M. Allan Thomas
Curriculum Vitae

UT MD Anderson Cancer Center
Department of Imaging Physics
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EDUCATION

UT MD Anderson Cancer Center, Houston, TX, 2019-present

CAMPEP Accredited Diagnostic Imaging Physics Residency/Fellowship
Completion Expected: July 2022
ABR Status: Passed Exam 1 in August 2019

Washington University, St. Louis, MO, 2017-2019

CAMPEP Accredited Medical Physics Certificate

University of Arkansas at Little Rock, Little Rock, AR, 2007-2012

Ph.D. in Applied Science (Applied Physics), 2012, Advisor: Jingbiao Cui
M.S. in Applied Science (Applied Physics), 2012

University of Memphis, Memphis, TN, 2000-2005

B.S. in Physics; B.S. in Mathematical Sciences
Magna Cum Laude, with Honors

APPOINTMENTS

UT MD Anderson Cancer Center, Houston, TX, 2019-present

Imaging Physics Fellow, Department of Imaging Physics
Clinical Supervisor: Dr. Anthony Liu Research Supervisor: Dr. Cheenu Kappadath

Washington University School of Medicine, St. Louis, MO, 2017-2019

Postdoctoral Researcher, Department of Radiation Oncology
Primary Supervisor: Dr. Deshan Yang Secondary Supervisor: Dr. Tiezhi Zhang

Catholic High School for Boys, Little Rock, AR, 2016-2017

Physics and Chemistry Teacher, Head Golf Coach

University of Arkansas at Little Rock, Little Rock, AR, 2014-2016

Assistant Professor (Tenure Track), Department of Physics and Astronomy

University of Tulsa, Tulsa, OK, 2013-2014

Instructor, Department of Physics and Engineering Physics

Stetson University, DeLand, FL, 2012-2013

Visiting Assistant Professor, Physics Department

MEDICAL PHYSICS RESEARCH AND EXPERIENCE

Medical Physics Research Interests:

My research in medical physics is currently focused on imaging physics aspects of nuclear medicine and radionuclide therapy. Specific topics include predictive dosimetry and treatment planning for ^{90}Y radioembolization, clinical applications of prediction models for net administered ^{90}Y activity from post-therapy SPECT/CT imaging, minimum detectable activity in novel PET imaging applications, and dual-isotope SPECT imaging in ^{227}Th radionuclide therapy. Various other clinical physics projects across the spectrum of diagnostic imaging have also been explored. Specific details are listed below:

- Analyzing the accuracy and precision of ^{99m}Tc-MAA and partition model based predictive dosimetry for ^{90}Y therapy. Identifying clinical scenarios that offer the best opportunity to utilize patient specific treatment planning based on ^{99m}Tc-MAA and partition model estimates.
- Data collection and analysis in the prospective clinical trial, RAPY90D, for patient specific dosimetry and tumor dose escalation in ^{90}Y therapy.
- Development of a clinical tool to enable real-time assessment of misadministrations and automated dosimetry calculations in ^{90}Y therapy. The tool utilizes prediction models for net administered ^{90}Y activity from post-therapy ^{90}Y SPECT/CT images.
- Analysis and clinical ramifications of minimum detectable activity for novel PET imaging applications, specifically PSMA-based tracers for prostate cancer.
- Exploration of dual isotope SPECT imaging for ^{227}Th radionuclide therapy – energy spectrum analysis, decay/buildup analysis of ^{227}Th/^{223}Ra for optimized imaging, and identifying SPECT imaging protocols.

Prior to joining MD Anderson, my research in medical physics focused on plan quality predictions and analysis as well as deformable image registration for applications in magnetic resonance image guided radiation therapy at Washington University in St. Louis.

Publications:

1. P. Kandlakunta, **A. Thomas**, Y. Tan, R. Khan, and T. Zhang; "Design and Numerical Simulations of W-Diamond Transmission Target for Distributed X-ray Sources," *Biomed. Phys. Eng. Express,* **5**, 025030 (2019).
2. Y. Fu, X. Wu, **M.A. Thomas**, H. Li, and D. Yang; "Accurate and Dense Landmark Pairs Detection for 4DCT Lung Deformable Image Registration Evaluation," *Med. Phys.,* **46**, 4490-4501 (2019).
3. **M.A. Thomas**, Y. Fu, and D. Yang; "Development and Evaluation of Machine Learning Models for Voxel Dose Predictions in Online Adaptive Magnetic Resonance Guided Radiation Therapy," *J. Appl. Clin. Med. Phys.*, DOI: 10.1002/acm2.12884.
4. D. Yang, **M.A. Thomas**, R. Kashani, T. Zhao, A. Curcuru, I. Kawrakow, O. Wooten, O. Green, H.H. Li, S. Mutic, and B. Cai.; VRART: An automated physics QA tool for MRI guided online radiation therapy *J. Appl. Clin. Med. Phys.* in press.

