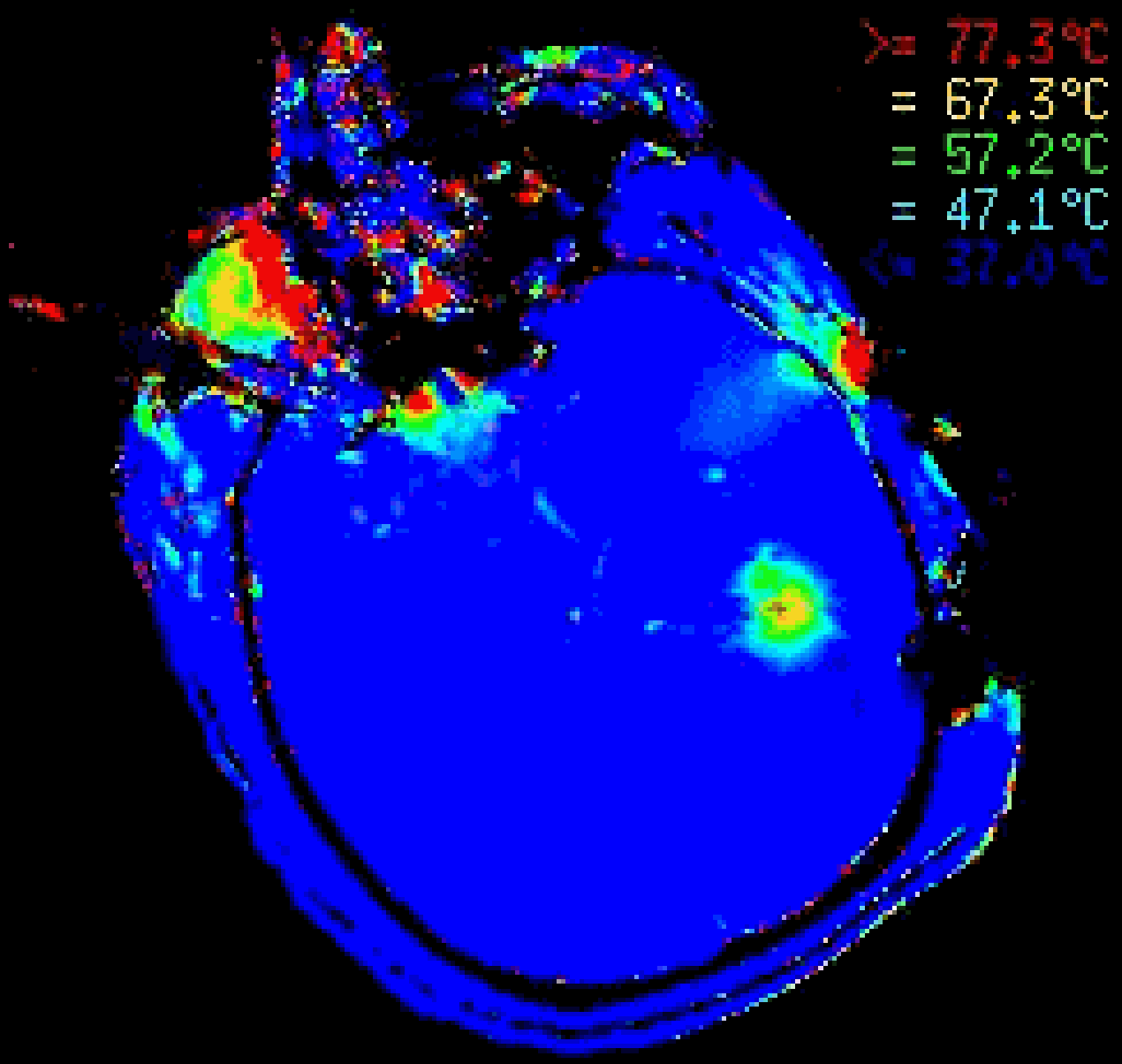
Medical Physics Graduate Program

Alumni Newsletter

2017 | volume 11



THE UNIVERSITY OF TEXAS MD Anderson Cancer Center | UTHealth The University of Texas Health Science Center at Houston

Graduate School of Biomedical Sciences

Director's Report


Richard E. Wendt, III, Ph.D.

This past year has been a good one for the Medical Physics Program. You will see in this newsletter that our alumni, our students and our faculty are all thriving and prospering.

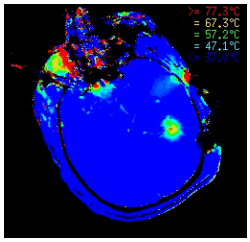
A prominent change has taken place at the graduate school, which has renamed itself The University of Texas MD Anderson UTHealth Graduate School of Biomedical Sciences. The goal of this renaming is to raise the visibility of the school by tying it explicitly to the reputations of our two parent institutions, The University of Texas MD Anderson Cancer Center and The University of Texas Health Science Center at Houston, the latter of which has adopted the UTHealth branding. Sometimes when I happen upon the curriculum vitae of an alumnus or alumna, I see that MD Anderson is listed as the degree-granting institution. Now, with the new name, it is possible to recognize the MD Anderson connection of a medical physics degree while acknowledging the graduate school as well when stating your alma mater. The Deans encourage using the new name, rather than just MD Anderson, in such circumstances as a means of enhancing the reputation of the school by connecting it explicitly to the accomplishments of our distinguished alumni.

While the roots of the Medical Physics Program can be traced back to the 1950's in the Physics Department at The University of Texas at Austin, we recently observed the semicentennials of the first medical physics degrees to be awarded by the Graduate School of Biomedical Sciences, which were to Peter Corry, M.S., 1966 and Robert Waggener, Ph.D., 1967. An accompanying article describes our initiative to build upon the first half-century of the program for the next five decades. Please support this effort generously.

It was almost a quarter century later that our M.S. program was first accredited by the Commission on the Accreditation of Medical Physics Education Programs. Every five years we renew our accreditation and this year is one of those years. Part of the re-accreditation process is a survey of some of our alumni in order to find out how well the program has served you. In order to minimize the nuisance of this, we will take advantage of a survey of alumni that the graduate school will be conducting anyway. If you receive the survey, please help us by participating. Also, if you have comments or advice beyond what the survey asks, please send them to me directly.

Another way in which we are looking to the future is through a revision of the curriculum. This was instigated by our students and has been through a lengthy process that has involved both the faculty and the student body. Starting with our entering class of 2017, the two clinical rotation courses will be replaced by an introduction to clinical medical physics and by enhanced laboratories in the introductory courses in therapy, imaging and nuclear medicine. The mathematics course will be replaced by an imaging science course and a statistics course. The courses in anatomy, oncology and in radiobiology will be replaced by a year-long sequence that integrates anatomy, physiology and radiobiology along with elements of the molecular imaging course that had been required of Ph.D. students. The molecular imaging course, which had replaced the old GSBS biochemistry course, will remain as an elective.

Another change is to the candidacy exam for the Ph.D. degree. After several years of using the so-called off-topic format, we have returned to an on-topic examination. Now, our Ph.D. students prepare the research plan section of an NIH-style grant proposal that describes their actual research project. During the fall of their third year, they present this to an examining committee and answer questions not only about their proposed research, but also across the gamut of medical physics. The latter section of the examination serves the same purpose of assessing breadth of knowledge as did the Raphex exams that many alumni will recall.



Cover art courtesy of David Fuentes, Ph.D., assistant professor of Imaging Physics.
Temperature imaging during MR guided laser ablation in brain.

Below, you will find a description of our entering class of 2017. There are fewer Ph.D. students than in past years because the graduate school has reduced the size of its overall entering class and has shrunken the number of medical physics students commensurately. Although the matriculants to our S.M.S. program maintain our high standards, and are indistinguishable in terms of test scores and GPAs from our Ph.D. students, the number of applicants to the S.M.S program is shrinking. We believe that this reflects the reality that residencies are now required for ABR certification and Ph.D.s are more competitive in getting them.

We are working with the MD Anderson School of Health Professions to develop a Doctor of Medical Physics Program to meet the needs of students who desire a clinically-directed career and who would, in the past, have been attracted to the S.M.S. program. This is a slow and detailed process that is still a year or two away from inauguration, as we have many administrative hurdles still to surmount. I am grateful to the numerous alumni who participated in our needs assessment survey. Your responses will be a crucial element of our application for approval by the State of Texas.

In closing, I am grateful to many people for their support of the program and their help to me. They include the present and past chairs of the two physics departments, John Hazle, Mary Martel and Geoff Ibbott; members of the Program Steering Committee, especially Rebecca Howell, our Deputy Director, and Laurence Court, our Program Admissions Director; Melissa Tovar, our Program Manager, and Frances Quintana, our Program Coordinator; Lisa Hebert, who edited this newsletter; and Carlos Cardenas, our Student-Faculty Liaison.

I would like to single out Mai Dinh, Department Administrator in Imaging Physics, who took on the interim management of the program before Melissa joined us, and Betsy Kindred who, despite having assumed new and demanding responsibilities in another program, has maintained a loyal devotion to the Medical Physics Program and has been a ready and willing resource for Mai, Melissa, Frances and me.

In the grand scheme of things, we are all about education. The work of the many members of our faculty who teach classes and advise students at the highest level of achievement is essential. The accomplishments of our students and alumni, and your unwavering support are of paramount importance to the success of our program. Thank you all.

Bud Wendt | 713.745.3250 | rwendt@mdanderson.org

Entering Class of 2017 Admission Data		
Applicant Data	**Ph.D.**	**S.M.S.**
Total Applicants	68	16
Offers	9	2
Matriculating	6	2
Average Scores of Matriculating Students	**Ph.D.**	**S.M.S.**
Undergraduate GPA	3.58	3.49
Graduate GPA	3.62	n/a
Verbal GRE	157	157
Quantitative GRE	166	162
Verbal + Quantitative GRE	324	319
Analytical GRE	4.08	3.80

Incoming Ph.D. Students

Brian Anderson
M.S., MD Anderson UTHealth Graduate School

Yasaman Barekatain
M.S., University of Delaware

Sharbacha Edward
B.S., Illinois Institute of Technology

Yulun He
B.S., Worcester Polytechnic Institute

Ben Musall
M.S., MD Anderson UTHealth Graduate School

Dong Joo Rhee
M.S., Duke University

Incoming S.M.S. Students

Shannon Hartzell
B.S., Lafayette College

Brandon Luckett
B.S., LSU & A&M College Baton Rouge

Student Report

Our Student Research Retreat was held on May 19, 2017. The theme of our retreat was "The past, present and future of medical physics". Our invited speaker, Walter Grant III, Ph.D., shared some great stories about his time as a postdoc at MD Anderson Cancer Center back in 1969, working under the direction of Robert J. Shalek, Ph.D., in the early days of the Radiological Physics Center (now IROC-Houston).

Throughout his talk, Grant provided us with great advice, and encouraged the students to remain active in research after graduation. He finished his talk by emphasizing the importance of taking leadership roles within our professional organizations to play a part in shaping the future of medical physics.

During the retreat, a SAMs style presentation competition was held and the student winners, determined by evaluations from the students in attendance, were as follows:

Pre-candidacy student talks

1st Travis Salzillo
Deciphering Spectra from NMR and MRS

2nd Mallory Carson
Pitfalls in IMRT: Past Problems and Future Solutions

3rd Evan Gates
Feeling Out Image Texture

Post-candidacy student talks

1st Megan Jacobsen
Applications of Dual-Energy CT for Radiation Oncology

2nd Sara Thrower
The Past, Present, and Future of Imaging in Radiation Therapy

3rd Angela Steinmann
The Future is Now: MR Guided Radiotherapy

4th Carlos Cardenas
Deep Learning and Convolution Neural Nets

This academic year has been productive and successful for the medical physics student body.

Academically, our student body has had a very productive year. To my knowledge, five students received GSBS Fellowships during the 2016/2017 academic year, and some have received similar awards from NIH/CPRIT and other industry partners. The AAPM's annual meeting is just around the corner. This year, our student first-authored abstracts account for 27 oral presentations, 12 posters, and one Young Investigator Symposium Talk at the annual meeting. I would like to congratulate Ashley Rubinstein for this honor and encourage everyone to attend her early Monday morning talk on July 31.

Our student body's academic success would not be possible without the dedication and didactic efforts from our mentors and course instructors. This year, the student body voted Donna Reeve as the recipient of the 2017 Outstanding Teaching Award. This award recognizes faculty members whose commitment to education has served to positively impact the students' experience in the Medical Physics Program. Reeve's didactic involvement and commitment to the diagnostic imaging rotation course earned her this award and the students recognized that she goes "above and beyond" her duties to make the rotation informative and valuable.

GSA Olympics

Team Orange Crush

Team Apples

The medical physics student body has continued to help maintain the future of the program by providing support during student interview and orientation weeks. During orientation week, the student council provided the incoming students information on tutorial opportunities during an informal session. In addition, Daniela Branco and Josh Gray established our Big Brother/Big Sister program which matched first year students with a more senior student mentor. This provided the new student with someone to reach out to with any academic or personal matter during their first year.

To promote social interaction between the students outside of our labs, Daniela took the lead organizing our yearly student picnic and recruited two teams for the Graduate School Association (GSA) Olympics. Our medical physics intramurals football team, lead this year by Cayla Wood and Ben Lopez, continues to compete against rival GSBS teams. We can say this has been a successful year thanks to the lack of any major student injuries.

It has truly been an honor to serve as the Student-Faculty Liaison this past academic year. I am thankful for this opportunity and very appreciative of the support from our student council and student body for making this a great year for our program. I look forward to seeing how the program grows and continues to succeed in the future.

Lastly, I would like to thank Frances Quintana, Melissa Tovar, and Richard Wendt, Ph.D., for their guidance and support throughout this part year. Without their assistance and support many of our student council endeavors would not be possible.

Carlos Cardenas

Picnic at the Rec Center

2017 - 2018

STUDENT COUNCIL

Daniela Branco
Student-Faculty Liaison

Serves as the main point of contact between the student body and the program director.

Mallory Carson
Education Chair

Provides a formal channel for students to discuss issues related to their educational experience.

Brian Anderson
Social Representative

Organizes student social events to promote student interaction and collaborations outside of individual labs.

Melissa Tovar became the new Education Program Manager last November.

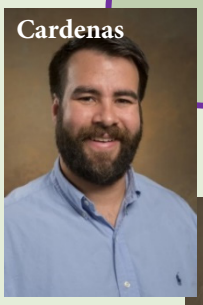
OUR NEW
PROGRAM MANAGER

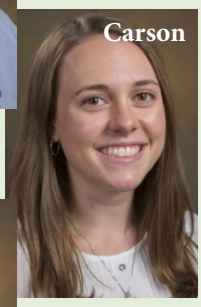
Melissa Tovar started at MD Anderson in 2000 working in various roles with increasing responsibilities. Prior to joining us, she served as the program coordinator in Diagnostic Radiology, overseeing their six fellowship programs. Overall, Tovar has 16 years of experience in coordinating educational activities, including student recruitment, admissions, event planning, visas and student advocacy.

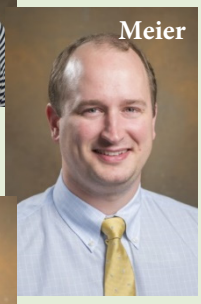
Melissa Tovar | 713.563.2548 | mtovar@mdanderson.org

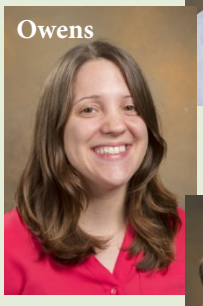
Recognition & Achievements

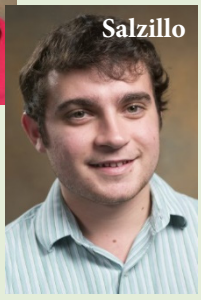
In addition to the awards listed below, throughout this newsletter other special student honors and recognitions are noted or highlighted. Dissertation and thesis abstracts are also included for students who defended July 2016 – May 2017.











Carlos Cardenas (Mentor: Laurence Court, Ph.D., assistant professor of Radiation Physics)

- George M. Stancel, Ph.D. Fellowship in the Biomedical Sciences from GSBS.

Mallory Carson (Mentor: Stephen Kry, Ph.D., associate professor of Radiation Physics)

- Rosalie B. Hite Fellowship Recipient from GSBS.

Rachel Ger (Mentor: Laurence Court, Ph.D., assistant professor of Radiation Physics)

- Rosalie B. Hite Fellowship Recipient from GSBS.
- American Legion Auxiliary Fellowship in Cancer Research from GSBS.

Joshua Gray (Mentor: Steven Millward, Ph.D., assistant professor of Cancer Systems Imaging)

- Finalist, 2017 Diagnostic Imaging Trainee Research Symposium. *Directed Evolution of Imaging Agents and Therapeutics Targeting LC3 and Autophagy.*

Kelly Kisling (Mentor: Laurence Court, Ph.D., assistant professor of Radiation Physics)

- Ellen Taylor Goldin Legacy Award from GSBS.

Joseph Meier (Mentor: Osama Mawlawi, Ph.D., professor of Imaging Physics)

- Selected for oral presentation in the Computer and Instrumentation Council Young Investigator Award Symposium at the 2017 Annual SNMMI Meeting. *Impact of elastic motion correction on quantitation and image quality of whole-body PET/CT.*

Constance Owens (Mentor: Laurence Court, Ph.D., assistant professor of Radiation Physics)

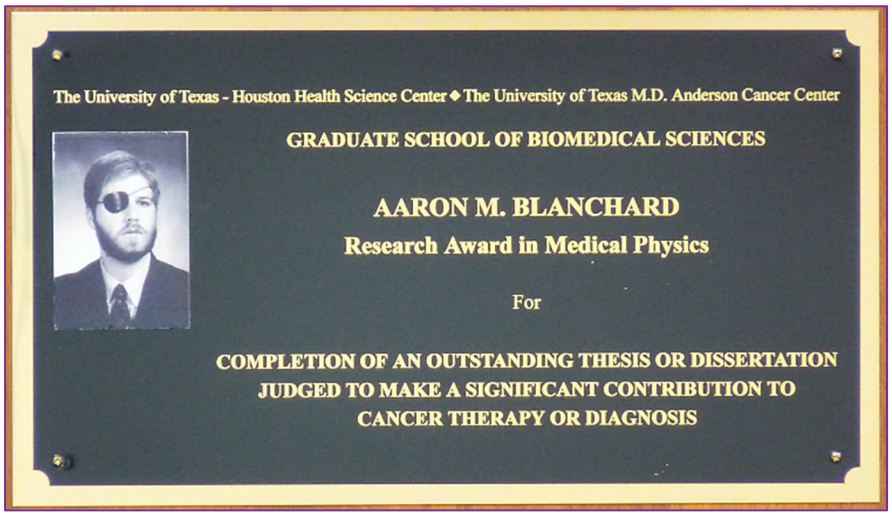
- SWAAPM Young Investigator's Symposium, Poster Award, 3rd Runner Up. *Assessing Radiomics Feature Reproducibility Using a Semi-Automatic Tool.*

Travis Salzillo (Mentor: Pratip Bhattacharya, Ph.D., associate professor of Cancer Systems Imaging)

- 2017-2018 CPRIT Scholar Award from the MD Anderson CPRIT Research Training Program.
- Investing in Student Futures Endowed Scholarship from GSBS.

The Aaron Blanchard Research Award

The Aaron Blanchard Research Award was established as a memorial to Aaron Blanchard, a graduate student in the Medical Physics Program, who succumbed to cancer before earning his degree.



