱好者，首要任务应该是确保加密货币的安全。加密货币存放在加密货币钱包(wallet)。加密货币钱包类似于网路银行帐户，由密钥组成，可以保证加密货币的安全，而这一组钱包密钥称为公钥(public key)和私钥(private key)。

私钥用来生成公钥和钱包地址(wallet address),也用来对交易进行签名。拥有了私钥就是拥有了对这个钱包余额的一切操作权力。所以，保护私钥是所有比特币钱包应用最基本也是最重要的功能.

私钥地址样本：

41a17b31e6251f2f132fc6ffbb232d7f3e6f2b63a738218c2b6277536858b2ad

这个地址称为私钥，是解锁钱包的一系列数字和字母。私钥就像银行帐户的密码，只要任何有私钥的人都可以使用钱包内的加密货币。

钱包地址样本:

0xC96BF3c0C513D94Ada653CCF2f0f9abd084479f4

这个地址是由私钥产生公钥经加密过后所产生，是一系列数字和字母，表示在区块链上存放加密货币的地址。举例来说，类似银行帐户的帐号，其他人要汇款给你时，就必须知道这个帐号才

行，所以别人要将加密货币给你，只需给他地址即可。

加密货币钱包简单两种分类：热钱包(hot wallet)和冷钱包(cold wallet)。热或冷的区别是指如何存储钱包的钥匙。热钱包是主动连接至网路任何类型的加密货币钱包。这些包括交易所钱包、桌面钱包和行动式钱包。热钱包容易被骇客攻击，因为它们连接到网路。此外，大多数的热钱包你都无法确保只有你自己拥有私钥。这意味着自身加密货币无法由自己直接控制，而是交由交易所或托管商控制。

冷钱包是一种未连接到网路的加密货币钱包，并将私钥存储在离线状态(off line)。冷钱包是较安全的加密货币存储方式，如果使用得当，加密货币资产几乎没有机会遭盗取。

热钱包与冷钱包各有优缺点，热钱包虽然安全性没有像冷钱包那么的安全，但是如果交易动作频繁，建议放置在交易所钱包中方便操作，不过交易所尽量选择安全性高和没有发生过骇客入侵的较为妥当，比如上面推荐的CoinBase 和Gemini. Gemini还提供Gemini Earn 服务，相当于加密货币的余额宝。BTC、ETH年化1-3%， Filecoin年化最高为7.4%，Gemini Dollar年化8.05% (1:1瞄定美元的稳定货币）。其他所有Gemini支持的币种基本都能在Earn里赚利息。

冷钱包则是适合本身拥有大量加密货币资产和以安全性为最高考量的投资者，虽然操作过程相对繁杂，但是为了加密货币资产的安全，还是多几道安全机制比较安心。

4. 如何发送和接收加密货币?

一旦你在CoinBase 或Gemini有了帐户，就可以轻松地发送和接收数字货币。所有钱包交易都是在区块链上完成的。如果你将资金发送到错误的地址，Coinbase 或Gemini钱包将无法收回资金。因此，必须检查并选择正确的钱包地址来进行交易, 确保你只发送比特币到一个比特币地址，以太坊到一个以太坊地址，等等。这方面的错误可能会导致你的资金永久损失。下面以CoinBase 为例详细地描述该过程。

首先，打开 Coinbase 并通过点击屏幕底部的“帐户”访问你的钱包。从那里，点击你要与之进行交易的加密货币，这里我们使用比特币(BTC)为例。

发送比特币首先点击屏幕右上角的纸飞机按钮。在提交页面上，选择你要发送的BTC数量。

如果你对要发送的数量感到满意，点击提交按钮并确认。如果你的收件人有一个Coinbase 帐户，你只需输入与其帐户关联的电子邮件地址。如果你要发送到未连接到 Coinbase 的钱包，比如Gemini的钱包，你将需要输入或粘贴确切的钱包地址或使用手机的相机扫描二维码。然后点击屏幕右上角的“提交”完成发送资金。

接受BTC需要点击BTC钱包页面屏幕右上角的纸区图标旁边的二维码按钮，你的BTC地址就会以QR格式显示。如果你进行个人交易，只需让对方对其进行扫描。如果远程交易，你需要点击“复制地址”，并通过电子邮件或文本与对方分享你的地址。一旦对方按照你的方式发送了BTC, 通常在十几分钟内，收到的BTC就会添加到你的钱包中。

5. 未来加密货币的趋势

2021年，从广泛的主流接受再到一系列新的数字代币和NFT(Non Fungible Token，即非同质化代币)的爆炸性流行，这是加密货币繁忙的一年。到目前为止，按市值计算，比特币是最大的加密货币，这一年开始的反弹使比特币市值达到了历史新高，然后在一系列的恐慌性抛售中损失了近50%的价值。比特币在夏季恢复了一些势头，到11月，已经重新攀升到接近历史记录的最高价格，但在12月晚些时候出现了下跌转折。