Papers Submitted/Under Review:

1. **M.A. Thomas**, A. Mahvash, M. Abdelsalam, A.O. Kaseb, and S. Cheenu Kappadath; "Planning Dosimetry for ^{90}Y Radioembolization: Evaluating the Fidelity of ^{99m}Tc-MAA and Partition Model Predictions," *Med. Phys.*, under review.

2. **M.A. Thomas**, J. Olick-Gibson, Y. Fu, and D. Yang; "Using Artificial Neural Network Models to Analyze MR Guided Radiation Therapy: Offline vs Online Adaptive and ^{60}Co vs Linac," *Phys. Imag. Radiat. Oncol.*, under review.

Presentations:

- **AAPM/COMP Virtual Meeting, July 12-16, 2020**

1. "Planning Dosimetry for ^{90}Y Therapy: Evaluating the Predictive Power of ^{99m}Tc-MAA and the Partition Model," **M.A. Thomas**, A. Mahvash, M. Abdelsalam, A. Kaseb, and S.C. Kappadath. (Oral)
2. "Predicting Net ^{90}Y Administered Activity in ^{90}Y-Radioembolization from Post-Therapy ^{90}Y-SPECT/CT Images," **M.A. Thomas**, B.P. Lopez, A. Neff, A. Mahvash, and S.C. Kappadath. (Oral)
3. "Using Prediction Models to Analyze MR Guided Radiation Therapy Plans," **M.A. Thomas**, J. Olick-Gibson, P. Parikh, and D. Yang. (Oral)
4. "3D Dose Predictions and Plan Quality Assessment in MRI Guided Online Plan Adaptation Using Artificial Neural Network (ANN) Models," D. Yang, **M.A. Thomas**, H. Gach, and H.H. Li. (Blue Ribbon Poster)
5. "Technique Evaluation of Dose Area Product Measurements for Dual-Energy X-Ray Absorptiometer System," J. Jiminez, **M.A. Thomas**, and W. Erwin. (Poster)
6. "Optimization and Validation of An Automatic Noise Measurement Algorithm for Clinical CT Image Data," M. Ahmad, **M.A. Thomas**, M. Jacobsen, R. Layman, and K. Brock. (Poster)

- **AAPM Annual Meeting, July 14-18, 2019; San Antonio, TX**

7. "Plan Metric and 3D Dose Prediction for Improved Online Adaptive Decisions in MR-Guided Radiation Therapy," **M.A. Thomas**, Y. Fu, P.J. Parikh, and D. Yang. (Oral)
8. "Evaluation of Surface-Based DIR Accuracy Using Digital Phantom Simulations and a Customized Physical Phantom for MR-Guided RT Plan Adaptation," **M.A. Thomas**, P.J. Parikh, and D. Yang. (Snap Oral)
9. "Deformable Registration of Uterus and Upper Vagina Wall Using Gaussian Mixture Model (GMM) Plus Finite Element Model (FEM) and Dose Gradient-Based Evaluation for Supporting GYN HDR Brachytherapy Dose Accumulation," X. Wu, **M.A. Thomas**, J. Williamson, and D. Yang. (Snap Oral)

- **AAPM Annual Meeting, July 29 – August 2, 2018; Nashville, TN**

10. "What Predicts Target Coverage in MR-Guided Adaptive Radiation Therapy of the Pancreas? It is Not OAR Nearest Distance," **M.A. Thomas**, A. Curcuru, O. Green, and P. Parikh. (Poster)
11. "A W-Diamond Transmission Target for Multi-pixel X-Ray Sources with a Stationary Anode," P. Kandlakunta, Y. Tan, **M.A. Thomas**, and T. Zhang. (Oral)