The award was created by Blanchard's family and is sustained by their generosity and by other donations to the GSBS. It recognizes a medical physics graduate (M.S. or Ph.D.) for completion of an outstanding thesis or dissertation that is judged to make a significant contribution to cancer therapy or diagnosis. The recipient of the award is selected by a subcommittee reporting to the Medical Physics Graduate Program's Steering Committee. The award consists of a certificate and cash. Additionally, the graduate's name is engraved on the Aaron Blanchard Research Award in Medical Physics plaque that is on display in the classroom, and a book plate is placed on the front page of the graduate's thesis in recognition of the award.

2016 Daniel Robertson, Ph.D.
2015 John Eley, Ph.D.
2015 Luke Hunter, M.S.
2013 Kevin Casey, M.S.
2012 Richard Castillo, Ph.D.
2011 Brian Taylor, Ph.D.
2010 Malcolm Heard, Ph.D.
2009 Jonas Fontenot, Ph.D.
2008 Stephen Kry, Ph.D.
2007 Jennifer O'Daniel, Ph.D.
2006 Jason Shoales, M.S.
2005 Kent Gifford, Ph.D.
2004 Stephen Kry, M.S.
2003 Jennifer O'Daniel, M.S.
2002 R. Jason Stafford, Ph.D.
2001 Brent Parker, M.S.
2000 Steven McCullough, Ph.D.
1999 Teresa Fischer, M.S.

2017 Recipient
Justin Mikell, Ph.D.

Mikell received this award in recognition of his Ph.D. dissertation, *Voxel-level absorbed dose calculations with a deterministic grid-based Boltzmann solver for nuclear medicine and the clinical value of voxel-level calculations*.

His research with Cheenu Kappadath, Ph.D., focused on the characterization and implementation of a new voxel-level radiation transport model (Grid-based Boltzmann Solution) for radiation dosimetry in Nuclear Medicine. A systematic evaluation of various dosimetry models as it applied to 90Y-microsphere Selective Internal Radiation Therapy (90Y-SIRT) was also undertaken.

FERRONE ATTENDS EXCLUSIVE NASA SPACE RADIATION SUMMER SCHOOL

Kristine Ferrone, doctoral student in our Medical Physics Program, was selected to participate in the highly competitive 2017 NASA Space Radiation Research Summer School (NSRSS). Only 16 among the hundreds of applicants were selected to attend. The three-week course is fully-funded and was held May 30 – June 23, 2017.

The curriculum is aligned with her dissertation topic, *Active Shielding Using Magnetic Fields to Reduce Absorbed Dose to Astronauts on an Interplanetary Mission*. Ferrone's co-advisors are Charles Willis, Ph.D., in Imaging Physics and Stephen Kry, Ph.D., in Radiation Physics.

From the NASA website:
The NASA Space Radiation Summer School ("NSRSS") at the U.S. Department of Energy's Brookhaven National Laboratory in Upton, New York, is designed to provide a "pipeline" of researchers to tackle the challenges of radiation exposure to humans who will travel on space exploration missions. Co-sponsored by NASA's Space Radiation Research Program, Brookhaven National Laboratory, and the Translational Research Institute, the course has been offered each summer for more than a decade through an open, competitive application process.

SANDERS CONDUCTS RESEARCH IN ELITE SUMMER INTERNSHIP

Jeremiah Sanders, doctoral student in our Medical Physics Program, was selected to participate in the highly competitive summer internship with the Air Force Research Laboratory (AFRL) Maui Optical and Supercomputing Site in Maui, Hawaii. The internship is fully funded to include a research stipend, housing, travel, and food for the duration of the summer (May 22 – August 12, 2017).

Sanders will support machine learning applications to space situation awareness. His project is to develop an unsupervised machine learning algorithm to detect satellites in resolution-limited deep space images acquired with the Department of Defense's largest optical telescope. The algorithm will be developed to run on some of the largest supercomputers in the world.

During his past internships with the AFRL, Sanders co-invented a large aperture, deployable spacecraft antenna for space-based imaging, communications, and moving target tracking, as well as co-authored a research paper and authored three technical memorandums. He was also involved with experimentally investigating the effects of high power electromagnetic pulses (EMPs) on the operational states of electronic devices. The research experience and skills he is learning are expected to substantially enhance the success of his Ph.D. project on establishing MRI-based post-implant dosimetry in prostate cancer brachytherapy. Jingfei Ma, Ph.D., is Sanders medical physics mentor.

Photoacoustic-based sO_2 assessment of femoral bone marrow in a murine model of leukemia

Cayla Wood[1,2], Karine Harutyunyan[3], Jorge Delacerda[1], Caterina Kaffes[1], Niki Zacharlas Millward[4], Sriram Shanmugavelandy[4], Marina Konopleva[2,3], Richard Bouchard[1,2]

[1] Department of Imaging Physics, The University of Texas MD Anderson Cancer Center
[2] Graduate School of Biomedical Sciences, The University of Texas MD Anderson Cancer Center UTHealth
[3] Department of Leukemia, The University of Texas MD Anderson Cancer Center
[4] Department of Cancer Systems Imaging, The University of Texas MD Anderson Cancer Center

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Introduction

It has been widely reported that leukemia interacts with the bone marrow environment, which leads to an expansion of hypoxic niches and the stabilization of hypoxia-inducible factor 1 alpha (HIF-1α)[1]. This stabilization, in turn, leads the leukemic cells to have increased survival and growth as well as elevated resistance to chemotherapy. The leukemic cells infiltrate throughout the body, including in the bone marrow of long bones and the skull.

In previous studies, hypoxia in leukemic mice has been observed in *ex vivo* tissue with the chemical hypoxia probe pimonidazole, as well as *in vivo* in the skull using multiphoton intravital microscopy to probe carbonic anhydrase IX (CAIX), a direct HIF-1α target[2]. However, this method requires a window to image *in vivo*, which is not only invasive but also perturbs the system and may not accurately observe normal conditions. As such, it is necessary to establish an *in vivo* imaging technique that can not only probe the oxygenation status, but is also non-invasive, can image the system *in situ*, and does not require an exogenous biomarker. Spectroscopic photoacoustic (PA) imaging-based estimation of blood oxygen saturation (SO_2)[3] can be used as a biomarker for tissue hypoxia. In this study, we investigate the longitudinal repeatability of PA-based SO_2 estimates in the femoral bone marrow of a murine model of leukemia.

Methods

C57ALB mice were injected with p190-BCR/ABL ALL cells, while control mice were not injected. Engraftment of cells expressing luciferase was confirmed with BLI (Fig. 2). Axial PA images were obtained in three-day intervals at six wavelengths through the full femoral extent to allow for linear unmixing of the oxy- and deoxy-hemoglobin (HbO_2, HHb) signals using the inVision 256-TF (iThera Medical) PA small-animal imaging system (Fig. 1A). Regions of interest (ROIs) were manually applied to the images over the blood-laden area of the bone marrow, as identified by PA-based HbO_2 signatures (Fig. 1B). Mean and standard deviation of SO_2 in each axial slice were then compared to different femoral locations and time-points to assess the spatial and temporal stability of the imaging technique. A matched CT scan of murine hind limbs was co-registered with 800-nm PA volumetric data to confirm that the PA signature co-located with the bone marrow cavity (Fig.1C,D).

Results

The mean and standard deviation of the mean in each ROI were calculated to determine the overall mean SO_2 in the femur. In control mice, the mean PA-based SO_2 estimate was 53.5% with a standard deviation of 2.1% over the four time-points. In the leukemic mice, the mean SO_2 signal was 56.0% initially; however, it dropped to 41.2% after two weeks, indicating that the SO_2 in the bone marrow cavity is affected by the disease progression of leukemia. This decrease in mean SO_2 is considered statistically significant (α=0.05) between each consecutive day, as shown in Table 1. Additionally, the mean and standard deviation of the standard deviations were calculated to determine the variation within each ROI. The standard deviation in SO_2 of leukemic mice increased from 1.6% on day 0 to 6.6% on day 14, indicating that the SO_2 also becomes less uniform as the disease progresses.

Table 1. Numbers in parenthesis indicate the difference between the previous and current values. * indicates statistical significance with p<0.01.

	Control		Leukemic	
Day	Mean [%]	ROI SD [%]	Mean [%]	ROI SD [%]
0	52.1 ± 1.0	1.9 ± 0.6	56.0 ± 1.6	2.1 ± 0.5
6/4	54.0 ± 1.8 (Δ1.9*)	2.9 ± 1.7 (Δ1.0)	50.3 ± 2.1 (Δ5.7*)	2.6 ± 0.9 (Δ0.5)
9/11	54.0 ± 2.4 (Δ0)	2.4 ± 0.9 (Δ0.5)	49.3 ± 4.2 (Δ1.0*)	4.8 ± 2.1 (Δ2.2*)
12/14	53.7 ± 3.2 (Δ0.3)	2.2 ± 0.6 (Δ0.2)	41.2 ± 6.6 (Δ8.1*)	6.7 ± 1.5 (Δ1.9*)

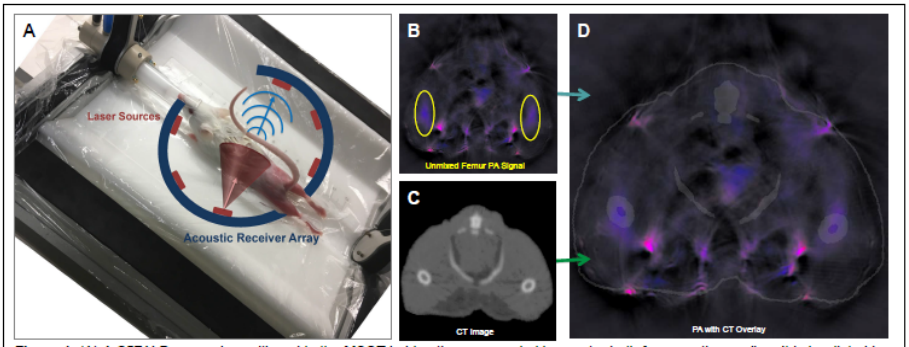


Figure 1. (A) A C57ALB mouse is positioned in the MSOT holder, then suspended in a water bath for acoustic coupling. It is irradiated by multiple laser bundles simultaneously, then the PA signal is collected by an acoustic receiver arc array. (B) PA unmixed and (C) corresponding CT images of the mouse were acquired sequentially to verify that the observed PA signal originated in the bone marrow of the femur. (D) Shows the PA and CT images co-registered, demonstrating that the signal originated in the bone marrow of the femur.

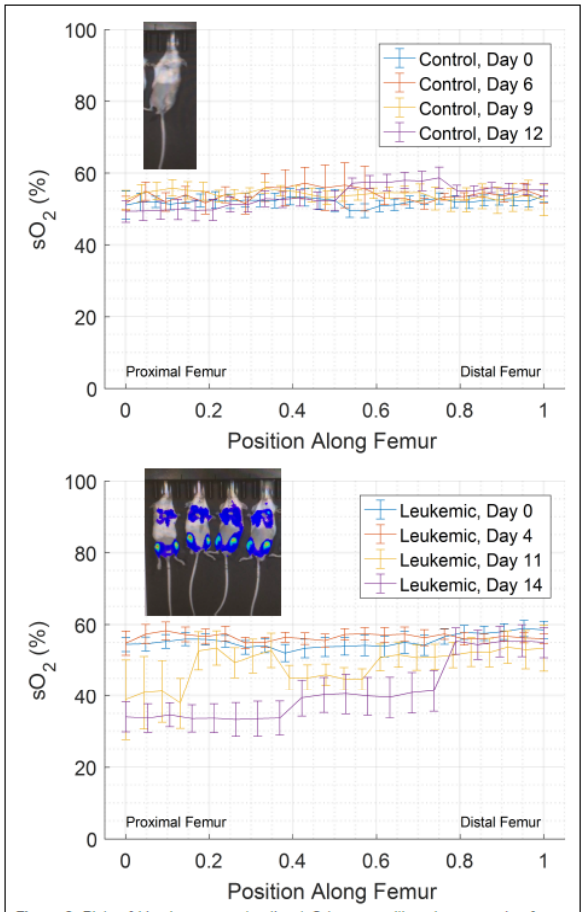


Figure 2. Plots of blood oxygen saturation (sO_2) over position along a murine femur, from the proximal end to the distal end. (A) sO_2 at different time points for a control mouse; (B) sO_2 at different time points for a leukemic mouse. The leukemic mouse starts at a comparable baseline to the control mouse, but as the disease progresses, the variation in sO_2 increases along the length of the femur. Bioluminescence images are included to show engraftment of the leukemic cells in the femoral bone marrow.

Conclusions

The initial results of this study indicate that there may be a correlation between changes in SO_2 and disease progression of leukemia. In future studies, we will compare the terminal time point in the SO_2 measurement to ex vivo measurements of femoral bone marrow with pimonidazole to determine a relationship between SO_2 changes in the blood and hypoxia levels in the tissue.

References

1. Konopleva et al. *Molecular Targets and Cancer Therapeutics*. 2015; 14:12.
2. Harutyunyan et al. *Blood*. 2014; 124:2396.
3. Bouchard et al. *IEEE transactions on ultrasonics, ferroelectrics, and frequency control*. 2014; 61:450-466.

1st Place Winner

Cayla Wood

Ph.D. Program

Mentor: Richard Bouchard, Ph.D.

2017 Diagnostic Imaging Trainee Research Symposium

May 25, 2017

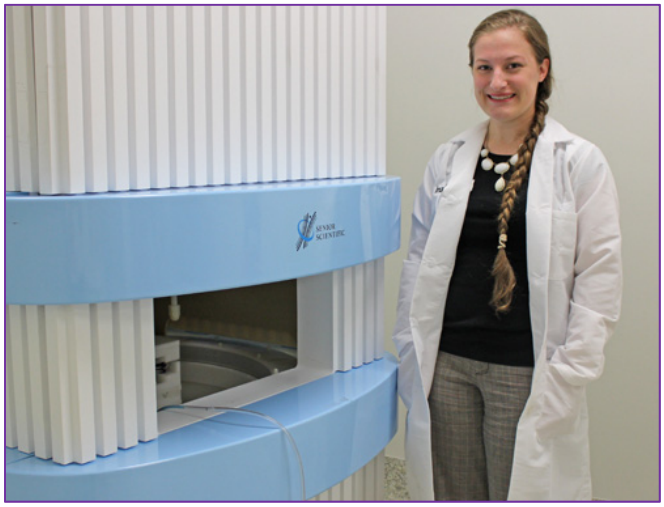
This annual event offers the opportunity for faculty and trainees to engage and learn about the research that other groups are working on within the Division of Diagnostic Imaging and may lead to potential future collaborations.

2017 Student Spotlight

A year of extraordinary recognition of 4th year Ph.D. student, Sara Thrower.

Sara Thrower

Mentor: John Hazle, Ph.D.



F31 Fellowship

Thrower was awarded a National Cancer Institute Ruth L. Kirschstein National Research Service Award (NRSA) Individual Predoctoral Fellowship. This award, targeted to talented doctoral candidates training in cancer related fields, will support Thrower's stipend and tuition for the remaining two years of her pre-doctoral education.

> ***Title:*** *A sparse reconstruction algorithm for superparamagnetic relaxometry.*
>
> ***Goal:*** *The overall goal of this project is to develop an algorithm to reconstruct the distribution of bound nanoparticle sources for superparamagnetic relaxometry.*

GSBS Biomedical Science Scholarship

Additionally, Thrower was awarded this year's George M. Stancel, Ph.D. Fellowship in the Biomedical Sciences. This award was established in 2011 to honor longtime GSBS Dean George Stancel, Ph.D. It recognizes a GSBS doctoral student who has attained candidacy within the past year, is making exceptional progress and demonstrating potential as a creative and independent scientist. The research focus of the award this year was medical physics.

Early Career Award

At the Winter Institute of Medical Physics in Breckenridge, Colorado, Thrower received the Early Career Medical Physicist Scholarship Award. The award covered most of her travel expenses and included $1,000 cash from Varian Medical Systems, a developer of hardware and software technology for radiation treatments.

The award was given to six graduate students and residents. "Sara is nothing short of amazing" stated Marc Kessler, Ph.D., director of the Winter Institute of Medical Physics. She was nominated for the award by Kristy Brock, Ph.D., professor of Imaging Physics.

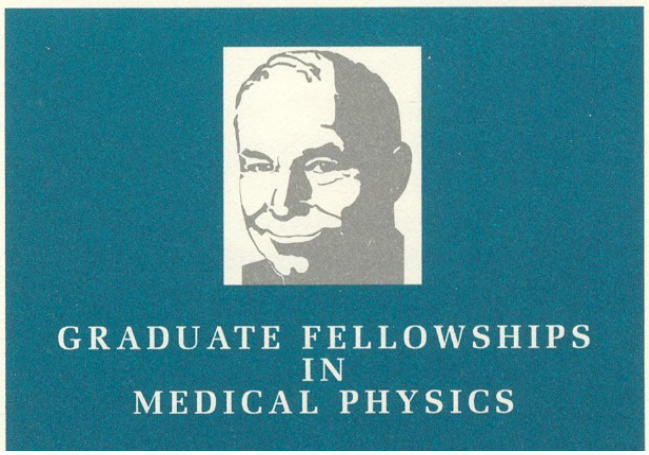
Thrower's research efforts are with the Magnetic Relaxometry Research Laboratory where John Hazle, Ph.D., and Robert Bast, M.D., are implementing a novel technology for early cancer detection – initially focusing on the early detection of ovarian cancer.

The MagSense™ device, developed by Senior Scientific, LLC, performs magnetic relaxometry using an array of ultra-sensitive Superconducting Quantum Interference Devices (SQUIDs) to detect cancer cell-bound superparamagnetic iron oxide nanoparticles by leveraging the difference in relaxation properties of tumor-bound nanoparticles from those with unrestricted motion, such as those in the vascular or extracellular spaces.

Thrower's dissertation research specifically focuses on the development of a sparse reconstruction algorithm to localize and quantify the bound particles from the magnetic field values measured by the MagSense™ system. She's working with David Fuentes, Ph.D., and Hazle on this aspect of the project. MD Anderson is the first research institution to have the MagSense™ technology, which provides Thrower with a truly pioneering opportunity as a student.

THE 2017 50TH ANNIVERSARY FUNDRAISING CAMPAIGN FOR THE ROBERT J. SHALEK FELLOWSHIP

CELEBRATING 50 YEARS OF EDUCATING MEDICAL PHYSICISTS



Last year, our Medical Physics Program celebrated the 50th anniversary of our first award of the M.S. degree to Peter Corey. This year, we celebrate the 50th anniversary of our first award of the Ph.D. degree to Robert Waggener[1] who completed his research under the mentorship of Robert J. Shalek, Ph.D. Waggener served as the twenty-first president of the American Association of Physicists in Medicine (AAPM), being the first of five our graduates to date to serve in that role; the others are Ann E. Wright (1982), Bhudatt R. Paliwall (1996), John D. Hazle (2013), and John E. Bayouth (2014). In the five decades since these first degrees, more than 180 M.S. and 100 Ph.D. degrees have been conferred. As we celebrate the semicentennials of the first medical physics degrees and a half-century of educating medical physicists, this year in particular, we ask you to consider making a generous donation to the Robert J. Shalek Fellowship Fund. Please help us to continue Shalek's legacy of educating and developing future leaders of medical physics.

Many of our graduates have served the AAPM as members of the Board of Directors and other offices both locally and nationally, on committees and task groups, and many have been elected as Fellows. Also of note is that many of our graduates are in the role of chief physicist or department chair at institutions around the world. We've listed AAPM Presidents and Fellows in the table to the right. Please contact us[2] with details of other prominent roles held by our graduates as we are working to compile a complete list for the 2018 newsletter.