从技术层面来说，加密货币属于单一资产类别。然而，在加密货币投资组合中，你可以针对代表不同目标和用例的产品、货币和代币开展多元化投资。例如，投资组合可配置为40%的比特币(BTC), 20%的以太币(ETH), 20% 的稳定币(GUSD)和20%的其他币。那么未来有哪些加密货币值得关注呢？

A. Web3将使互联网去中心化

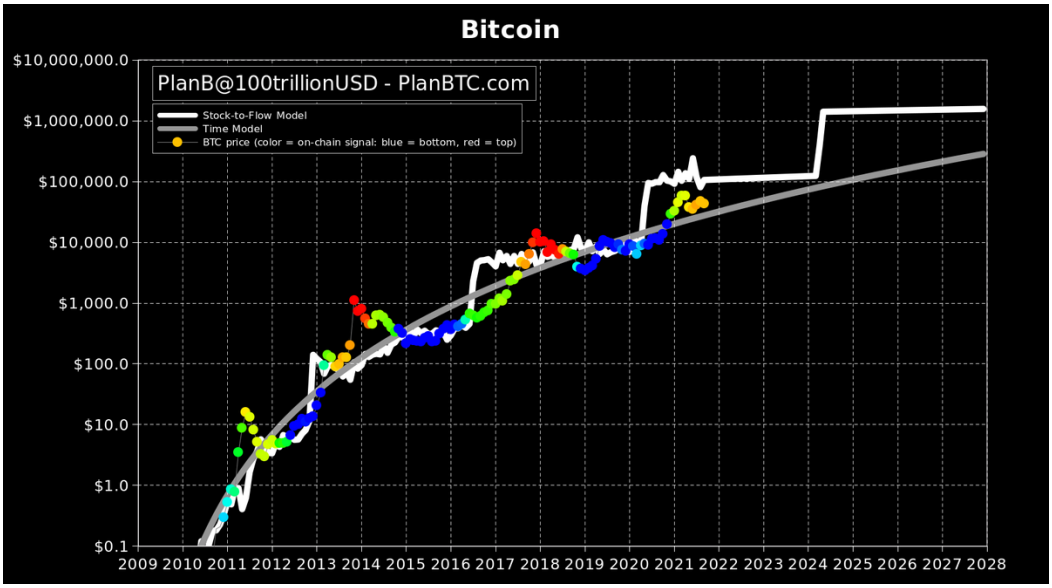

Fig.1. The Stock to flow chart is used by many people to try and predict the future price of Bitcoin. The stock-to-flow line is an estimated future price point for $BTC.

区块链正在为互联网而来。Web3是互联网技术的下一个演变，一个基于区块链的去中心化应用系统将个人数据控制权还给人们。大公司通过利用个人信息进行广告宣传来实现网络盈利的模式将被取而代之。Web3 用户将因他们的关注而获得加密代币的奖励。

B. 金融服务将采用区块链

建立在区块链基础设施上的DeFi（decentralized finance 去中心化金融）应用，最初是作为一种无需第三方中介处理金融交易的手段而引入的，从而提供更快、更便宜和更安全的服务。 2021年见证了DeFi应用或dApps的起飞，锁定在DeFi协议中的总价值从去年的200亿美元猛增到今天的2500亿美元以上。随着越来越多的金融服务提供商开始转向区块链平台，这种加密货币趋势有望在未来加速发展。

C. NFT和现实世界资产的代币化

2021年一批神秘的NFT收藏品，像CryptoPunks和Bored Ape Yacht Club价格高得惊人。去年12月初，Merge向28,983名买家出售了超过312,000个单位，这些单位共同构成一个整体艺术品。48小时销售的总价格是9100万美元。

未来还有可能增加房地产或汽车等现实世界资产的代币化，为NFT增加一个全新的维度。随着二级市场的蓬勃发展和需求的激增，NFT加密货币的趋势可能会在2022年继续下去。

D. DiFi游戏趋势将加剧

2021年基于区块链的游戏呈现爆炸式增长。像Axie Infinity (AXS), Sandbox (SAND)和Crabada(CRA)这样的游戏彻底改变了游戏赚钱的概念，让玩家能赚取游戏中的代币和奖励，还可以在加密货币交易所兑换成现金。结合改进的图形、更好的游戏性、更多的NFT游戏选择和越来越多的玩家，预计2022年，玩赚的加密货币游戏趋势将加剧。

E. 元宇宙增长(metaverse)

2021年底，出现了元宇宙，这是一个可能在2022年真正起飞的加密货币趋势。Meta（以前的Facebook）正在建立一个3D社交宇宙，而微软正在开发协作的虚拟工作场所Mesh。像《堡垒之夜》和Roblox这样的流行游戏已经发展成为虚拟世界。元宇宙将是这一概念的延伸，为人们和企业提供了新的方式来实现体验的货币化。

本文所提供的信息不是投资建议，所提供的示例仅用于演示和教育用途，并非用于购买、出售或持有任何特定加密货币或使用任何特定策略的推荐或招揽。

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