12. "X-Ray Field Imaging with a Linear Scan X-Ray Source and Linear Detector Array," T. Zhang, P. Kandlakunta, X. Chen, Y. Tang, and **M.A. Thomas**. (Invited)

Medical Physics Clinical Experience

- I have observed and/or directly participated in the following clinical medical physics tasks:
  - Monthly linac QA (Varian Trilogy and TrueBeam)
  - Monthly CT Sim QA (Siemens)
  - Monthly MR Sim QA (ViewRay 0.35 T, Phillips 1.5 T)
  - TG-51 single point dose measurement and output calibration/adjustment (Varian Trilogy)
  - 3D beam scanning with IBA full size water phantom (Varian TrueBeam)
  - Radiochromic film dosimetry for protons (Mevion S250)
  - HDR Brachytherapy source exchange and verification (Ir-192)
  - Motion management analysis and QA with motion phantom (2D lung)

Medical Physics Teaching Experience

- In the Fall of 2018 I served as the primary in-class instructor for the first half of the Radiological Physics and Dosimetry graduate course at WashU. This course is offered by the Radiation Oncology department and serves both the CAMPEP Certificate program in Medical Physics as well as graduate students in physics, biomedical engineering, and other fields.
- In the Radiological Physics course described above, I utilize many of the active learning and engaged teaching practices I developed significant experience and comfort with during my previous academic teaching career in physics. I feel strongly that the future of medical physics and other education related to Radiation Oncology and Diagnostic Medical Imaging will need to focus more on modern and evidence-based teaching methods to ensure that future students and workers in these fields are well educated and well informed.

PRIOR GRANTS AND FUNDING

1. "**SiGeSn Based Photovoltaic Devices for Space Applications**," NASA EPSCoR Award

   - Co-Principal Investigator with Fisher Yu (PI) and Hameed Naseem (Co-PI) from University of Arkansas at Fayetteville and Mansour Mortazavi (Co-PI) from University of Arkansas at Pine Bluff
   - Total award amount: **$750,000**; Thomas share: **$96,500**
   - Award period: August 1, 2015 – July 31, 2018

2. "**Doped Nanocarbons for Sustainable Energy and Water Purification**," UALR Research Cluster Seed Grant Award

- Co-Principal investigator with Tito Viswanathan (PI), Brian Berry (Co-PI), and Nawab Ali (Co-PI), all from UALR
- Total award amount: **$50,000**; Thomas share: **$12,500**
- Award period: January 1, 2016 – December 31, 2017

3. "**Improving Cu_2O Solar Cells with Atomic Layer Deposition Techniques**," Arkansas Science and Technology Authority (ASTA) Basic Research Award

   - Principal and sole investigator
   - Award amount: **$46,554**
   - Award period: November 21, 2014 – May 30, 2016

4. "**An Optoelectronic Material Integration Platform Using SiGeSn for Advanced NASA Applications**," NASA Arkansas Space Grant Consortium RID Award

   - Co-Principal investigator with Fisher Yu (PI) from University of Arkansas at Fayetteville
   - Total award amount: **$25,000**; Thomas share: **$9,000**
   - Award period: December 1, 2014 – October 17, 2015

5. "**UALR Science Show: Exploring The Magic of Physics**," NASA Arkansas Space Grant Consortium K-12 Award

   - Principal and sole investigator
   - Total award amount: **$5,000**
   - Award period: December 8, 2014 – May 25, 2015

PRIOR RESEARCH AND EXPERIENCE

Before transitioning into the field of medical physics, I focused my research on semiconductor thin films and nanomaterials and their potential applications in optoelectronic devices and energy conversion. Specific details are listed below:

- Improved thin film solar cells with optimized device layers and interfaces via atomic layer deposition techniques
- Enabled wide tunability of ZnO's optical and electrical properties in atomic layer deposition processes utilizing plasmas and doping, extended this work to other oxides such as Cu_2O
- Enhanced the properties and device application potential of ZnO materials in core-shell nanostructures
- Achieved first success of *p*-type doping in ZnO using a low cost and low temperature electrodeposition technique
- Developed techniques for deposition and structure/properties relationships in undoped and doped ZnO nanowires and thin films

Deposition Techniques: atomic layer deposition, electrodeposition, solution deposition techniques (wet chemistry), thermal evaporation, RF and DC sputtering, chemical vapor deposition.