AAPM Presidents and Fellows who earned degrees in Medical Physics from The University of Texas MD Anderson UTHealth Graduate School of Biomedical Sciences[3].

Presidents
Robert G. Waggener
Ann E. Wright
Bhudatt R. Paliwall
John D. Hazle
John E. Bayouth
Fellows
Benjamin R. Archer
Peter Balter
John E. Bayouth
James C. H. Chu
Carlos E. de Almeida
Lei Dong
David S. Followill
John D. Hazle
Edward F. Jackson
Tariq A. Mian
Bhudatt R. Paliwal
Almon S. Shiu
R. Jason Stafford
Russell B. Tarver
Robert G. Waggener
Ann E. Wright

[1]Dr. Waggener went on to have a very successful career in imaging physics at The University of Texas Health Science Center at San Antonio and was an active participant in their Medical Physics Graduate Program. More information about Dr. Waggener's life and career can be found in his AAPM history interview: http://www.aapm.org/org/history/InterviewVideo.asp?i=157

[2]Melissa Tovar, Program Manager, Education: mtovar@mdanderson.org

The Robert J. Shalek Fellowship Fund is used specifically for the support of the Medical Physics Educational Programs. Donations to the fund also support the long-term goal of providing continuous funding for the fellowships.

2017
Shannon Hartzell
Brandon Luckett

Robert J. Shalek Fellowship Fund

2016
- Mary Peters

2015
- Brian Anderson
- Laura Bennett
- Benjamin Musall

2014
- Daniela Branco
- Harlee Harrison
- Joseph Weygand

2013
- Mattie McInnis
- Olivia Popnoe

2012
- Ming Jung Hsieh
- Jennifer Sierra Irwin
- Dana Lewis
- Justin Mikell

2011
- Shuaiping Ge
- Annelise Giebeler
- Olivia Huang
- Elizabeth McKenzie
- James Neihart
- Matthew Wait

2010
- Jennelle Bergene
- Kevin Casey
- Jared Ohrt
- Kevin Vredevoogd

2009
- Sarah Joy
- Emily Neubauer
- Paige Summers
- Jackie Tonigan Faught

2008
- Joseph Dick
- James Kerns
- Kelly Kisling
- David Zamora

2007
- Triston Dougall
- Georgi Georgiev
- Ryan Grant Lafratta
- Malcolm Heard
- Katie West

2006
- Maria Bellon
- Jimmy Jones
- Nathan Pung
- Yevgeney Vinogradskiy

2005
- Renee Dickinson
- Susannah Lazar
- Alanna McDermott
- Paige Nitsch

2004
- Michael Bligh
- Ryan Hecox
- Hilary Voss

2003
- Blake Cannon
- Scott Davidson

2002
- Earl Gates
- Kenneth Homann
- Hilary Voss
- Claire Nerbun

2001
- Melinda Chi
- Gary Fisher
- Jackeline Santiago

2000
- Michael Beach

1999
- Laura Butler
- Amanda Davis
- Nicholas Koch
- Jennifer O'Daniel
- Nicholas Zacharopoulos

1998
- Shannon Bragg-Sitton
- Christopher Cherry
- Dee-Ann Radford

1997
- Christopher Baird
- Aaron Blanchard
- Michael Lemacks
- Luke McLemore

1996
- Michael Bieda
- Tamara Duckworth
- Gwendolyn Myron

1995
- Jonathan Dugan
- Teresa Fischer
- Russell Tarver

1994
- Victor Howard
- Usman Qazi
- Donna Reeve
- Steve Thompson
- Matthew Vossler

1993
- Kyle Antes
- Sarah Danielson
- Dena McCowan
- Donna Reeve
- Matthew Vossler

1992
- Peter Balter
- Kay Jones

1991
- John Bayouth
- Robert Praeder
- Twyla Willoughby

1990
- Maria Graves
- John Wallace

1989
- Mike Gazda
- Scott Jones

From 1987 to 2017, 96 Shalek Fellowships have been awarded. In recent years, an average of two Ph.D. students a year have received short-term bridge funding.

The selection of Shalek Fellows is the responsibility of the Medical Physics Program Steering Committee.

DONATION/PLEDGE CARD

ROBERT J. SHALEK FELLOWSHIPS IN MEDICAL PHYSICS
2017 50TH ANNIVERSARY FUNDRAISING CAMPAIGN

NAME _____ **TITLE** _____

ADDRESS _____

_____

EMAIL _____ **TELEPHONE** _____

Total Donation/Pledge: (all contributions are fully tax deductible)

☐ $100 ☐ $200 ☐ $500 ☐ $1000 ☐ $_____

Payment Enclosed _____

Amount Pledged _____ by _____

Does your (or your spouse's) institution/company have a matching gift program?

☐ Yes ☐ No

Would you consider making a legacy donation as part of your estate planning?

☐ Yes ☐ No

If so, may we contact you to discuss?

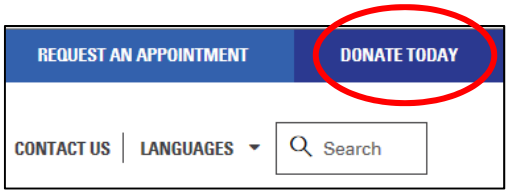
☐ Yes ☐ No

TO DONATE BY CHECK:

Check should be made payable to: Robert J. Shalek Fellowship Fund

Mail all donations/pledges to:
Shalek Fellowships
Attn: Melissa Tovar, Program Manager
Dept. of Imaging Physics – Unit 1472
The University of Texas MD Anderson Cancer Center
1400 Pressler Street
Houston, TX 77030

TO DONATE ONLINE:



1. Go to: http://www.mdanderson.org
2. In the menu bar near the top right hand corner, click on DONATE TODAY
3. Proceed by filling in the online donation form
4. Check the box "I'd like to choose where my donation will go", from the drop down menu, choose Other and enter Robert J. Shalek Fellowship (this annotation is essential to ensuring that your gift is directed as you intend)
5. Please send an email message to mtovar@mdanderson.org to inform the program of your gift so that we can thank you as promptly as possible

THE CAREER OF ROBERT J. SHALEK

In the period between 1950 and 1984, Robert J. Shalek, Ph.D., for whom this fellowship is named, worked at The University of Texas MD Anderson Cancer Center. During that time, the institution grew from small beginnings in temporary buildings to being a leading cancer center with a large campus and over 6,000 employees. During the same period medical physics, which had started in the United States around 1915 but had languished as a profession, took guidance from the well-developed British example and grew into a confident and respected profession. Shalek was shaped by and contributed to these events. Following Leonard Grimmett, Ph.D., and Warren Sinclair, Ph.D., both very experienced medical physicists from England, he led the Physics Department from 1960 to 1984. Under his direction, the department became a major center for research in and teaching of medical physics.

Shalek earned his undergraduate degree in physics from The University of Illinois and his Ph.D. from the Rice Institute (now Rice University). He spent a postdoctoral year at the Royal Cancer Hospital in London, England. He published about 100 scientific papers, served in various editorial capacities, and served as President of the AAPM. He received many prestigious honors, including the William D. Coolidge Award of the American Association of Physicists in Medicine, the Marvin M. D. Williams Professional Achievement Award of the American College of Medical Physics, and the Gold Medal Award of the American Society for Therapeutic Radiology and Oncology.

His career encompassed both basic research and the application of physics to clinical problems. His basic research included studies of oxygen reactions following radiation interactions and the proportion of direct and indirect radiation action in living cells. His clinically-related work included the dosimetry of external treatment beams, brachytherapy dosimetry, and quality assurance in radiotherapy physics.

The Radiological Physics Center (now the Imaging and Radiation Oncology Core Houston) grew out of his interest in quality assurance. This program, after more than four decades, continues to make important contributions to interinstitutional clinical trials and to contribute to the implementation of quality and safety standards in the broader radiological community. Many people have participated in the program and many more have been affected by it. The contributions that Shalek made to the Radiological Physics Center have been his most enduring work.

Anticipating the end of his institutional career, he studied law at night school, lectured regularly on legal questions in medical physics and regularly gave professional legal advice to physicists. He also participated in medical malpractice suits, usually as an expert witness.

Teaching and dissemination of knowledge and skills to the community have been an important activity of the physicists at The University of Texas MD Anderson Cancer Center. As a member of the faculty of The University of Texas Graduate School of Biomedical Sciences[3], Shalek lectured to and supervised a large number of graduate students. He directed the M.S. in Medical Physics Program for 25 years and always demonstrated a sincere sense of responsibility for our students and derived particular satisfaction in observing former students perform to high scientific and professional standards.

His death on April 20, 2015, was a great loss to the medical physics community. We were saddened in May of this year by the death of his wife, Mrs. Elaine Shalek, and thank the family for their request that memorial gifts be made to the Shalek Fellowship Fund.

ROBERT J. SHALEK GRADUATE FELLOWSHIPS IN MEDICAL PHYSICS

In 1987, shortly following the retirement of Robert J. Shalek, Ph.D., as Chairman of the Department of Radiation Physics at The University of Texas MD Anderson Cancer Center and Director of the M.S. in Medical Physics Program in The University of Texas Graduate School of Biomedical Sciences, the Department of Radiation Physics established graduate fellowships in medical physics in honor of Shalek.

The selection of Shalek Fellows is the responsibility of the Medical Physics Program Steering Committee. From 1987 to 2017, the Shalek Fellowships have supported 98 graduate students. All gifts to the Robert J. Shalek Fellowship Fund will be used specifically for the support of the Medical Physics Educational Programs, and will be used in conjunction with other funds to support current fellowships.

GRADUATE STUDIES IN MEDICAL PHYSICS AT THE UNIVERSITY OF TEXAS MD ANDERSON UTHEALTH GRADUATE SCHOOL OF BIOMEDICAL SCIENCES[3]

The M.S. in Medical Physics Program was first accredited by the Commission on Accreditation of Medical Physics Education Programs (CAMPEP) in 1989. It has a clinical focus that prepares the student for a professional career in a clinical environment, a clinical support research laboratory, or a clinical support industry. The program's curriculum educates the student in the areas of therapy, imaging, and safety as related to both ionizing and non-ionizing radiation.

The Ph.D. in Medical Physics Program has been CAMPEP-accredited since 1997. It has a scholarly focus that prepares the student for an academic and/or research career in medical physics with a clinical component. In addition to the requirements of the M.S. program, the Ph.D. program requires a course in fundamental biological principles of molecular imaging and therapy, additional elective course work, research tutorials, and the research dissertation.

Both programs prepare the student for entry into a Medical Physics Residency Program and certification by the American Board of Radiology, the American Board of Science in Nuclear Medicine, or the American Board of Medical Physics, and they meet the educational requirement of licensure to practice medical physics in the State of Texas.

[3]The University of Texas Health Science Center Houston Graduate School of Biomedical Sciences has renamed itself to raise the visibility of the school by tying it explicitly to the reputations of our two parent institutions, UT MD Anderson Cancer Center and the UT Health Science Center at Houston.

Course Spotlight

GS02 1053
Radiation Detection, Instrumentation & Data Analysis

Course Coordinator: Stephen Kry, Ph.D.

This course reviews the theory and practical application of radiation dosimetry and radiation dosimeters. Detectors including ion chambers, luminescent dosimeters, diodes, film, NaI/HPGe, and Bonner sphere systems are introduced, providing a framework for dosimetry of x-rays, electrons and neutrons.

Emphasis is placed on selection of the right dosimeter for the right application based on an understanding of how the dosimeter works in the context of specific medical physics applications.

Under the instruction of Bill Erwin, M.S., Sr. Medical Physicist, students in this course are connecting electronic components (right) and observing signals on an oscilloscope (left) during the NaI spectroscopy lab.

I enjoyed the radiation detection course because the hands-on labs allowed us to work with the detectors and make measurements that demonstrated the underlying physics principles we were learning about in class. Radiation detectors are vital to performing quality and safety assurance, and I think this course prepared me well to understand which detectors to use for specific measurements and their limitations.

Garrett Baltz, S.M.S. Student

The radiation detection course provided me with an opportunity to learn about radiation detection practices and the different radiation detectors used in medical physics. Learning about the different types of detectors, how they operate, differences in technology, and why certain detectors are suited for specific applications has already proved useful in my medical physics career. I expect that to continue, even as technology and detection practices change.

This course included a detailed overview of the instrumentation and data analysis used in radiation detection. The concepts I learned in class were strengthened by time spent in the laboratory where we gained hands-on learning experience and time spent with experts in the field.

Together, the lessons taught in this class provided me with the confidence needed to make decisions concerning radiation detection, instrumentation, safety, and technology - all of which are essential in medical physics!

Emily Thompson, Ph.D. Student

2017

OUTSTANDING

TEACHING AWARD

Recognizing a faculty member whose commitment to education has enriched students' experiences in the Medical Physics Graduate Program.

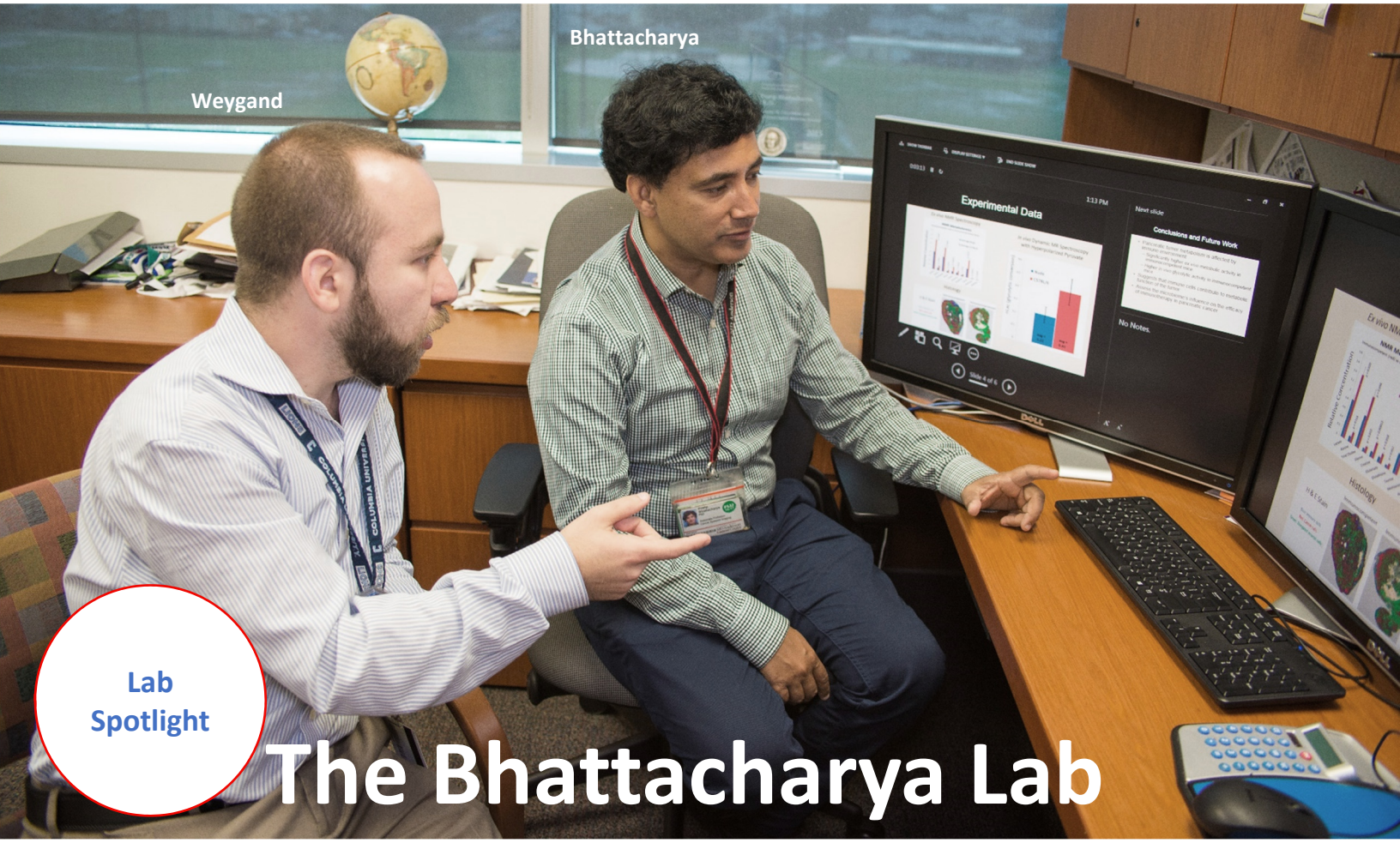
Donna Reeve, M.S.

Senior Medical Physicist

Department of Imaging Physics
MD Anderson Cancer Center

Program Faculty
Medical Physics Program
MD Anderson UTHealth Graduate School

The students of the Medical Physics Graduate Program thank Donna for her efforts in promoting exceptional learning and setting an academic example to the students and other faculty members alike.



Lab Spotlight

The Bhattacharya Lab

Pratip Bhattacharya, Ph.D., associate professor of Cancer Systems Imaging joined MD Anderson in 2012. He became a Medical Physics Program Faculty Member in December 2015 and currently is the mentor of two Medical Physics Graduate Program students, Travis Salzillo and Joe Weygand.

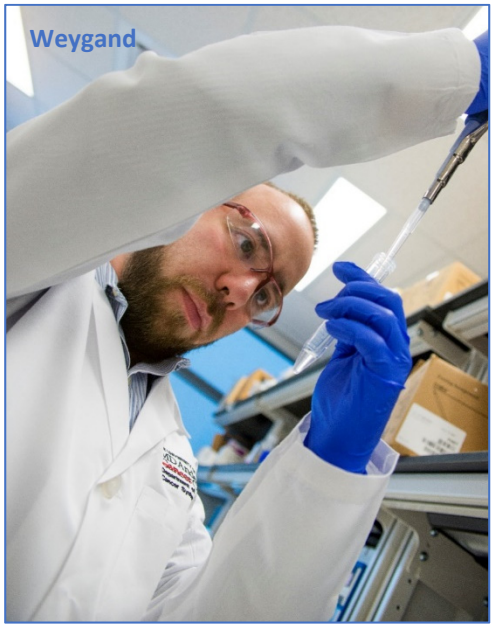
The focus of Bhattacharya's research is the development of real-time metabolic and imaging applications by hyperpolarization. His laboratory is exploring novel ways to utilize Magnetic Resonance Imaging (MRI) to create more detailed metabolic and molecular imaging studies by employing hyperpolarized, non-radioactive carbon-13 and nitrogen-15 labeled compounds and silicon-29 nanoparticles to tag specific metabolic and biochemical structures and functions that are altered in cancer.

The Bhattacharya laboratory is focused in three primary areas of research:

- Real time metabolic imaging with hyperpolarized ^{13}C and ^{15}N labeled non-radioactive compounds.
- Real-time molecular imaging with hyperpolarized silicon nanoparticle (SiNPs) functionalized to target specific biological functions and structure.
- High resolution MR-based metabolomics of animal and human tissues.

Magnetic Resonance Imaging (MRI) is a technique utilized in the clinic every day. In conventional MR, anatomical images are produced by using the signal from the water in our blood and tissues for detection. However, due to the inherent Boltzmann Distribution, there is a low signal to noise ratio (SNR) in conventional MR and many diagnostic techniques become unreasonable in the clinic because of the amount of time needed for the examination.