Characterization Techniques/Equipment: photoluminescence spectroscopy – room temperature and low temperature, Hall effect and resistivity, electrochemical impedance spectroscopy, UV-Vis spectroscopy (transmittance, reflectance, absorption), x-ray photoelectron spectroscopy, x-ray diffraction, scanning electron microscopy, probe-station/transistor measurements.

Computational and Data Analysis: I am proficient in programming in MATLAB and have some experience with C++, VBA, and LABVIEW. I have written many of my own scripts for specific image processing and statistical analysis projects. More generally:

- I am comfortable working with advanced equipment and the related software that is common in a quantitative research field
- I have led/developed (or both) a wide range of research projects that were highly quantitative in nature and involved significant planning, critical thinking, and data analysis, including regression and statistical analysis

I am comfortable working with and processing large datasets, my specific experience relates to medical imaging and patient data analysis.

Below is a full list of the publications and presentations prior to my transition to medical physics:

BOOK CHAPTER

1. **M.A. Thomas** and J.B. Cui; "Electrodeposition of ZnO Nanostructures: Growth, doping, and physical properties" in *Handbook of Nanoelectrochemistry: Electrochemical synthesis methods, properties and characterization techniques*, edited by M. Aliofkhazraei (Springer, 2015).

JOURNAL PUBLICATIONS

17. W.W. Sun, K.Y. Wu, **M.A. Thomas**, F. Meng, X.P. Song, Z.Q. Sun, Z.L. Zhang, and J.B. Cui; "Current oscillations in the layer-by-layer electrochemical deposition of vertically aligned nanosheets of zinc hydroxide nitrate," J. Electrochem. Soc., **160**, D558 (2013).

16. **M.A. Thomas** and J.B. Cui; "Highly uniform 2D growth, substrate transfer, and electrical characterization of electrodeposited ZnO thin films," J. Electrochem. Soc., **160**, D218 (2013).

15. **M.A. Thomas**, J.C. Armstrong, and J.B. Cui; "New approach toward transparent and conductive ZnO by atomic layer deposition: Hydrogen plasma doping," J. Vac. Sci. Technol. A, **31**, 01A130 (2013).

14. Y. Caglar, D.D. Oral, M. Caglar, S. Ilican, **M.A. Thomas**, K.Y. Wu, Z.Q. Sun, and J.B. Cui; "Synthesis and characterization of $(CuO)_x(ZnO)_{1-x}$ composite thin films with tunable optical and electrical properties," Thin Solid Films, **520**, 6642 (2012).

13. **M.A. Thomas** and J.B. Cui; "Highly tunable electrical properties in undoped ZnO grown by plasma enhanced thermal-atomic layer deposition," ACS Appl. Mater. Interfaces **4**, 3122 (2012).

12. S. AbdulAlmohsin, M. Mohammed, Z. Li, **M.A. Thomas**, K.Y. Wu, and J.B. Cui; "Multi-walled carbon nanotubes as a new counter electrode for dye-sensitized solar cells," J. Nanosci. Nanotechnol., **12**, 2374 (2012).

11. K.Y. Wu, Q.Q. Fang, W.N. Wang, **M.A. Thomas**, and J.B. Cui; "On the origin of an additional Raman mode at 275 cm^{-1} in N-doped ZnO thin films," J. Appl. Phys., **111**, 063530 (2012).

10. **M.A. Thomas**, W.W. Sun, and J.B. Cui; "Mechanism of Ag-doping in ZnO nanowires by electrodeposition: Experimental and theoretical insights," J. Phys. Chem. C, **116**, 6383 (2012).

9. **M.A. Thomas** and J.B. Cui; "Core-shell nanowire arrays of metal oxides deposited by atomic layer deposition," J. Vac. Sci. Technol. A **30**, 01A116 (2012).

8. **M.A. Thomas** and J.B. Cui; "Electrochemical route to *p*-type doping of ZnO nanowires," J. Phys. Chem. Lett. **1**, 1090 (2010).

7. J.B. Cui and **M.A. Thomas**; "Power dependent photoluminescence of ZnO," J. Appl. Phys. **106**, 033518 (2009).

6. J.B. Cui, **M.A. Thomas**, Y.C. Soo, H. Kandel, and T.P. Chen; "Effects of nitrogen on the growth and optical properties of ZnO thin films grown by pulsed laser deposition," J. Phys. D: Appl. Phys. **42**, 155407 (2009).