Hyperpolarized MR is a non-toxic, non-radioactive method for non-invasively assessing tissue metabolism and other physiologic properties. Hyperpolarization allows for a >10,000-fold signal enhancement relative to conventional MRI. After hyperpolarization, the signal enhancement can be retained on the metabolites of the hyperpolarized molecules for several minutes depending upon the longitudinal relaxation times.



"The best thing about having Pratip as my mentor is that he is very supportive and clearly cares about my career development."

Joe Weygand's project, *Identifying the Immune Related Metabolic Properties of Pancreatic Cancer Using Nuclear Magnetic Resonance Spectroscopy and Dynamic Magnetic Resonance Spectroscopic Imaging with Hyperpolarized Pyruvate*, aims to use MR-based approaches to interrogate the metabolism of pancreatic tumors and how the immune environment in which a pancreatic tumor is harvested affects this.

"One of the best qualities of Pratip as an advisor is that he always focuses on the well-being of all of the members in his lab. He promotes our success, rather than his own, at every available opportunity. I feel very fortunate to have ended up in his lab."

Travis Salzillo's project, *Non-invasive and real-time assessment of glioblastoma tumor aggressiveness through hyperpolarized magnetic resonance imaging,* aims to improve the diagnosis of glioblastoma through the early detection of metabolic transformations during tumor development with novel imaging techniques.

Bhattacharya's Research Team

From left to right
Back row: Pratip Bhattacharya, Ph.D., associate professor; Sriram Shanmugavelandy, research assistant; Jaehyuk Lee, Ph.D., research scientist; Prasanta Dutta, Ph.D., research scientist; Nicholas Whiting, Ph.D., research scientist; Jingzhe Hu, graduate student, Bioengineering at Rice University.
Front row: Travis Salzillo, medical physics graduate student; Caitlin McGowen, graduate student, Electrical Engineering at Rice University; Shivanand Pudakalakatti, Ph.D., postdoctoral fellow; Joseph Weygand, medical physics graduate student; Niki Zacharias Millward, Ph.D., assistant professor.

Julianne M. Pollard-Larkin, Ph.D.

Faculty Spotlight

Assistant Professor
Department of Radiation Physics
Division of Radiation Oncology

- Ph.D., Biomedical Physics
  University of California, Los Angeles
- M.S., Biomedical Physics
  University of California, Los Angeles
- B.S., Physics & Mathematics
  University of Miami

Clinical Residency, Medical Physics
University of Texas MD Anderson Cancer Center

Board Certification
American Board of Radiology

How do you describe your role to non-medical physicists?

When I am explaining my role to the general public, I explain that I help assist physicians with safely and effectively delivering radiation therapy to cancer patients. I also mention medical physicists' role in radiation safety and evaluating the quality of our radiation producing equipment/linear accelerators.

What's a typical workday like for you?

Treating thoracic stereotactic body radiotherapy cases from 7:30 a.m. until 1 – 2 p.m., teaching a graduate level medical physics course from 2 – 3 p.m., checking patient treatment plans from 3 – 5 p.m. and handling any other clinical issues that needs physics input from 5 – 6 p.m.

How does your role fit into the bigger health care picture?

Our role in Radiation Oncology is one of the foundational blocks to help offer cure to 70% of cancer patients. Without clinical medical physicists doing our role, oncology would suffer greatly.

Who do you interact with during the course of the day?

I interact with everyone each day. I assist patients, physicians, nurses, dosimetrists, radiation therapists, engineers, students from our graduate program, fellow physicists and even the family and friends of the patients who ask questions before and after their loved one's treatment.

Why did you become a medical physicist?

Because I met a medical physicist when my mom was being treated for breast cancer.

What do you like about your work?

I like the satisfaction of working for a cause much larger than myself. I work here because I believe in ***Making Cancer History***®.

New Program Faculty
Steven Millward, Ph.D.
Oleg Vassiliev, Ph.D.
Shouhao Zhou, Ph.D.

New Program Associates
Mary Farach-Carson, Ph.D.
Fada Guan, Ph.D.
Dennis Mackin, Ph.D.
Paige Nitsch, M.S.
Aradhana Venkatesan, M.D.

Why did you become a medical physicist?

My first career was in geophysics, where physics is used to image the earth and map geologic structures. I had always been interested in medicine. So, when I first learned about the field of medical physics I knew that I wanted to work in this profession where physics principles are applied to medical imaging.

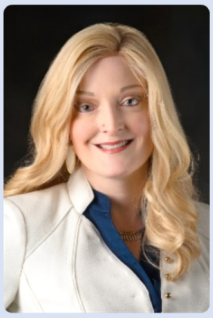
Donna Reeve, M.S., Imaging Physics

How do you describe your role to non-medical physicists?

I specialize in therapeutic radiation physics. A radiation physicist ensures that a patient's radiation treatment plan is delivered accurately, that each "faction" or dose is delivered to the patient consistently, that each plan optimizes treatment of the cancer with the fewest possible side effects, and that the plan is delivered in the safest manner possible to both the patient and the staff. The radiation physicist achieves these aims with a rigorous quality assurance program that includes monitoring and adjusting equipment performance, development and translation of new radiotherapy technology into the clinic, supervision of treatment planning simulation, planning, and delivery, and safety prospectively in the form of radiation shielding and education of the staff and retrospectively in the form of personnel dosimetry.

Adam Melancon, Ph.D., Radiation Physics – Patient Care

What do you like most about your work?



I love so many things about my career in medical physics and my work at MD Anderson. If I had to pick a single favorite, I'd say that what I love the most is that I get to do many different things, sometimes within the same day. I'll mention just a few…..

I am part of the breast clinical service and while I am only in the clinic a few days per week, it is rewarding to be part of the care of individual women with breast cancer. I find each patients' case to have unique aspects, which makes me feel challenged and engaged in my clinical work.

I am also fortunate to work within Outreach Physics and lead the Radiation Dosimetry Service (RDS), which provides independent peer review verification of radiation beam outputs for 2000 institutions in the United States and 150 institutions in other countries. Most of the time the checks are well within criteria, but on occasion, the RDS output checks identify real calibration issues or equipment malfunctions. Knowledge of output issues leads to investigation, correction, and ultimately reduction of treatment errors in radiation therapy.

I also lead the Late Effects Research Group, which participates in radiation epidemiology studies having hundreds to thousands of participants. Our team provides retrospective dose reconstructions to estimate the dose to specific organ or body regions for individual patients in those studies. Those data are correlated with late adverse outcomes to establish temporal trends with treatment over time as well as dose response models. This research is both incredibly interesting and I believe important to cancer survivors.

Last, and of great personal significance to me is my role within our graduate program. I have the opportunity to work with our amazing students. It is extremely fulfilling to work with our students and see them develop clinical and research skills and ultimately go on to success in their careers.

Rebecca Howell, Ph.D., Radiation Physics

Melinda Chi, Ph.D.

Alumni Spotlight

Assistant Professor
Department of Radiation Physics
Division of Radiation Oncology
MD Anderson Cancer Center

Associate Member
MD Anderson UTHealth Graduate School

What led you to decide to enroll in the Medical Physics Graduate Program?

My undergraduate degree was in a medical and health physics program. After graduating, I worked as a physics assistant at a cancer center in Ontario, Canada. The assistant job allowed me to work with medical physicists for two years. I enjoyed the aspect of problem solving in medical physics, and wanted more responsibilities than what a physics assistant was allowed to do. So, it was time to go back to school.

What were your thesis and dissertation titles and topics?

My M.S. thesis, *A three dimensional pencil-beam redefinition algorithm for electron arc therapy,* was in Radiation Therapy under the supervision of Kenneth Hogstrom, Ph.D., I used a previously validated model for electron to further perform dose calculation for electron arc therapy; and also incorporated modeling of skin collimation in the algorithm. The dose calculation accuracy was then validated with measurements in water and film phantoms.

My Ph.D. dissertation, *Thoracic cancer imaging with PET/CT in radiation oncology,* was in Imaging Physics under the supervision of Tinsu Pan, Ph.D., I used averaged CT generated from 4DCT to correct for the PET and CT mis-registration due to respiratory motion, thereby increasing the accuracy in PET SUV measurements. I also quantified the effects this correction may have on tumor delineation in radiation therapy process.

What was the most significant, memorable, or surprising event during the program?

Memorable: working from 9 p.m. to 5 a.m. on machines to collect data.

Significant: very helpful discussions (work related or non-work related) with supervisors and other medical physicists.

How did your mentors help you to achieve your educational and career goals?

I needed a lot of guidance when I was doing my M.S. thesis, and Dr. Hogstrom provided a lot of insight and support in order for me to do science correctly. Dr. Pan, on the other hand, allowed me to take charge of my projects and I was able to build on what I learned previously in my M.S. thesis.

What opportunities or job offers did you have upon graduation and which did you select?

I wanted to stay in Houston and have a solid training in the clinic, so I chose to stay for the radiation physics residency program. I didn't look elsewhere.

What three words best describe your experience in the Medical Physics Graduate Program.

Very intellectually rewarding.

2017 President's Recognition for FACULTY EXCELLENCE

Each division nominated one faculty member for each category below. Four of the seven honors were awarded to our program faculty.

Clinical Quality Improvement
Research Excellence
Prevention Outreach
Education & Mentorship
OneConnect Leadership
Financial Stewardship
Network Development

Clinical Quality Improvement
Peter Balter, Ph.D.
Radiation Physics

Education & Mentorship
Rebecca Howell, Ph.D.
Radiation Physics

Financial Stewardship
Osama Mawlawi, Ph.D.
Imaging Physics

Research Excellence
Steven Millward, Ph.D.
Cancer Systems Imaging

Paying Tribute

to George Starkschall, Ph.D., FAAPM, FACR, on His Last Year in the Program

"For three decades, George has been the consistent, reliable core of the graduate program. Through his work as teacher, advisor, leader, mentor and innovator, both students and faculty members have benefitted from his deep knowledge and wise counsel. The program and medical physics education more broadly will continue to reflect his indelible influence for years to come." *Bud Wendt*

Selected Highlights from a Distinguished Career

B.S., Chemical Physics, MA Institute of Technology — '67
M.A., Chemistry, Harvard University — '68
Ph.D., Chemical Physics, Harvard University — '72
Completed Postdoctoral Fellowship, The James Franck Institute — '74
ABR Certified, Therapeutic Radiological Physics — '77
Appointed Assistant Professor, MD Anderson — '85
ABMP Certified, Radiation Oncology Physics — '90
Promoted Associate Professor, MD Anderson — '91
Promoted Professor, MD Anderson — '01
Physics in Medicine & Biology Citations Prize — '08
Editor-in-Chief, Journal of Applied Clinical Medical Physics, 5 Years — '08
MD Anderson Distinguished Service Award — '10
Director, AAPM, 6 Years — '10
Retires as Full-Time Faculty, Radiation Physics — '10
Returns as Part-Time Faculty, Imaging Physics — '10
Chair, AAPM Education Council, 3 Years — '10
148 Research Contributions to Making Cancer History® — '11
Chair, AAPM Education Council, 5 Years — '11
Executive Secretary, CAMPEP, to Present — '11
Medical Physics Program Outstanding Teaching Award — '13
Edith H. Quimby Lifetime Achievement Award — '13
GSBS Commended Course Recognition — '14
Retires, MD Anderson Cancer Center — '18

Q & A with Dr. Starkschall

What did you enjoy most about your participation in the Medical Physics Graduate Program?

Working with an outstanding group of students, all of whom were eager to learn.

What did you find most challenging?

Changing my teaching style from conventional lecturing to use of "Peer Instruction" after I took over responsibility for the Introduction to Medical Physics I course.

Let me explain what I mean:

For many years, my teaching style was what I learned by copying some of my more effective instructors while I was in grad school. It consisted of presenting information to the students via a formal lecture, and providing them with homework assignments that would elaborate on the subject material. During the lecture, I would present new information to the students either on the whiteboard or via PowerPoint slides, and they would dutifully write down everything I presented. Information traveled from my notebook to their notebooks, without necessarily passing through the brain of either.

I realized that this was a very inefficient way to present information. If a student didn't quite understand a point I was making or fell asleep during my lecture, they were often hesitant to ask for clarification, and, in all likelihood, failed to understand the concept I was trying to present. Moreover, conveying information on Monday and Wednesday afternoons from 2:30 to 3:30 p.m. in the Radiation Physics Classroom may not have been the most conducive way for the student to learn the information.

In 2008, after the Houston AAPM Meeting, I attended an AAPM-sponsored workshop on the teaching of medical physics. One of the presentations addressed the methodology of Peer Instruction, developed by a Harvard physics professor. Using Peer Instruction, students prepare for class by reading appropriate materials or listening to a recorded lecture. In class, the instructor presents the students with a multiple-choice question that tests their understanding of a particular concept. Students respond to the question in a way that only the instructor sees their answers. If all the students answer correctly, it can be assumed they understand the concept, and after a brief discussion, the instructor moves on to the next concept. More likely than not some students understand the concept and get the right answer, while others guess the wrong answer.

When that occurs, the instructor asks the students to gather into small groups (4-6 students) and each student is charged with convincing the other students in the group that their answer is correct. The student who does not understand the material will fail to give a convincing argument, while the student who understands the material can instruct the others on the concept. After several minutes of discussion, the students are once again asked to respond to the question. The second time around, almost all students typically get the right answer. Some discussion of the question ensues, and then the students go onto the next concept.

I recalled having seen a video clip of Peer Instruction previously, and decided that I would adopt this technique to my Med Phys I class. However, I only had about two weeks before the start of class. Fortunately, I had previously recorded all of my lectures, so it was not extremely difficult to recast the teaching of my course into the Peer Instruction format.

What did you find most rewarding?

Finding out that Peer Instruction worked. Student evaluations of the course were very positive and several years later, I received recognition from the GSBS when my course was evaluated and recognized by the graduate school for commendation.

What did you gain from the program?

I have always derived a great deal of satisfaction from working with students, either in the classroom or on a one-on-one basis mentoring their research.

What is your favorite piece of advice to give the students?

Don't be afraid to move out of your comfort zone. That's the way you learn.

What will you miss most when you retire?

Coming in to my office on a regular basis to interact with peers and students.

What are your retirement plans?

When I reduced my appointment from full-time to part-time, I began spending more time in my vacation home in Southwest Colorado and traveling with my wife. Every year, however, I knew I had to return to Houston at the end of August and spend the next few months in residence to teach in the fall semester. Once I am fully retired, I can spend autumn in Colorado and enjoy the fall colors. And, of course, do some more traveling.

The following pages highlight dissertation and thesis abstracts for students who defended July 2016 – May 2017

Daniela Branco, M.S.

Graduated: August 2016

Development and Implementation of an Anthropomorphic Head & Neck Phantom for the Assessment of Proton Therapy Treatment Procedures

Thesis Abstract Reprinted with Permission

Proton therapy has been used to treat cancer for more than 50 years, and over the past decade, its use has grown rapidly. One of the main goals of modern radiation therapy is to deliver a high dose to the planning target volume (PTV) with minimal exposure and damage to the surrounding healthy tissue. Protons offer a unique advantage over photon radiotherapy in that they deposit dose over a finite range, in contrast to the more gradual energy deposition of photon and electron beams. At present, 23 proton centers are in operation in the United States and another 13 centers are in development. The increasing interest in the use of protons creates a demand for quality monitoring and evaluation of the treatments provided, especially as they apply to NCI funded clinical trials. The goal of the Imaging and Radiation Oncology Core (IROC) Houston QA Center is to assure NCI that institutions participating in clinical trials deliver radiation treatment plans/doses that are clinically comparable and consistent. IROC Houston makes use of anthropomorphic QA phantoms in order to help verify the quality of the proton treatment process from imaging to treatment delivery. With new Head and Neck (H&N) proton therapy trials being developed, IROC Houston needs a H&N proton phantom that can be used as part of credentialing. Therefore, the hypothesis of this study is that an anthropomorphic H&N phantom can be designed and built to evaluate proton therapy H&N treatment procedures that can reproducibly (±3%) assure agreement between the measured doses and calculated doses to within ±7%/4mm.

Advisory Committee

David Followill, Ph.D.
(Advisor & Committee Chair)

Michele Guindani, Ph.D.

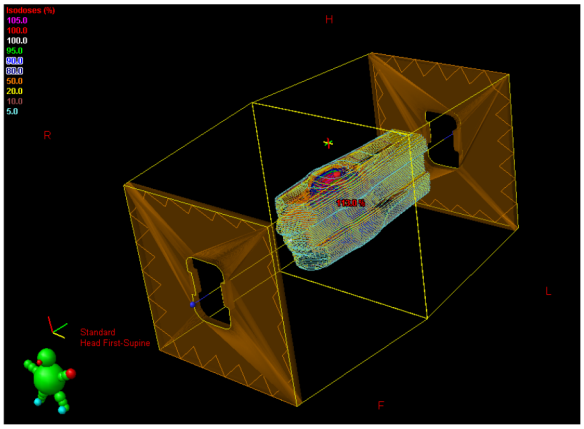
Heng Li, Ph.D.

Paige Taylor, Ph.D.

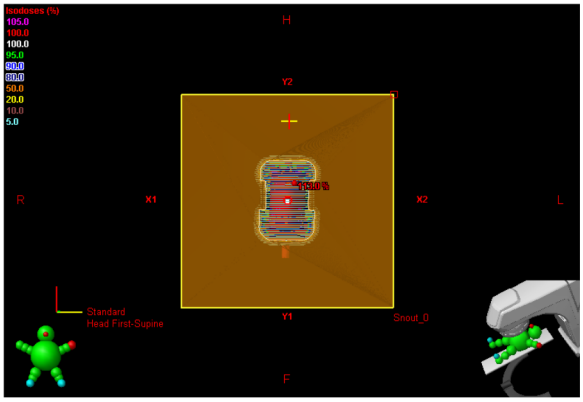
Xiaodong Zhang, Ph.D.

Branco is currently a Ph.D. student in the Medical Physics Graduate Program where she continues her research under the supervision of David Followill, Ph.D.

Her project involves developing a CT image metal artifact reduction technique that can improve dose calculation accuracy for Head and Neck proton therapy.



3D view of the AP PA proton beams through brass blocks.

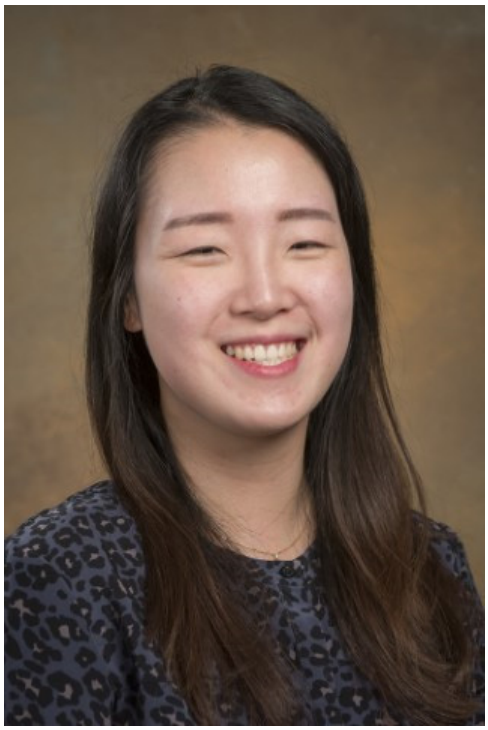


Beam's eye view of the brass block fit to target structure with indentations protecting parotids.

Gye Won "Diane" Choi, M.S.