5. **M.A. Thomas** and J.B. Cui; "Electrochemical growth and characterization of Ag-doped ZnO nanostructures," J. Vac. Sci. Technol. B **27**, 1673 (2009).

4. **M.A. Thomas** and J.B. Cui, "Investigations of acceptor-related photoluminescence from electrodeposited Ag-doped ZnO," J. Appl. Phys. **105**, 093533 (2009).

3. J.B. Cui, **M.A. Thomas**, H. Kandel, Y.C. Soo, and T.P. Chen; "Low temperature doping of ZnO nanostructures," Sci. China Ser. E – Tech. Sci. **52**, 318 (2009).

2. J. B. Cui, Y.C. Soo, H. Kandel, **M.A. Thomas**, T.P. Chen, and C.P. Daghlian; "Investigations of ZnO thin films deposited by a reactive pulsed laser ablation," Sci. China Ser. E – Tech. Sci. **52**, 99 (2009).

1. J.B. Cui, Y.C. Soo, **A. Thomas**, H. Kandel, and T.P. Chen; "Variable temperature photoluminescence of pulsed laser deposited ZnO thin films," J. Appl. Phys. **104**, 043521 (2008).

CONFERENCE PROCEEDINGS (all peer-reviewed)

5. **M.A. Thomas** and J.B. Cui, "Improving thin film solar cells with atomic layer deposited ZnO: Highly tunable buffer, intrinsic, and top contact layers in a single fabrication process," Photovoltaic Specialists Conference (PVSC), 39th IEEE, 1187 (2013).

4. **M.A. Thomas** and J.B. Cui, "Investigations of the optical properties of ZnO-metal oxide core-shell nanowires arrays for use in advanced optoelectronics," Photovoltaic Specialists Conference (PVSC), 38th IEEE, 001931 (2012).

3. L. Ji, **M.A. Thomas**, J.B. Cui, and V.V. Varadan, "Blazed pyramidal gratings for enhanced light trapping in very thin film solar cells," Photovoltaic Specialists Conference (PVSC), 38th IEEE, 000338 (2012).

2. **M.A. Thomas**, J.B. Cui, and F. Watanabe; "Structure and photoluminescence of metal oxide core-shell nanowire arrays," ECS Trans. **45**, 41 (2012).

1. **M.A. Thomas** and J.B. Cui; "The effects of an O_2 plasma on the optical properties of atomic layer deposited ZnO," ECS Trans. **45**, 87 (2012).

PRESENTATIONS AT CONFERENCES AND MEETINGS

13. "Improving thin film solar cells with atomic layer deposited ZnO: Highly tunable buffer, intrinsic, and top contact layers in a single fabrication process;" **M.A. Thomas** and J.B. Cui.

- 39th IEEE Photovoltaic Specialists Conference, June 16-21, 2013; Tampa, FL

12. "Tuning material properties in ALD ZnO films: *in situ* plasma treatments and doping;" **M.A. Thomas** and J.B. Cui.

- 59th American Vacuum Society International Symposium, October 28-November 2, 2012; Tampa, FL

11. "Investigations of the optical properties of ZnO-metal oxide core-shell nanowires arrays for use in advanced optoelectronics;" **M.A. Thomas** and J.B. Cui.

- 38th IEEE Photovoltaic Specialist Conference, June 3-8, 2012; Austin, TX

10. "The use of a remote plasma to tune the optical and electrical properties of atomic layer deposited ZnO;" **M.A. Thomas** and J.B. Cui.

- 221st Electrochemical Society Meeting, May 6-11, 2012; Seattle, WA

9. "Enhanced optical properties of metal oxide core-shell nanowire arrays;" **M.A. Thomas** and J.B. Cui.

- 221st Electrochemical Society Meeting, May 6-11, 2012; Seattle, WA

8. "Enhancing the tunability of material properties in ZnO: The use of an oxygen plasma in atomic layer deposition;" **M.A. Thomas** and J.B. Cui.

- Arkansas Academy of Science Meeting/Conference, April 13-14, 2012; Magnolia, AR

7. "Structural and optical properties of metal oxide core-shell nanowire arrays fabricated by atomic layer deposition;" **M.A. Thomas** and J.B. Cui.