Graduated: August 2016

Measurement of the Electron Return Effect Using PRESAGE® Dosimeter



Advisory Committee

Geoffrey Ibbott, Ph.D.
(Advisor & Committee Chair)

Laurence Court, Ph.D.

David Followill, Ph.D.

Zhifei Wen, Ph.D.

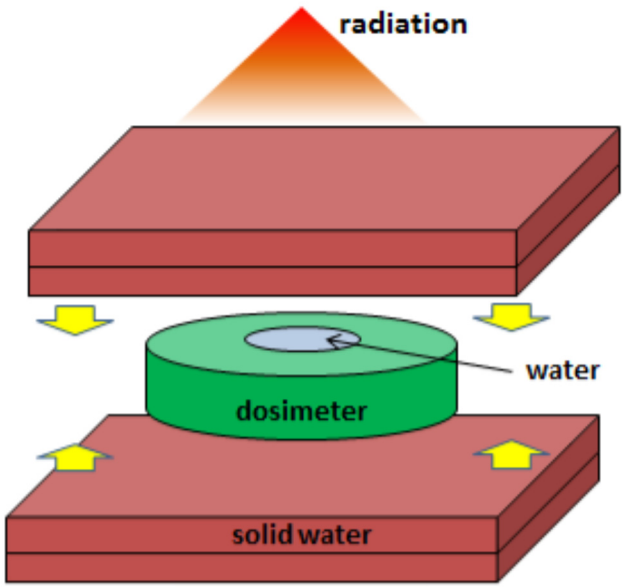
Shouhao Zhou, Ph.D.

Choi is currently a medical physics resident in the Department of Radiation Physics at MD Anderson. She is participating in the routine clinical duties of therapeutic medical physicists under the supervision of board-certified physicists, including her mentor Paige Nitsch, M.S., senior medical physicist. Upon completion of residency, she is looking forward to working as a clinical therapeutic medical physicist.

Thesis Abstract Reprinted with Permission

MR-guided radiation therapy (MRgRT) provides benefits such as superior soft tissue contrast, no imaging dose, and functional imaging capacities, but it also has concerns to be addressed. The electron return effect (ERE) refers to dose enhancement at the interface between different media, caused when radiation is delivered in the magnetic field. The ERE poses clinical concerns in MRgRT because it significantly enhances the dose at interfaces, and the intensity and pattern of the dose enhancement depends on many factors. The ERE results in a complex pattern of dose enhancement over a three-dimensional (3D) volume around tissue interfaces inside the patient body, giving rise to the need for 3D dosimetry. If proven reliable in the magnetic field, 3D dosimetry will provide a more rigorous means for the quality assurance (QA) of MRgRT than two-dimensional dosimetry. The 3D dosimeters can also be used to estimate the volumetric dose distribution in MRgRT treatment of heterogeneous treatment sites (e.g., lung), around simple structures such as the trachea and the esophagus, and in MR-guided brachytherapy.

In this thesis, the performance of PRESAGE® in the magnetic field was evaluated by investigating how well PRESAGE® could measure the ERE. The radiation response of Gafchromic® EBT3 film was shown to be unaffected by the magnetic field in a previous study, and the reliability of EBT3 film measurement in the magnetic field was independently verified in this thesis. As a result, the performance of PRESAGE® was evaluated by comparing against EBT3. Before measuring the volumetric ERE, the in-house made PRESAGE® formulation that was used throughout this thesis was tested for magnetic field effects. The formulation showed ~ 9% under-response when irradiated in the magnetic field, but the response remained strictly linear and thus did not interfere with using PRESAGE® as a relative dosimeter. Finally, it was hypothesized that the measurement of the ERE using PRESAGE® would agree with EBT3 within 5%/3 mm local gamma criteria. The EBT3 and PRESAGE® measurements agreed well with a passing rate over 90%. The hypothesis was proven correct and showed that PRESAGE® is a promising material for the QA of MRgRT.



Schematic showing the setup for the irradiation. A PRESAGE® dosimeter with a cavity filled with water is positioned in between solid water slabs and is irradiated.

Xenia Favè, Ph.D.

Defended: May 2017

Detecting and Evaluating Therapy Induced Changes in Radiomics Features Measured from Non-Small Cell Lung Cancer to Predict Patient Outcomes

Advisory Committee

Laurence E. Court, Ph.D.
(Advisor & Committee Chair)

Peter Balter, Ph.D.

David Followill, Ph.D.

Daniel Gomez, Ph.D.

Aaron Kyle Jones, Ph.D.

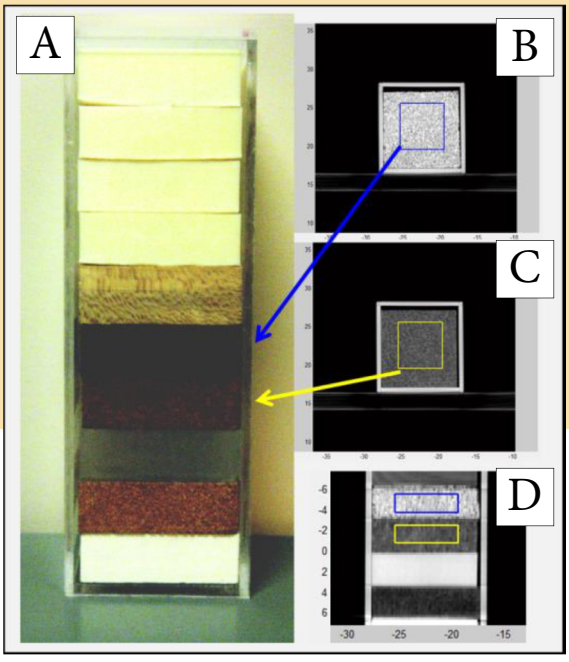
Christine Peterson, Ph.D.

Favè is currently working as a medical physics resident at The University of California San Diego Moores Cancer Center.

Dissertation Abstract Reprinted with Permission

The purpose of this study was to investigate whether radiomics features measured from weekly 4-dimensional computed tomography (4DCT) images of non-small cell lung cancers (NSCLC) change during treatment and if those changes are prognostic for patient outcomes or dependent on treatment modality. Radiomics features are quantitative metrics designed to evaluate tumor heterogeneity from routine medical imaging. Features that are prognostic for patient outcome could be used to monitor tumor response and identify high-risk patients for adaptive treatment. This would be especially valuable for NSCLC due to the high prevalence and mortality of this disease.

A novel process was designed to select feature-specific image preprocessing and remove features that were not robust to differences in CT model or tumor volumes. These features were then measured from weekly 4DCT images. These features were evaluated to determine at which point in treatment they first begin changing if those changes were different for patients treated with protons versus photons. A subset of features demonstrated significant changes by the second or third week of treatment, however changes were never significantly different between patient groups. Delta-radiomics features were defined as relative net changes, linear regression slopes, and end of treatment feature values. Features were then evaluated in univariate and multivariate models for overall survival, distant metastases, and local-regional recurrence. In general, the delta-radiomics features were not more prognostic than models built using clinical factors or features at pre-treatment. However one shape descriptor measured at pre-treatment significantly improved model fit and performance for overall survival and distant metastases. Additionally for local-regional recurrence, the only significant covariate was texture strength measured at the end of treatment. A separate study characterized radiomics feature variability in cone-beam CT images to increased scatter, increased motion, and different scanners. Features were affected by all three parameters and specifically by motion amplitudes greater than 1 cm.



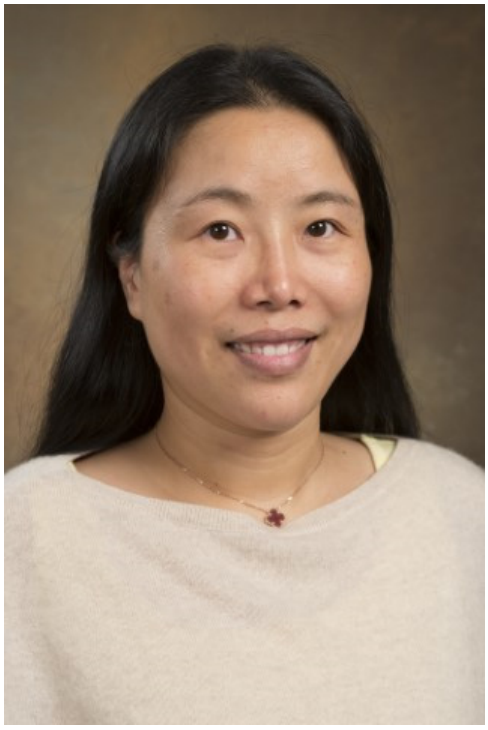
The Credence Cartridge Radiomics Phantom. (A) Photograph of the radiomics phantom used in this study and (B-D) CBCT images of the phantom with the ROIs used. Only the (B) shredded rubber and (C) dense cork cartridges were used for the current analysis.

This study resulted in strong evidence that a set of robust radiomics features change significantly during treatment. While these changes were not prognostic or dependent on treatment modality, future studies may benefit from the methodologies described here to explore delta-radiomics in alternative tumor sites or imaging modalities.

Shuaiping Ge, Ph.D.

Graduated: May 2017

Improvements in Robustness and Optimality of Intensity-Modulated Proton Therapy Plans for Lung Cancer Patients with 4-Dimensional Robust Optimization



Advisory Committee

Radhe Mohan, Ph.D.
(Advisor & Committee Chair)

Steven J. Frank, M.D.

Narayan Sahoo, Ph.D.

Xiaochun Wang, Ph.D.

Jing Wang, Ph.D.

Ge currently works as a junior medical physicist with the Advanced Radiation Physics Service in the Houston area.

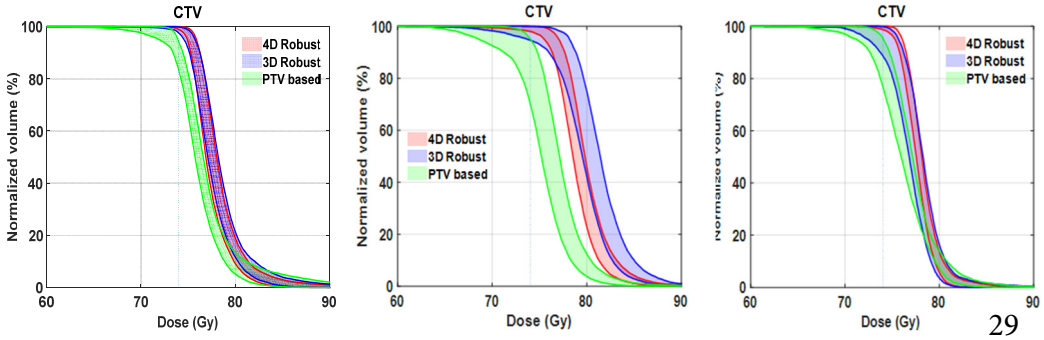
Dissertation Abstract Reprinted with Permission

A major challenge in the application of intensity-modulated proton therapy (IMPT) for lung cancer patients is the mitigation and consideration of uncertainties associated with breathing motion in treatment planning. The primary objective of this research was to develop a novel four-dimensional robust optimization (4DRO) method and find an appropriate optimization strategy to make IMPT dose distributions less sensitive to both respiratory motion as well as to setup and range uncertainties simultaneously.

For full 4DRO, the effect of respiratory motion, characterized by different phases of 4D computed tomography (CT), was incorporated into a 4DRO algorithm. Dose distributions from multiple setup and range uncertainty scenarios were calculated for each of the 10 phases of CT datasets. Dose differences caused by respiratory organ motion and deformation were accounted for by the 4D CT datasets. The 4DRO algorithm optimizes dose distributions to achieve target dose coverage and normal tissue sparing for multiple setup and range uncertainty scenarios and for all 10 respiratory phases simultaneously. IMPT dose distributions of ten lung cancer patients with differing tumor sizes and motion magnitudes were optimized to illustrate and evaluate our method. Compared with treatment plans generated by 3D Robust optimization (3DRO) and the conventional planning target volume (PTV)-based IMPT optimization, plans generated by 4DRO were found to have superior clinical target volume coverage and dose robustness in the face of setup and range uncertainties as well as respiratory motion.

However, contouring GTV on every phase of respiratory process is a very time-consuming process. And 4D dose calculation, especially 4D influence matrix calculation, is time consuming and memory demanding. We also conducted a study to investigate if we can reduce the number of phases to be-included in the 4DRO process without affecting the IMPT plan quality and plan robustness of full 4DRO with all ten phases.

Compared to plans produced by full 4DRO strategies, reducing the phases included in robust optimization process improve computational efficiency, at the same time, decreases target coverage and plan robustness, increases dose heterogeneity and increases normal tissue sparing. But the reduction of target coverage and plan robustness is very small. The plans produced by 4DRO strategy including only two extreme phases, phase T0 and phase T50, achieve very good plan quality and plan robustness for lung cancer patients with tumor motion size less than 10mm. While for lung cancer patients with large tumor motion and diaphragm intruding into proton beam path, 5 phases 4D robust optimization or full 4D robust optimization is necessary.



The diagram shows Dose volume histogram (DVHs) of CTV of treatment plans resulting from 4D robust optimization (red), 3D robust optimization (blue) and PTV-based optimization (green) for patients with different GTV motion size. Plans produced by 4D robust optimization method achieves better CTV coverage and more robust dose distribution compared to other methods.

Harlee Griffin, M.S.

Graduated: August 2016

An Automated Syringe Pump System for Improving the Reproducibility of Dynamic Hyperpolarized MRI Phantoms

Thesis Abstract Reprinted with Permission

Magnetic Resonance Imaging (MRI) is a powerful tool in the diagnosis of cancer due to its ability to provide good soft tissue contrast and image resolution without the use of ionizing radiation. The use of hyperpolarized pyruvate as a contrast agent for tumor metabolism during MR scans has the potential to provide information about tumor metabolism *in vivo* that is not available from traditional imaging measurements or any other method. Hyperpolarization is achieved through dynamic nuclear polarization. This is a process in which a sample is quickly frozen to near absolute zero (~1.4K), and placed in a strong magnetic field. In these conditions, magnetization in unpaired electrons, in this case from a Trityl radical, can convey their polarization to a nearby ^{13}C nucleus through microwave irradiation. Pyruvate, which plays a central role in metabolism, is involved in aerobic glycolysis, a primary energy pathway for cancer cells. In this process, known as the Warburg effect, the up-regulation of lactate dehydrogenase leads to the increased chemical conversion of pyruvate to lactate. Due to the conservation of hyperpolarized ^{13}C-enriched pyruvate's nuclear spin state through chemical conversion, the signal from pyruvate and metabolites such as lactate can be observed. Although the signal is largely increased, this improvement is short lived. The hyperpolarization of pyruvate only lasts for a few minutes and this time is shortened when in the scanner due to excitation losses. The use of hyperpolarized pyruvate in the clinic is promising, but requires development of robust methods to ensure the reproducibility of results. The purpose of this work is to design an automated dynamic phantom system that will allow for the characterization and optimization of quantitative imaging and analysis strategies. We have created a hydraulic pump system that reduces the variance in the reproducibility of hyperpolarized ^{13}C reaction rates and signal evolution. Eliminating error in the methods of injection, will allow focus on the reduction of error due to imaging strategies.

Advisory Committee

James Bankson, Ph.D.
(Advisor & Committee Chair)

David Followill, Ph.D.

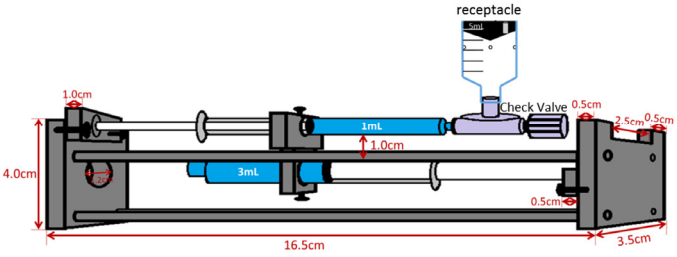
Arvind Rao, Ph.D.

Donna Reeve, M.S.

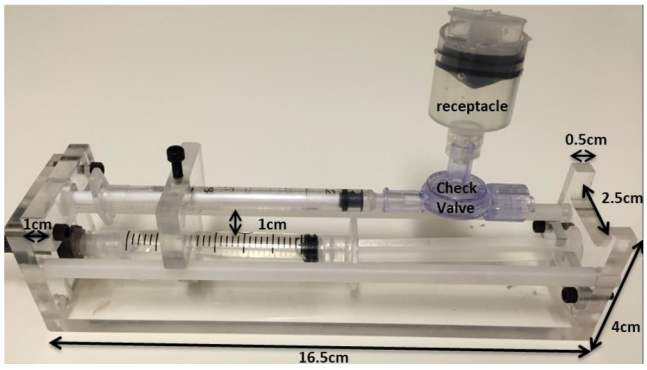
Jason Stafford, Ph.D.

Griffin is currently a third year Doctor of Medical Physics (DMP) student at UT Health San Antonio.

After she graduates, Griffin plans to work for Deep South Physics, which is a medical imaging physics consulting company.



Hydraulic syringe pump and receptacle original design.



Finished syringe pump.

William Scott Ingram, Ph.D.

Defended: May 2017

Image Registration to Map Endoscopic Video to Computed Tomography for Head and Neck Radiotherapy Patients

Advisory Committee

Laurence Court, Ph.D.
(Advisor & Committee Chair)

Arvind Rao, Ph.D.

Xin Wang, Ph.D.

Richard Wendt III, Ph.D.

Jinzhong Yang, Ph.D.

Ingram is currently living in Philadelphia, where he is a medical physics resident in the Department of Radiation Oncology at the University of Pennsylvania Perelman School of Medicine.

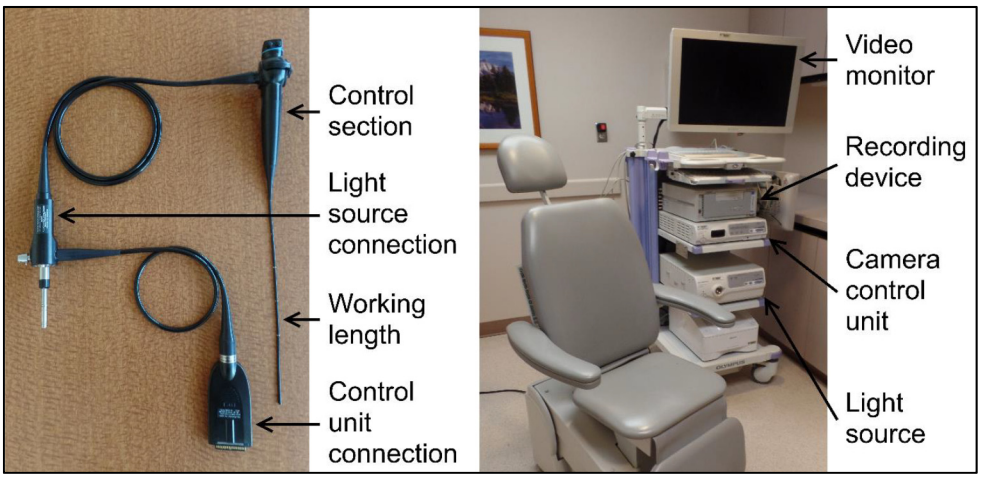
Dissertation Abstract Reprinted with Permission

The purpose of this work was to explore the feasibility of registering endoscopic video to radiotherapy treatment plans for patients with head and neck cancer without physical tracking of the endoscope during the examination. Endoscopy-CT registration would provide a clinical tool that could be used to enhance the treatment planning process and would allow for new methods to study the incidence of radiation-related toxicity.

Endoscopic video frames were registered to CT by optimizing virtual endoscope placement to maximize the similarity between the frame and the virtual image. Virtual endoscopic images were rendered using a polygonal mesh created by segmenting the airways of the head and neck with a density threshold. The optical properties of the virtual endoscope were matched to a calibrated model of the real endoscope. A novel registration algorithm was developed that takes advantage of physical constraints on the endoscope to effectively search the airways of the head and neck for the desired virtual endoscope coordinates.

This algorithm was tested on rigid phantoms with embedded point markers and protruding bolus material. In these tests, the median registration accuracy was 3.0 mm for point measurements and 3.5 mm for surface measurements. The algorithm was also tested on four endoscopic examinations of three patients, in which it achieved a median registration accuracy of 9.9 mm. The uncertainties caused by the non-rigid anatomy of the head and neck and differences in patient positioning between endoscopic examinations and CT scans were examined by taking repeated measurements after placing the virtual endoscope in surface meshes created from different CT scans. Non-rigid anatomy introduced errors on the order of 1-3 mm. Patient positioning had a larger impact, introducing errors on the order of 3.5-4.5 mm.

Endoscopy-CT registration in the head and neck is possible, but large registration errors were found in patients. The uncertainty analyses suggest a lower limit of 3-5 mm. Further development is required to achieve an accuracy suitable for clinical use.



The endoscope and auxiliary equipment.

Left: the Olympus ENF-VQ rhinolaryngoscope used to acquire endoscopic videos.

Right: The exam chair and endoscope control tower in the head and neck clinic.

Shane Krafft, Ph.D.

Graduated: August 2016

Utilizing Computed Tomography Image Features to Advance Prediction of Radiation Pneumonitis

Dissertation Abstract Reprinted with Permission

Improving outcomes for non-small-cell lung cancer patients treated with radiation therapy (RT) requires optimizing the balance between local tumor control and risk of normal tissue toxicity. In approximately 20% of patients, severe acute symptomatic lung toxicity, termed radiation pneumonitis (RP), still occurs. Identifying the individuals at risk of RP prior to or early during treatment offers tremendous potential to improve RT by providing the physician with information to assist in making clinical decisions that enhance therapy. Our central goal for this work was to demonstrate the potential gain in predictive accuracy of normal tissue complication probability models for RP by considering CT-based image features extracted from the normal lung volume.

To accomplish this, a software framework was first built to facilitate CT image feature extraction using multiple image analysis methods. Subsequently, we applied the implemented methods towards understanding the temporal change in the normal lung volume during treatment. After identifying a subset of highly reproducible and non-redundant image features, we investigated change in lung features on weekly CT image sets acquired during treatment. While multiple features exhibited significant association with dose, no temporal response was identified and we were unable to produce a predictive model that could outperform simple treatment-related factors.

CT-based image features calculated in regional subvolumes and on a voxel-wise basis in the normal lung were explored in the context of RP incidence. There was no clear spatial variation in the considered regionally extracted features or voxel-based feature maps. However, a limited subset of features were significantly associated with RP which may be a useful finding to consider in development of predictive models to assess toxicity risk.

We also considered the utility of pre-treatment total normal lung CT features for predicting RP using LASSO logistic regression and were able to successfully demonstrate improved discrimination of RP using such features relative to models constructed with clinical and dosimetric variables only. This is a significant step towards building robust models of RP with image based features that can subsequently be used to achieve personalized RT.

Advisory Committee

Mary K. Martel, Ph.D.
(Advisor & Committee Chair)

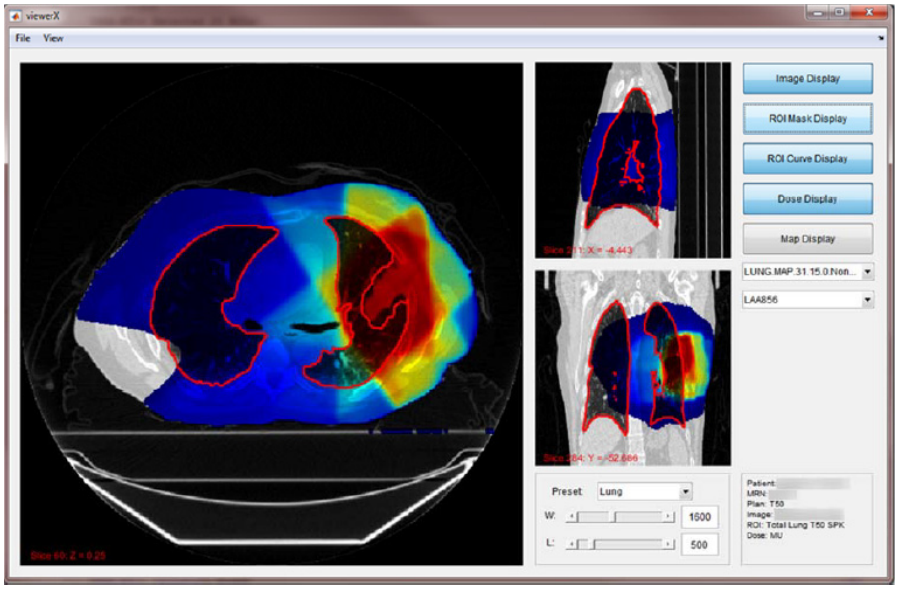
Tina Marie Briere, Ph.D.

Laurence E. Court, Ph.D.

Arvind Rao, Ph.D.

Francesco Stingo, Ph.D.

Krafft is currently a medical physics resident in the Department of Radiation Physics at MD Anderson.



An example of the current visualization module. Image, structure, dose, and feature maps can be displayed and browsed for easy review.

Christopher MacLellan, Ph.D.

Graduated: December 2016

Determination of Thermal Dose Model Parameters Using Magnetic Resonance Imaging

Advisory Committee

Jason Stafford, Ph.D.
(Advisor & Committee Chair)

James Bankson, Ph.D.

John Hazle, Ph.D.

Marites Melancon, Ph.D.

Arvind Rao, Ph.D.

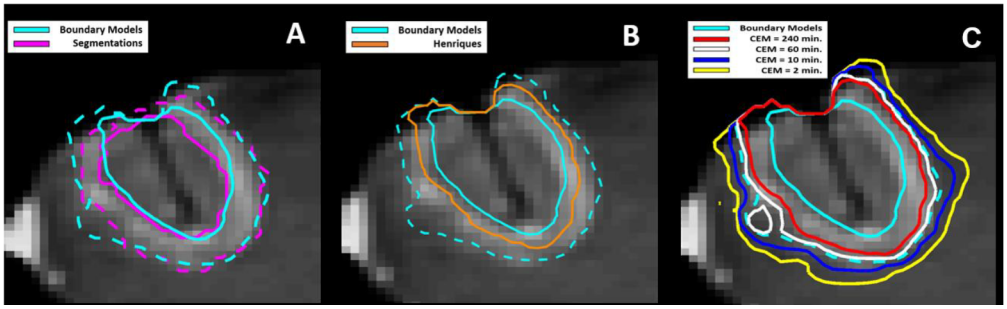
MacLellan is currently a first year medical physics resident in the Imaging Physics Residency Program.

Once he completes the two-year program he plans to complete ABR certification in diagnostic medical physics and pursue a position as a physicist at an academic medical center.

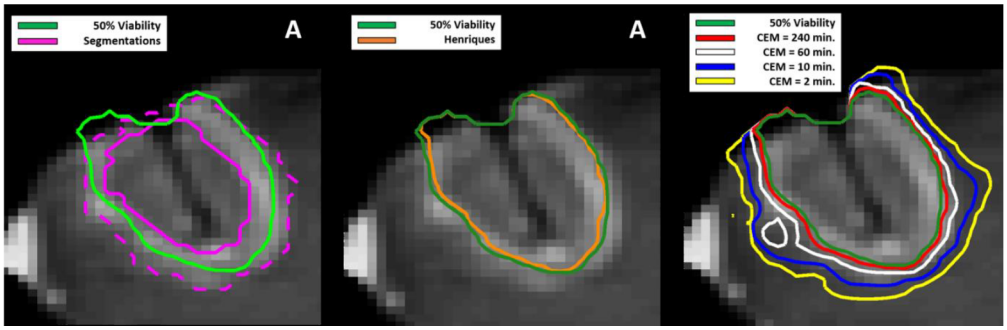
Dissertation Abstract Reprinted with Permission

Magnetic Resonance Temperature Imaging (MRTI) is a powerful technique for noninvasively monitoring temperature during minimally invasive thermal therapy procedures. When coupled with thermal dose models, MRTI feedback provides the clinician with a real-time estimate of tissue damage by functioning as a surrogate for post-treatment verification imaging. This aids in maximizing the safety and efficacy of treatment by facilitating adaptive control of the damaged volume during therapy. The underlying thermal dose parameters are derived from laboratory experiments that do not necessarily reflect the surrogate imaging endpoints used for treatment verification. Thus, there is interest and opportunity in deriving model parameters from clinical procedures that are tailored to radiologic endpoints.

The objective of this work is to develop and investigate the feasibility of a methodology for extracting thermal dose model parameters from MR data acquired during ablation procedures. To this end, two approaches are investigated. One is to optimize model parameters using post-treatment imaging outcomes. Another is to use a multi-parametric pulse sequence designed for simultaneous monitoring of temperature and damage dependent MR parameters. These methodologies were developed and investigated in phantom and feasibility established using retrospective analysis of *in vivo* thermal therapy treatments. This technique represents an opportunity to exploit experimental data to obtain thermal dose parameters that are highly specific for clinically relevant endpoints.



Isodose lines predicted by the inner and outer boundary models compared to the inner and outer boundary segmentations (A), Henriques model (B), and CEM model (C).



Isodose lines predicted by the tissue viability model compared to the inner and outer boundary segmentations (A), Henriques model (B), and CEM model (C).

Joshua Scott Niedzielski, Ph.D.

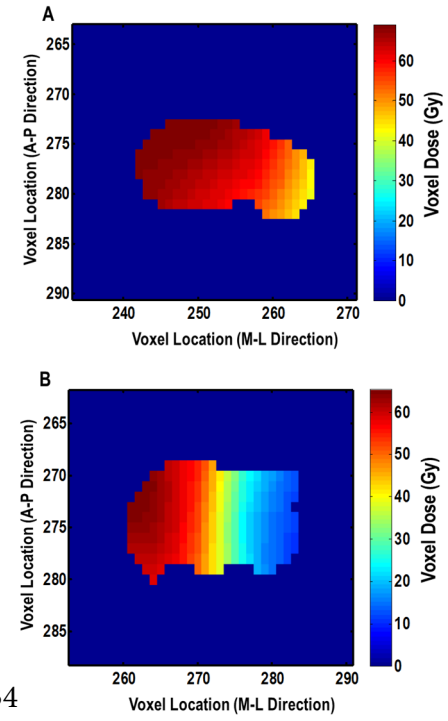
Graduated: December 2016

Investigation of Radiation Injury in the Esophagus from Definitive Chemoradiation Therapy using Novel Imaging Biomarkers

Advisory Committee

Laurence Court, Ph.D.
(Advisor & Committee Chair)

Tina Marie Briere, Ph.D.
Daniel Gomez, Ph.D.
Mary Martel, Ph.D.
Francesco Stingo, Ph.D.
Jinzhong Yang, Ph.D.



Plot of voxel dose within the esophagus in the axial plane for two different example dose conformities. The dose-geometry in (A) is more uniform, when compared to (B), which has a partial-sparing of dose towards the lateral end of the esophagus.

Dissertation Abstract Reprinted with Permission

Radiation injury in the esophagus occurs with high frequency from the treatment of non-small cell lung cancer (NSCLC). Acute radiation injury during treatment is common and negatively affects treatment efficacy by limiting dose, and interrupting radiation therapy if toxicity becomes sufficiently severe. Grading criterion are most commonly utilized to quantify toxicity (radiation esophagitis) using physician chosen interventions on an escalating scale of severity. These grading systems are subjective in nature and lack numerical meaning. Furthermore, radiation therapy planning guidelines for the esophagus are derived from toxicity prediction models utilizing these subjective grading scores as complication endpoints. Not only does this schema of toxicity analysis leads to lack of consistency between models from different patient populations, and therefore radiation therapy planning esophagus avoidance recommendations, but inherent patient radiosensitivity is ignored, possibly leading to suboptimal treatment regimens.

The purpose of this work was to investigate radiation injury in the esophagus by first developing in-vivo biomarkers of radiation response in the esophagus from functional imaging using 4-dimensional computed tomography (4DCT) and 18fluorodeoxyglucose positron emission tomography (FDG-PET), separately. These imaging biomarkers were then statistically analyzed to radiation esophagitis grade, using traditional and machine learning techniques, and shown to objectively quantify esophageal radiation toxicity. Metrics describing the esophageal radiation response from either functional imaging modality were strong classifiers of radiation esophagitis grade ($p<0.05$, area under the curve (AUC) ≥ 0.85). Multivariate models to predict maximum esophagitis treatment grade (4DCT), and esophagitis symptom progression (FDG-PET) were developed and had AUC ≥ 0.72 for both scenarios.

These biomarkers were then used to comprehensively investigate the influence of dose-geometry and radiation type on esophageal response. Using these radiation response biomarkers in esophageal dose-response analysis, dose metrics with (e.g. dose to a subregion of the esophagus with specific percent cross-sectional area coverage) and without (traditional dose-volume histogram) spatial information of esophageal dose coverage was analyzed separately using machine learning. No detectable difference in response was observed when comparing dose metrics with and without spatial information. Statistical analysis showed no significant difference ($p<0.05$) in biomarker value when comparing patient populations of different radiation type (intensity-modulated photon radiation therapy versus passive scatter proton therapy).

Inherent patient radiation sensitivity was investigated using biomarker metric value and dose to the corresponding esophageal subregion. Cluster analysis was used to group patient patients based on their maximum expansion and delivered dose to the subregion of the esophagus. Patients clustered with proportionally higher expansion per delivered dose were considered radiosensitive. These results were then applied to NTCP toxicity modelling by using patient radiosensitivity cluster membership as a predictor. Models with the radiosensitive predictor outperformed models not including the cluster membership variable, for prediction of grade 3 esophagitis.

Niedzielski is currently a postdoctoral research fellow at the University of Colorado-School of Medicine.

Christopher Peeler, Ph.D.

Graduated: December 2016

Assessing the Potential Clinical Impact of Variable Biological Effectiveness in Proton Radiotherapy

Advisory Committee

Radhe Mohan, Ph.D.
(Advisor & Committee Chair)

David Followill, Ph.D.
David Grosshans, M.D., Ph.D.
Dragan Mirkovic, Ph.D.
Arvind Rao, Ph.D.
Uwe Titt, Ph.D.
Xiaorong Ronald Zhu, Ph.D.

Peeler is currently an advanced fellow in medical physics in the Department of Radiation Physics at MD Anderson Cancer Center. This is a four-year combined postdoctoral fellowship and radiation therapy physics residency. His mentor for the postdoc portion of the program is Dragan Mirkovic, Ph.D.

Peeler is investigating multiple areas, including understanding non-small cell lung cancer treatment outcomes based on Monte Carlo dose data and investigating imaging surrogates for proton therapy biological effects in brain tumor patients.

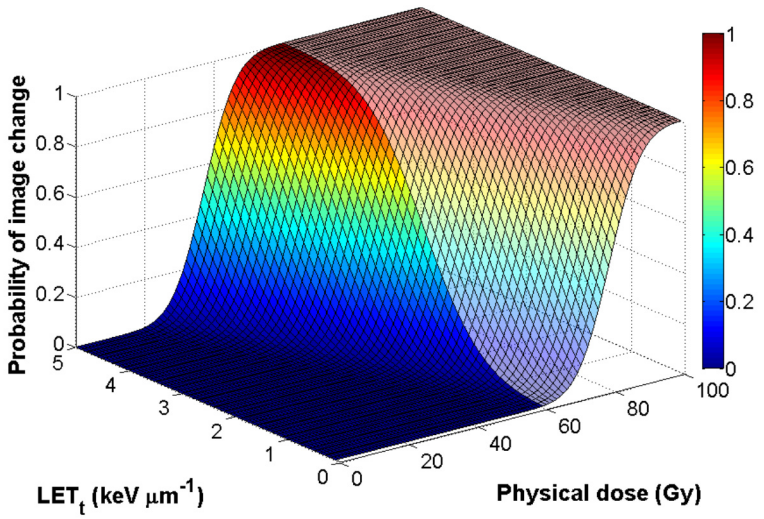
Dissertation Abstract Reprinted with Permission

It has long been known that proton radiotherapy has an increased biological effectiveness compared to traditional x-ray radiotherapy. This arises from the clustered nature of DNA damage produced by the energy deposition of protons along their tracks in medium. This effect is currently quantified in clinical settings by assigning protons a relative biological effectiveness (RBE) value of 1.1 corresponding to 10% increased effectiveness compared to photon radiation. Numerous studies have shown, however, that the RBE value of protons is variable and can deviate substantially from 1.1, but experimental data on RBE and clinical evidence of its variability remains limited.

The potential for using the variable RBE of proton radiation to improve clinical treatment plans has been theorized, but it is accepted that more experimental *in vitro* and *in vivo* data are needed before clinical adaptation of these techniques may occur. Nevertheless, it will be important to identify strategies in which the variable nature of proton RBE may be used to inform treatment planning. The goal of this work is thus to investigate if the assumption of a constant proton RBE has an adverse effect in current clinical applications and if the variable biological effectiveness of protons can be quantified from clinical data.

First, results from high-resolution experiments quantifying proton RBE are compared to multiple models for calculating RBE. A new model is then proposed which can more accurately reproduce the experimental results. These models are implemented in a Monte Carlo-based dose calculation system and their output is compared for a cohort of pediatric patients treated for brain tumors with proton radiotherapy who subsequently presented with post-treatment image changes identified on magnetic resonance imaging. One RBE model is identified as the best candidate for further study; however, results of volumetric analyses of RBE-weighted dose prove inconclusive in correlating with image changes. A model is developed that can describe the probability of voxel-level image changes (signifying normal tissue damage) based on proton dose and linear energy transfer. The model constitutes the first clinical evidence for the variable biological effectiveness of protons and holds promise for the improvement of proton therapy treatment planning.

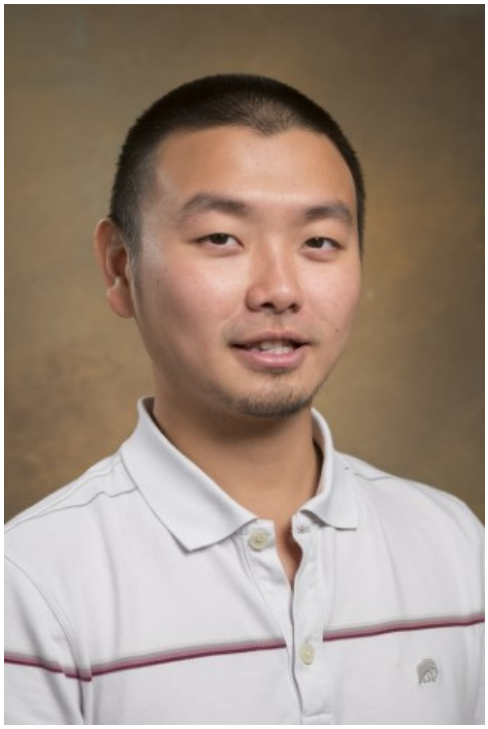
Surface plot of generalized linear model for image change based on dose and LET_t.



Wendy "Siman" Siman, Ph.D.