- Arkansas Academy of Science Meeting/Conference, April 13-14, 2012; Magnolia, AR

6. "Electrochemical doping and *p*-type conductivity of ZnO;" J.B. Cui and **M.A. Thomas**.

- 6th International Workshop on ZnO and Related Materials, August 5-7, 2010; Changchun, China

5. "*p*-Type ZnO nanowires doped with Ag by a low temperature electrochemical process;" **M.A. Thomas** and J.B. Cui.

- Arkansas Academy of Science Meeting/Conference, April 9-10, 2010; Little Rock, AR

4. "Photoluminescence characteristics of pulsed laser deposited ZnO thin films grown in N_2/O_2 ambients;" **M.A. Thomas**, J.B. Cui, Y.C. Soo, H. Kandel, and T.P. Chen.

- American Physical Society March Meeting, March 16-20, 2009; Pittsburgh, PA

3. "Electrochemical growth and characterization of Ag-doped ZnO nanostructures;" **M.A. Thomas** and J.B. Cui.

- 5th International Workshop on ZnO and Related Materials, September 22-24, 2008; Ann Arbor, MI

2. "Power dependent photoluminescence of ZnO;" J.B. Cui and **M.A. Thomas**.

   - 5th International Workshop on ZnO and Related Materials, September 22-24, 2008; Ann Arbor, MI

1. "Li-doped ZnO nanowires grown by a low temperature electrochemical process;" **M.A. Thomas**, Y.C. Soo, H. Kandel, and J.B. Cui.

   - Arkansas Academy of Science Meeting/Conference, April 11-12, 2008; Arkadelphia, AR

PHYSICS TEACHING EXPERIENCE

- I maintain significant teaching experience in a variety of introductory physics courses and labs, as well as upper level courses such as electricity and magnetism, quantum mechanics, and thermodynamics.
- The breadth of my teaching experience is likely enhanced in comparison to other early-career academics in physics – I have been the sole instructor for over 50 course and lab sections and roughly 1000 students in physics.

SUPERVISORY AND MENTORING EXPERIENCE

- At UALR, supervised three PhD students and two undergraduate physics majors on research projects related to materials for energy applications; two of the PhD students were female and I recruited the two undergraduate students directly from my introductory physics courses
- During my first year at UALR, supervised the senior research project for a physics major in the Donaghey Scholars Program, and also supervised a five week summer research project for a female minority freshman engineering student
- At Tulsa, supervised a sophomore physics major's summer project to build, test, and use a Hall effect measurement system for electrical characterization of metals and semiconductors
- At Stetson, initiated and supervised the junior year progress of a senior research project involving electrical characterization of metals and semiconductors for a physics major
- During my PhD, supervised research projects of both undergraduates (3) and high school students (3), all of whom are now graduated and/or pursuing degrees in the sciences/engineering at schools such as Swarthmore College, University of Pennsylvania, etc.

INDUSTRY EXPERIENCE

Molex, Inc.: Quality Engineer, Maumelle, AR, 2006-2007

- Created and monitored quality and process control measures for both established and newly developed electronic interconnect product lines, statistical process control, handled customer complaints and issues and resolved the product problems associated with such issues.

AWARDS AND HONORS

Outstanding Graduate Researcher – Department of Physics and Astronomy, UALR, 2011-2012
Publication and Presentation Award – Department of Applied Science, UALR, 2010-2011
Outstanding Graduate Researcher – Department of Physics and Astronomy, UALR, 2010-2011

Outstanding Graduate Teaching Assistant – Dpt. of Physics and Astronomy, UALR, 2008-09

REFERENCES

- Dr. Cheenu Kappadath, Assoc. Professor, Department of Imaging Physics, MD Anderson CC skappadath@mdanderson.org, (713) 745-2835

- Dr. Anthony Liu, Professor, Residency Dir., Department of Imaging Physics, MD Anderson CC hlaliu@mdanderson.org, (713) 563-7383

- Dr. Jingbiao Cui, dissertation advisor, Chair, Department of Physics, University of Memphis jcui@memphis.edu, (901) 678-2620

- Dr. Deshan Yang, Assoc. Professor, Department of Radiation Oncology, Washington University yangdeshan@wustl.edu, (314) 747-8969

- Dr. Tiezhi Zhang, Assoc. Professor, Department of Radiation Oncology, Washington University tiezhizhang@wustl.edu, (314) 362-2639