Graduated: August 2016

Bias and Variability in Image-Based Volumetric Yttrium-90 Dosimetry



Advisory Committee

Cheenu Kappadath, Ph.D.
(Advisor & Committee Chair)

Veera Baladandayuthapani, Ph.D.

Peter A. Balter, Ph.D.

Armeen Mahvash, Ph.D.

Osama R. Mawlawi, Ph.D.

Dissertation Abstract Reprinted with Permission

90Y-microsphere therapy has been widely accepted as a treatment option for both primary and metastatic liver tumors where the patients are ineligible for surgical resection and external beam radiation therapy. The prognosis of untreated patient having liver cancer is very poor with life expectancy less than a year at advance stage. Hence the ability to predict treatment efficacy right after the treatment from post-therapy imaging will help personalize treatment strategies and achieve better outcome. Such prediction can be modeled from correlation of dose and tumor response metrics.

It has been shown that local dose deposition method can generate dose map from 90Y emission images with accuracy comparable to dose-point kernel and Monte Carlo simulation methods. The bias and variability of the input images remain to be the weakest link in volumetric dosimetry. The objectives of this dissertation project were to improve image-based volumetric 90Y dose quantification using current commercially available systems and to determine its limitation (bias/variability).

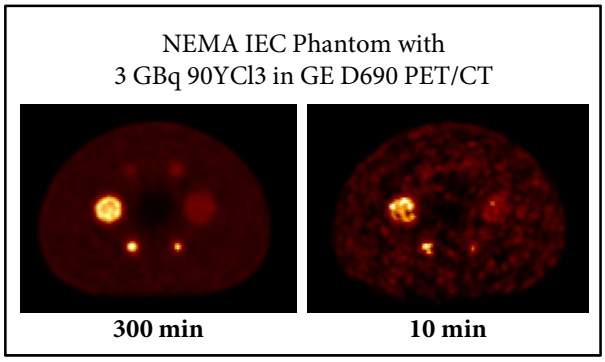
We have developed a practical image reconstruction method for 90Y bremsstrahlung SPECT/CT (bSPECT/CT) images with CT attenuation correction and energy-window based background compensation. Although the volumetric quantitative accuracy of our bSPECT/CT images is limited by partial volume effect, the images can be used to accurately quantify the total 90Y activity delivered to the patient, which allow gross treatment delivery verification and limited outcome prediction.

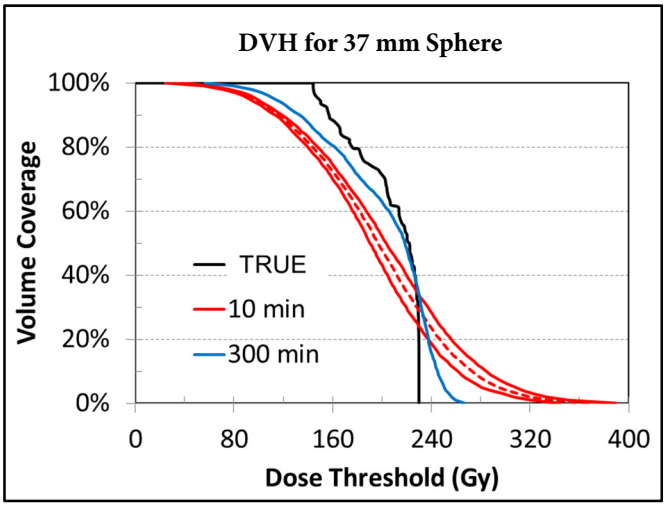
We have also characterized the accuracy and variability of volumetric 90Y dosimetry calculated from count-limited 90Y-PET/CT images. Knowledge of overall errors (systematic and random) in volumetric 90Y dosimetry is important to derive statistically significant dose-response model, which in turn allowing prediction of treatment outcome and personalization of treatment strategy.

Siman is currently a medical physicist in the Department of Radiology at the University of Tennessee Medical Center.

He has a secondary appointment as an assistant professor in the Department of Radiology at the University of Tennessee Graduate School of Medicine.

Impact of low count data on 90Y-PET-based dose volume histogram (DVH)





(Left) Experiment setup using modified NEMA IEC Phantom (3 GBq 90YCl3) acquired for 300 and 10 min using GE D690 PET/CT scanner. (Right) Low-counts result in both systematic and random errors in DVH.

Christopher M. Walker, Ph.D.

Graduated: December 2016

Novel Simulation to Avoid Bias in Measurement of Hyperpolarized Pyruvate: Demonstrated in Phantom and In Vivo

Advisory Committee

James A. Bankson, Ph.D.
(Advisor & Committee Chair)

John Hazle, Ph.D.

Steven Millward, Ph.D.

Arvind Rao, Ph.D.

Dawid Schellingerhout, Ph.D.

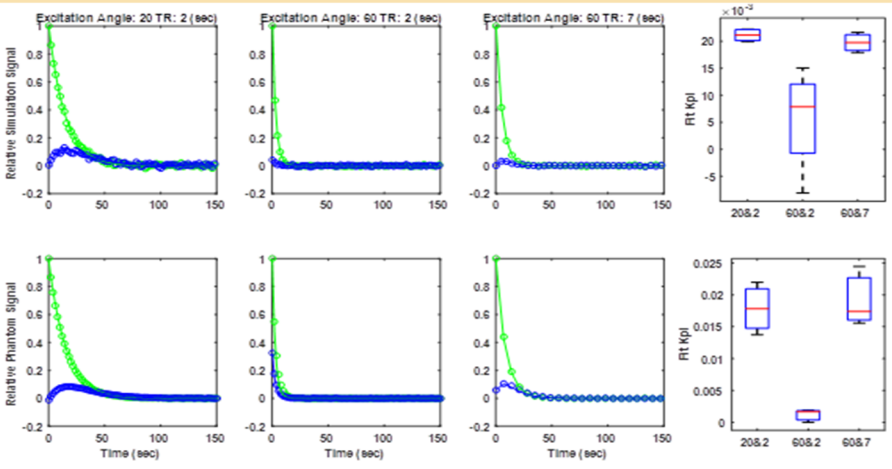
Richard Wendt, Ph.D.

Walker is currently following the Hybrid Pathway option in the Imaging Physics Residency Program. During his three-year appointment as an MD Anderson fellow in medical physics, Walker will receive two-years of full-time equivalent clinical training while performing one full-time equivalent year of research.

Walker's research mentor is James Bankson, Ph.D., who worked closely with him through his graduate studies.

Dissertation Abstract Reprinted with Permission

Dynamic nuclear polarization creates a transient hyperpolarized nuclear state that can dramatically increase the signal detected by magnetic resonance imaging. This signal increase allows real-time spectroscopic imaging of specific metabolites in vivo by magnetic resonance. Real-time imaging of both the spatial and chemical fate of hyperpolarized metabolites is showing great promise to meaningfully benefit clinical care of cancer patients. Imaging of hyperpolarized agents will have a larger clinical impact if it can function as a quantitative modality upon which clinical decisions can be made. However, quantitative measurement of hyperpolarized agents is currently difficult due to the restrictions imposed by the transient hyperpolarized state and the complexity inherent in biological systems. As more advanced imaging and measurement techniques are developed for imaging hyperpolarized substrates, it is critical to characterize their effect on any relevant quantitative measure. To assist in accurate quantitative measurement of hyperpolarized agents, an infrastructure where acquisition strategies can be developed, compared, optimized and validated was critically need. A novel simulation architecture was developed that combines classical chemical kinetics with the basic physics of nuclear magnetic resonance and couples them to multiple perfusion models. Simulation results showed that changes in the acquisition strategy used will affect the resulting quantification of chemical exchange rates and suggested that any bias that is imposed by the acquisition strategy can be avoided by using optimized pulse sequences. To validate these predictions, a phantom system was developed that allows controllable chemical conversion of hyperpolarized pyruvate into lactate with a variability less than 20%. Using this phantom system, studies showed that poorly optimized pulse sequences significantly reduced the measured value of the chemical exchange rates, whereas optimized pulse sequences showed no significant difference in chemical exchange measurements. In order to test simulation predictions for a perfused system, an animal cohort with orthotropic anaplastic thyroid cancer was scanned with multiple sequences. Again, optimized sequences showed no significant difference in measured exchange rates while poorly designed sequences significantly underestimated the exchange rates, which is consistent with the simulation results. These validation studies suggest that this simulation architecture will be a powerful tool for developing and optimizing acquisition and quantization methods for hyperpolarized magnetic resonance imaging.



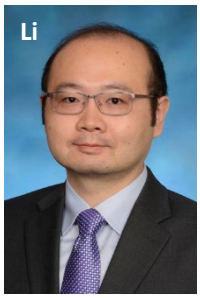
Comparing simulated to dynamic phantom data for the closed system. A qualitative comparison of the closed system signal curves predicted by the simulation at various excitation angles and repetition times to the measured signal curves in the dynamic phantom system.

Imaging Physics Residency Program

Ho-Ling Anthony Liu, Ph.D., Program Director

Recent Graduates

Steven Bache, M.S., (Duke University) completed his residency in August 2016, and passed the ABR oral exam this year. He is now a medical physicist at Mission Health in Asheville, North Carolina.

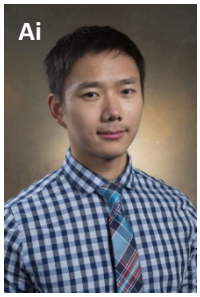


Guang Li, Ph.D., (UTHSC San Antonio) completed his residency in July 2015, and passed the ABR oral exam in 2016. He is now an assistant professor at the University of Maryland Medical Center. In this year's AAPM meeting, Li will be sharing the JACMP Editor-in-Chief Award for an outstanding General Medical Physics Article published in 2016, *Evaluation of cassette-based digital radiography detectors using standardized image quality metrics: AAPM TG-150 Draft Image Detector Tests*, with Travis Greene, M.S., (also an alumnus of our residency program), Thomas Nishino, Ph.D., and Charles Willis, Ph.D.

As of June 2017, 23 residents have completed the program and all have obtained board certification.

Current Residents

Asher Ai, Ph.D., (MD Anderson UTHealth Graduate School) plans to graduate this August.



Diana Carver, Ph.D., (Vanderbilt University) will complete the program this July and become an assistant professor at Vanderbilt University.

Chris MacLellan, Ph.D., (MD Anderson UTHealth Graduate School) is in his first year of residency.

Current Fellows

Samuel Einstein, Ph.D., (University of Minnesota) just started his second year and is working with James Bankson, Ph.D., on his research in fluorine-19 MR imaging and spectroscopy.

Samuel Fahrenholtz, Ph.D., (MD Anderson UTHealth Graduate School) is in the second year of his fellowship and is working with Erik Cressman, M.D., Ph.D., for his research on thermochemical ablation and embolization.

Benton Pahlka, Ph.D.,(University of Texas - Austin) plans to graduate this August.

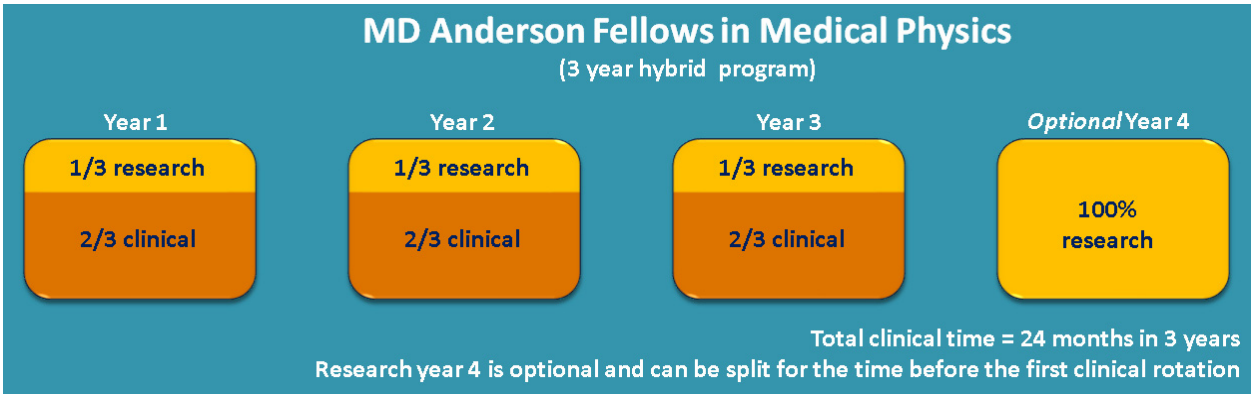
Chris Walker, Ph.D., (MD Anderson UTHealth Graduate School) is in his first year of residency. Walker is working with Bankson for his research on hyperpolarized MRI. He recently placed third in the basic science research oral competition at the 2017 MD Anderson Trainee Research Day.

Hybrid Pathway

We have launched a new Hybrid Pathway that combines clinical and research training over a period of three years. The aim is to enable Ph.D. graduates to obtain the two-year residency training required for ABR certification while continuing to do research and pursue an academic career.

The residents enrolled in the program are recognized with the title of MD Anderson Fellow in Medical Physics. During the three-year period, the fellows will spend 2/3 of their time in clinical training and 1/3 in research. Typically, a month long rotation becomes a month and a half for the fellows. This way, they are expected to receive identical clinical experiences and achieve high levels of clinical competency.

To meet their research goals, each fellow is matched with a faculty member who serves as his or her research mentor. This relationship is based upon a mutual interest in an area of research in biomedical imaging. An optional fourth year of full-time research is possible if funding is available.



Other Updates

The program faculty has grown to 27 in number. In the past year, Rick Layman, Ph.D., joined the faculty and started supervising our residents. We have built a new agreement with UTHealth for them to become one of the external rotation options for our residents. For this, Charles Beasley, Ph.D., and Janet Feng, Ph.D., at UTHealth joined the program faculty. We added structural training in professionalism and ethics to the curriculum. This includes presentations and discussion of related topics in the program's monthly roundtable meeting. We restructured the monthly journal club to become a residency seminar series that includes invited lectures on topics such as leadership, Radiation Safety Officer (RSO) as a physicist, professionalism in imaging physics, career development and tips for job searching. For more of the latest information, please visit our program website at: mdanderson.org/imaging-physics-residency-program.

2017 New Year's Party
Residents, Fellows, Faculty and Family

Radiation Physics Residency Program

Mohammad Salehpour, Ph.D., Program Director

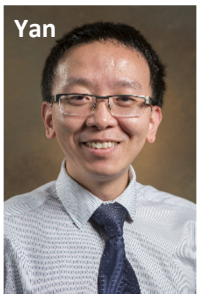
Graduates

Three residents will complete the program on August 31, 2017.

Kevin Kauweloa, Ph.D., (UTHSC San Antonio) will be joining the University of Kansas as a clinical assistant professor.

Surendra Prajapati, Ph.D., (University of Wisconsin - Madison) will be joining Wake Forest Baptist Medical Center as an assistant professor.

Yue Yan, Ph.D., (University of Wisconsin - Madison) will be joining St. Jude Children's Research Hospital as a medical physicist II.



Current Residents

There are four first year residents in the program. They will complete the program on August 31, 2018.

Mikhail Chetvertkov, Ph.D., (Wayne State University)

Gye Won "Diane" Choi, M.S., (MD Anderson UTHealth Graduate School)

Shane Krafft, Ph.D., (MD Anderson UTHealth Graduate School)

Yilin Liu, Ph.D., (Duke University)

Incoming Residents

Three new residents will start the program on September 1, 2017.

Rachael Martin, Ph.D., (MD Anderson UTHealth Graduate School)

Jordan Slagowski, Ph.D., (University of Wisconsin-Madison)

Wenjun Yang, Ph.D., (University of Wisconsin-Madison)

Other News

This year the program was due for its second reaccreditation renewal. This process was successfully completed in May 2017 and our accreditation certificate was received from CAMPEP in June.

Advanced Fellowship in Medical Physics

In order to train the next generation of academic leaders in medical physics, The Department of Radiation Physics has created a new training program that combines advanced research studies and clinical training. This training program is available only to those candidates who exhibit future leadership potential in radiation physics:

- Publications in high impact journals (i.e., Science, Nature, Physical Review)
- Student leadership (preferably on the national level)
- A compelling personal statement including expressed interest and demonstrated leadership

The successful applicants will spend 24 months in a research lab followed by 24 months of clinical training.

Current Advanced Fellow in Medical Physics

Christopher Peeler, Ph.D., (MD Anderson UTHealth Graduate School) is the first trainee to enter the Advanced Fellowship in Medical Physics. His current research, under the mentorship of Dragan Mirkovic, Ph.D., is primarily focused in two areas.

The first area is the analysis of post-proton radiotherapy normal tissue outcomes in pediatric patients treated for brain cancer. The second area of focus involves the analysis of treatment plans for patients treated for non-small cell lung cancer in a randomized clinical trial comparing intensity-modulated photon therapy to proton therapy during the previous NCI P01 grant held jointly by MD Anderson Cancer Center and Massachusetts General Hospital.

Questions about the program should be directed to the Program Director at:

Mohammad Salehpour, Ph.D.
Department of Radiation Physics
The University of Texas MD Anderson Cancer Center
1400 Pressler Street, Unit 1420
Houston, TX 77030
(713) 563-2636 (Office)
msalehpour@mdanderson.org

IROC

Imaging & Radiation Oncology Core

The only QA center that performs an independent peer review of proton centers.

200

radiotherapy facilities monitored in

59

countries

We are excited about a new agreement with an organization in The Peoples Republic of China to provide our OSLD/TLD service and phantoms program to the 1148 Chinese RT sites (~1700 megavoltage treatment machines). The roll out of the program will be gradual over a 3 year period.

Global Outreach Mission

in **2016**

16,742

megavoltage beams with remote OSLD/TLD service monitored

746

shipped end-to-end anthropomorphic phantoms

Graduate School Announces New Name

Source: ***MD Anderson UTHealth Graduate School FAQs***

Why did we change the name of our school?
In 2017, the school changed its name to **The University of Texas MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences** to celebrate the enduring and strong partnership between our parent institutions, MD Anderson and The University of Texas Health Science Center at Houston, and their shared commitment to the school's talented, innovative and passionate students and faculty.

How should I refer to the school name in written or spoken references?
First reference without logo present:
The University of Texas MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences
First reference with logo present:
MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences
Second/subsequent reference:
MD Anderson UTHealth Graduate School

If I already have a degree, will my transcripts be changed to reflect the new name?
No. Transcripts for all UTHealth schools include the name of our institution as The University of Texas Health Science Center at Houston and then include the student's degree program.

AAPM Awards Ceremony
Monday 7/31/2017
6:30 – 8 p.m.
Centennial Ballroom

Faculty receiving HONORS at AAPM 2017

Michael Gillin, Ph.D.

Professor, Radiation Physics

Marvin M.D. Williams Professional Achievement Award

This award recognizes an AAPM member for an eminent career in medical physics with an emphasis on clinical medical physics. No more than two awards will be given in any year and the award does not have to be awarded every year.

JACMP Editor-in-Chief Award

Outstanding General Medical Physics Article Published in 2016

"Evaluation of cassette-based digital radiography detectors using standardized image quality metrics: AAPM TG-150 Draft Image Detector Tests," *Journal of Applied Clinical Medical Physics*, 17(5) 2016. They share this award with former Imaging Physics residents, Guang Li, Ph.D. and Travis Greene, M.S.


Nishino


Willis

2017 Class of Fellows

We are pleased and proud to recognize two members of the 2017 class of Fellows of the AAPM who are alumni or members of the faculty of the Medical Physics Program: Rajat Kudchadker, Ph.D., and Jason Stafford, Ph.D.

Rajat Kudchadker, Ph.D.
Professor
Radiation Physics

Jason Stafford, Ph.D.
Professor
Imaging Physics

GSBS Alumnus
Ph.D., 2002

2017

Alumni Event

Medical Physics Alumni Reception at AAPM

Sunday, July 30, 2017
8:30 - 10:30 p.m.
Hyatt Regency Denver at the Convention Center
4th Floor
Capitol Ballrooms 1 & 2





Photos from 2016 Alumni Event at AAPM in Washington, D.C.

1-1:55 p.m. Room: 108

SU-E-108-2. **M Peters**, **D Craft**, **G Baltz**, D Followill, R Howell. *Dual-Material 3D Printing of An Anthropomorphic Head Phantom.*

2:05-3 p.m. Room: Four Seasons 1

SU-F-FS1-1. **CR Peeler**, U Titt, DR Grosshans, Z Liao, R Mohan, D Mirkovic. *Analysis of Differences in Tumor Control Probability Calculated From Monte Carlo and Treatment Planning System Dose Distributions for Proton Therapy.*

SU-F-FS1-2. L Court, **J Niedzielski**, U Titt, J Yang, R Mohan, D Mirkovic, F Stingo, D Gomez, Z Liao, M Martel, T Briere, L Court. *Analysis of Normal Tissue Response in the Esophagus Between IMRT and Proton Therapy Using Imaging Biomarkers.*

3:30-4 p.m. Room Joint Imaging-Therapy ePoster Lounge-A

SU-H2-GePD-J(A)-3. **H Lee**, G Bosco, M Kadbi, G Ibbott. *Reusable, MR-Visible, and Radiosensitive 3D Dosimeters for MR-Guided Radiation Therapy.*

3-6 p.m. Room: Exhibit Hall

SU-I-GPD-J-68. **H Lee**, G Bosco, M Kadbi, G Ibbott. *Use of 3D Gels for Determining MR and Radiation Isocenters in MR-Guided Radiation Therapy.*

SU-I-GPD-J-91. L Tian, L Lu, B Singhana, **M Jacobsen**, A Melancon, M Melancon. *Novel Radiopaque Bismuth Nanoparticle Coated Polydioxanone and Comparison of Attenuation in Pre-Clinical and Clinical CTs.*

SU-I-GPD-T-97. D Mirkovic, P Yang, Z Belal, U Titt, **CR Peeler**, Z Liao, R Mohan. *Analysis of Recurrences in Lung Patients Treated with Protons.*

SU-I-GPD-T-103. O Vassiliev, F Guan, **L Bronk**, D Grosshans, R Mohan. *An LET-Based Model of Proton RBE Consistent with New High Accuracy RBE Data Measured Near Distal Fall-Off.*

SU-I-GPD-T-217. **D F Craft**, RM Howell. *Material Matters: Concerns with 3D Printed Material Consistency.*

SU-I-GPD-T-218. **DF Craft**, **M Peters**, **G Baltz**, RM Howell. *Comparison of Single and Dual Material 3D Printed Patient-Specific Radiotherapy Phantoms.*

SU-I-GPD-T-232. L Court, **R McCarroll**, **K Kisling**, L Zhang, J Yang, H Simonds, M du Toit, A Jhingran, P Balter, B Beadle. *An Initial Plan Check Procedure Specifically Designed for Fully-Automated Treatment Planning.*

SU-I-GPD-T-457. **M Carroll**, **H Lee**, S Venkataraman, G Ibbott. *Investigation of a PRESAGE Three-Dimensional Dosimetry Protocol That Allows for Internal Calibration.*

SU-I-GPD-T-513. **G Baltz**, P Chi, **D Craft**, **M Peters**, J Pollard, R Howell. *Use and Validation of Contoured 3D-Printed Neck Compensators for Total Body Irradiation.*

4-6 p.m. Room: 108

SU-K-108-2. **M Newpower**, O Vassiliev, F Guan, D Grosshans, **L Bronk**, R Mohan. *A Novel Linear-Quadratic-Cubic Cell Survival Model for Proton Therapy Response Based On the Microdosimetric Quantity Specific Energy.*

SU-K-108-8. **L Bronk**, F Guan, D Ma, Y Wang, M Kerr, D Patel, U Titt, O Vassiliev, S Lin, R Mohan, D Grosshans. *High-Throughput Proton Irradiations Uncover a Differential DNA Damage Repair Response to P53 Depletion in Two Lung Cancer Cell Lines.*

4-6 p.m. Room: 601

SU-K-601-13. **B Anderson**, **C Cardenas,** A Klopp, S Kry, J Johnson, J Ho, A Rao, J Yang, E Cressman, L Court. *Computer-Aided Detection of Pathologically Enlarged Lymph Nodes On Non-Contrast CT in Cervical Cancer Patients for Low-Resource Settings.*

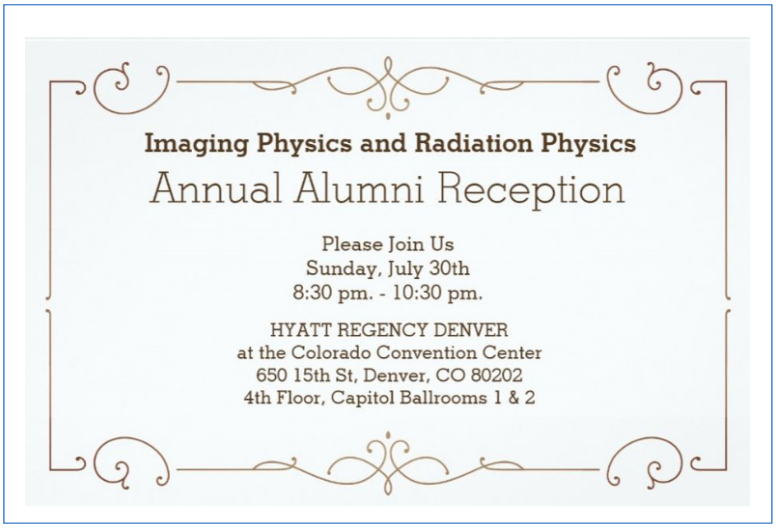
4-6 p.m. Room: 708

SU-K-708-11. **T Salzillo**, J Gumin, J Lee, N Zacharias, F Lang, P Bhattacharya. *Non-Invasive Assessment of Glioblastoma Tumor Aggressiveness Using Hyperpolarized Magnetic Resonance Imaging and Spectroscopy.*

SU-K-708-12. K Hwang, **S Fahrenholtz**, **C MacLellan**, J Yung, R Stafford. *Improved Chemical Exchange Saturation Transfer (CEST) with a Multiple Gradient Echo Sequence.*

4-6 p.m. Room: Four Seasons 4

SU-K-FS4-5. **W S Ingram**, J Yang, J Qiu, R Weersink, B Beadle, R Wendt, A Rao, L Court. *Mapping Endoscope Images to CT: Methods and Uncertainties.*



Monday, July 31

7:30-9:30 a.m. Room: Four Seasons 4

MO-AB-FS4-2. **A Rubinstein**, C Peterson, C Kingsley, J Pollard, R Tailor, D Followill, A Melancon, L Court. *A Pre-Clinical Study of Radiation-Induced Lung Toxicity When Treating in a Strong Magnetic Field.*

10-10:30 a.m. Room Joint Imaging-Therapy ePoster Lounge-B

MO-C2-GePD-J(B)-2. **SJ Fahrenholtz**, C Guo, **CJ MacLellan**, J Yung, K Hwang, RJ Stafford, E Cressman. *Tracking Thermoembolization Via Multiparametric MRI.*

4:30-6 p.m. Room: Four Seasons 1

MO-F-FS1-3. **T Netherton**, **Y Li**, P Nitsch, P Balter, S Gao, M Muruganandham, S Shaitelman, **R McCarroll**, S Frank, S Hahn, A Klopp, L Court. *Efficiency and Efficacy of Intensity Modulated Treatments On a Prototype Linear Accelerator.*

1:15-1:45 p.m. Room: Imaging ePoster Lounge

MO-L-GePD-I-3. **J Sanders**, S Frank, A Venkatesan, T Bathala, J Szklaruk, P Blanchard, R Kudchadker, J Ma. *TrueFISP for Single Sequence MR-Only Post-Implant Dosimetry of Prostate Brachytherapy.*

1:15-1:45 p.m. Room Joint Imaging-Therapy ePoster Lounge-B

MO-L-GePD-J(B)-3. **C Cardenas**, **R McCarroll**, L Court, B Elgohari, H Elhalawani, C Fuller, M Jomaa, M Meheissen, A Mohamed, A Rao, B Williams, A Wong, J Yang, M Aristophanous. *Deep Learning On Clinically-Clustered Patients Improves Auto-Delineation of Oropharyngeal High-Risk Clinical Target Volumes.*

1:15-1:45 p.m. Room: Joint Imaging-Therapy ePoster Theater

MO-L-GePD-JT-5. **A Steinmann**, R Stafford, G Sawakuchi, Z Wen, L Court, C Fuller, D Followill. *Developing and Characterizing MR/CT Compatible Materials Used in QA Phantoms for MRgRT Modalities.*

9:30-10 a.m. Room: Imaging ePoster Lounge

MO-RAM-GePD-I-6. L Lu , **M Jacobsen**, T Li, M Jonathan, E Tasciotti, R Layman, M Melancon, A Melancon. *Gold Nanoparticle and Iodine Prediction of Concentration Using Dual Energy Computed Tomography in Phantoms.*

MO-RAM-GePD-T-4. U Titt, J Yang, D Mirkovic, P Yepes, A Liu, **C Peeler**, R Mohan. *Monte Carlo Cumulative 4D and 5D Proton Dose Distribution Computations and Their Comparison with Analytical Dose Computation Model Predictions for Lung Cancer Patients.*

9:30-10 a.m. Room: Therapy ePoster Theater

MO-RAM-GePD-TT-2. D Patel, **L Bronk**, F Guan, **C Peeler**, S Brons, I Dokic, A Abdollahi, O Jakel, D Grosshans, R Mohan, U Titt. *Effect of Physics Based Monte Carlo Parameterization On the Accuracy of Transport Quantities.*

MO-RAM-GePD-TT-3. **D Branco**, P Taylor, D Mirkovic, X Zhang, P Yepes, S Kry, N Sahoo, D Followill. *Evaluation of Proton Therapy Analytic Algorithm Distal Dose Calculation in Static Lung Phantom.*

Tuesday, Aug. 1

7:30-9:30 a.m. Room: 601

TU-AB-601-3. **R Ger**, J Yang, Y Ding, **M Jacobsen**, C Fuller, R Howell, H Li, R Stafford, S Zhou, L Court. *Assessment of the Accuracy of DIR On MR Images Using Velocity and An In-House Demons Algorithm.*

TU-AB-601-4. **R Ger**, A Mohamed, M Awan, Y Ding, K Li, **X Fave**, A Beers, B Driscoll, H Elhalawani, D Hormuth, P van Houdt, R He, S Zhou, K Mathieu, H Li, C Coolens, C Chung, J Bankson, W Huang, J Wang, V Sandulache1, S Lai, R Howell, R Stafford, T Yankeelov, U van der Heide, S Frank, D Barboriak, J Hazle, L Court, J Kalpathy-Cramer, C Fuller. *Comparison of Parameter Calculation Algorithms for DCE-MRI: Results From a Multi-Institutional Study.*

TU-AB-601-7. **E Gates**, A Hsu, P Wang, P Hou, R Colen, A Kumar, S Prabhu, H Liu. *Denoising of Resting State MRI Signal Fluctuation Using Machine Classifiers for Cerebrovascular Reactivity Mapping.*

TU-AB-601-8., **C MacLellan,** J Yung, K Hwang, R Stafford. *Evaluation of the Impact of Eddy Current and Excitation Corrections On ADC Map Uniformity.*

TU-AB-601-9. **C Walker**, J Bankson. *Quantitative Evaluation of Excitation Angle Strategy Effects On Detection Accuracy of Hyperpolarized Pyruvate Metabolism.*

9:30-10 a.m. Room: Joint Imaging-Therapy ePoster Lounge–A

TU-C1-GePD-J(A)-5. **Y Li**, **T Netherton**, P Nitsch, P Balter, S Gao, A Klopp, L Court. *Organ Doses From MV IGRT Using MV-MV and MV-CBCT.*

10:30-11 a.m. Room: Therapy ePoster Theater

TU-C3-GePD-TT-5. S Gay, **A Rubinstein, W Ingram**, **B Anderson**, **X Fave**, **R Ger**, **R McCarroll**, **C Owens**, **T Netherton**, **K Kisling**, L Court, J Yang, **Y Li**, J Lee, D Mackin, **C Cardenas**. *Low-Cost Immobilization Techniques for Whole-Brain Irradiation*

1:45-3:45 p.m. Room: 605

TU-FG-605-9. **R McCarroll**, J Yang, **C Cardenas**, P Balter, H Burger, S Dalvie, **K Kisling**, M Mejia, K Naidoo, C Nelson, D Followill, C Peterson, K Vorster, J Wetter, L Zhang, B Beadle, L Court. *Physician Edits to Clinical Auto-Contours in the Head-And-Neck.*

TU-FG-605-11. **C Cardenas**, **R McCarroll**, L Court, B Elgohari, H Elhalawani, C Fuller, M Jomaa, M Meheissen, A Mohamed, A Rao, B Williams, A Wong, J Yang, M Aristophanous. *Deep Learning Algorithm for Auto-Delineation of High-Risk Oropharyngeal Clinical Target Volumes with Built-in Dice Similarity Coefficient Parameter Optimization Function.*

1:45-3:45 p.m. Room: 702

TU-FG-702-9. **M Carson**, **J Kerns**, S Zhou, D Followill, S Kry. *Treatment Plan Complexity as a Factor of IROC Head and Neck Phantom Performance.*

4:30-6 p.m. Room: Four Seasons 4

TU-H-FS4-3. D Mackin, **R Ger**, **X Fave**, L Zhang, J Yang, S Bache, P Chi, A Jones, C Dodge, L Court. *The Effect of Reducing Milliamp Seconds On Computed Tomography Radiomics Features.*

TU-H-FS4-9. J Yan, **A Steinmann**, D Mackin, R Stafford, D Followill, J Li, L Court. *Development of An MRI Radiomics Phantom.*

Wednesday, Aug. 2

10:15-11:15 a.m. Room: 108

WE-D-108-1. **C Cardenas @ 10:15 a.m.** *Covering Your Assets: A Brief Overview of General and Professional Liability Insurance for Medical Physicists.*

10:15 a.m.-12:15 p.m. Room: Four Seasons 4

WE-DE-FS4-2. **C Peeler @ 10:40 a.m.** *An Introduction to NIH Research Career Development Awards.*

1:45-3:45 p.m. Room: 205

WE-F-205-11. **C Owens**, C Tang, C Peterson, **X Fave**, E Koay, M Salehpour, D Fuentes, J Li, L Court, J Yang. *Reproducibility and Robustness of Radiomic Features Extracted with Semi-Automatic Segmentation Tools.*

4:30-6 p.m. Room: 201

WE-G-201-5. **M Jacobsen**, K Hwang, LG Le Roux, C Kale, D Cody, D Schellingerhout. *Classification of Intracranial Calcific and Hemorrhagic Lesions Using Quantitative Susceptibility Mapping: Preliminary Results of a Human Trial.*

4:30-6 p.m. Room: 601

WE-G-601-7. **B Lopez**, M Rauch, B Adrada, S Bache, K Hess, S Kappadath. *Quantification of in Vivo Tumor Uptake in Clinical Molecular Breast Imaging (MBI) Examinations.*

4:30-6 p.m. Room: Four Seasons 1

WE-G-FS1-2. **J Niedzielski**, J Yang, F Stingo, Z Liao, D Gomez , R Mohan, M Martel, T Briere, L Court. *A Novel CT Imaging Biomarker to Quantify Radiation Injury in the Esophagus with Application to Outcome Assessment.*

A Message from Outreach Physics:

The University of Texas MD Anderson Section of Outreach Physics will be hosting a booth at the AAPM Annual Meeting in Denver, Colorado. We will have representatives from Radiation Dosimetry Services (RDS), the Accredited Dosimetry Calibration Laboratory (ADCL), and the Phantom Lab (MDAPL). This year, we have a great location along the main walkway, ***Booth 5068***. Be sure to stop by and put your name in for the drawing and pick up some of our giveaways, including collimator readout sheets, stylus pen lights, rulers, calculators, and more. Also, so we stand out in the crowd, we will be giving out MD Anderson logo ribbons to our alumni as well as current students, faculty and staff. Please hang it from your name badge. We look forward to seeing you in Denver!

Thursday, Aug. 3

7:30-9:30 a.m. Room: 605

TH-AB-605-8. F Guan, **L Bronk**, M Kerr, D Ma, Y Wang, X Wang, **Y Li**, O Vassiliev, D Patel, U Titt, S Lin, D Grosshans, R Mohan. *Investigation of the Spatial Ionization Density Dependence of the DNA Damage in a Lung Cancer Cell Line with Proton Irradiations.*

7:30-9:30 a.m. Room: 708

TH-AB-708-1. **S Loupot**, D Fuentes, W Stefan, J Sovizi, K Mathieu, J Hazle. *A 3D Reconstruction Algorithm for Superparamagnetic Relaxometry.*

7:30-9:30 a.m. Room: Four Seasons 1

TH-AB-FS1-12. J Johnson, **T Netherton**, **Y Li**, P Nitsch, S Gao, P Balter, A Klopp, L Court. *Process Failure Modes and Effects Analysis On Human Errors Using a Novel Linac with Simplified Workflow.*

10 a.m.-12 p.m. Room: 205

TH-CD-205-3. **R McCarroll**, L Zhang, **C Cardenas**, P Balter, **K Kisling**, M Mejia, C Nelson, D Followill, C Peterson, J Yang, B Beadle, L Court. *Fully Automated VMAT Planning in the Head and Neck.*

TH-CD-205-9. **T Netherton**, **Y Li**, P Nitsch, P Balter, S Gao, A Klopp, L Court. *The Interplay Effect When Treating Moving Tumors Using High Dose Rate and Increased MLC and Gantry Rotation Speeds.*

TH-CD-205-12. **Y Li, T Netherton**, P Nitsch, A Klopp, L Court, P Balter, S Gao. *Application of the AAPM TPS Professional Practice Guideline in Commissioning a Paired Prototype Linear Accelerator/TPS.*

10 a.m.-12 p.m. Room: 708

TH-CD-708-8. P Balter, **Y Li**, **T Netherton**, P Nitsch, H Pan, S Gao, A Klopp, L Court. *Palliative Radiotherapy Simulation and Treatment in Under 10 Minutes On a Novel Linear Accelerator.*

1-3 p.m. Room: Four Seasons 1

TH-EF-FS1-7. **K Kisling**, L Zhang, A Jhingran, J Yang, H Simonds, **R McCarroll**, M du Toit, P Balter, R Howell, K Schmeler, O Bogler, B Beadle, L Court. *Fully-Automated Treatment Planning for Cervical Cancer Radiotherapy.*

TH-EF-FS1-9. **Y Li**, **T Netherton**, P Nitsch, P Balter, S Gao, A Klopp, L Court. *Independent Validation of Machine Performance Check (MPC) for a Prototype Linac.*

TH-EF-FS1-11. **T Netherton**, S Shaitelman, **Y Li**, P Nitsch, P Balter, S Gao, M Muruganandham, S Frank, S Hahn, A Klopp, L Court. *Multi-Isocenter Breast Treatments On a Prototype Linear Accelerator: A Study of Interplay Effect and Robustness.*