|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| BIOGRAPHICAL SKETCH | | | | |
|  | | | | |
| NAME  Anderson, Brian Mark | | POSITION TITLE  Graduate Research Assistant (Ph.D Student)  Email  bmanderson@mdanderson.org | | |
| eRA Commons User Name  BrianMAnderson | |
| EDUCATION/TRAINING | | | | |
| INSTITUTION AND LOCATION | DEGREE | | MM/YY | FIELD OF STUDY |
| Georgia Institute of Technology | BS | | 5/15 | Nuclear and Radiological Engineering |
| UT Graduate School of Biomedical Sciences at Houston & UT MD Anderson Cancer Center  UT Graduate School of Biomedical Sciences at Houston & UT MD Anderson Cancer Center | S.M.S  Ph.D | | 9/17  10/17 | Medical Physics  Medical Physics |
|  |  | |  |  |
|  |  | |  |  |
|  |  | |  |  |

A. Personal Statement

My PhD work is centered on the improvement of liver treatments with RF ablation therapy. This work can be broken down into several parts, the first of which was preliminary work with biomechanical models for assessment of colorectal liver metastasis ablation treatments at MD Anderson. A unique method of treatment assessment using biomechanical, model based image registration and deformation was used to determine if local recurrence and non-local recurrence could be determined based on imaging available during the treatment procedure. While this method proved useful, it was not clinically ideal due to the necessity of manual contours. This problem was addressed with the creation of a deep learning neural network to segment the liver in contrast and non-contrast enhanced CT images. This network will later be expanded to include gross disease, ablative zone, internal vasculature, and the individual segments of the liver. The final goal is to create a rapid, streamlined process which can assist in localization of the ablation needle, and identify in real time if sufficient ablation has been delivered.

My goal is to become an academic research physicist.

B. Positions and Honors

**Editorial and Review Activities**

Ad hoc Associate Editor**,** The International Journal of Medical Physics Research and Practice (2020-present)

Manuscript Reviewer, The International Journal of Medical Physics Research and Practice (2019-present)

**Honors/Awards/Grants**

Dr. John J. Kopchick Fellowship (2020)

Society of Interventional Radiology: Allied Scientist Grant (2019)

Science Council Session, AAPM 2019

Early Career Medical Physicist Scholar from Winter Institute of Medical Physics (WIMP) (2018)

2nd place Student Research Retreat (2017)

Graduated with Highest Honors, Georgia Institute of Technology (2015)

AAPM Summer Fellowship: Commissioning of new Elekta LINAC (2014)

Recipient of the Presidents Undergraduate Research Award (PURA) (2013-2014)

**Positions and Employment**

Graduate Student Researcher, MDA Cancer Center, Houston, TX (2015-present)

AAPM Fellowship, St. Joseph’s Hospital, Eureka, CA (2014)

Research Assistant, Georgia Institute of Technology (2013-2014)

**Invited Talks**

Invited Speaker, Winter Institute of Medical Physics annual meeting, “Getting Started with Deep Learning: Dicom to Predictions” Workshop and presentation (02/2020)

Image Guided Cancer Therapy Research Program, MD Anderson Cancer Center “How to Get Started in AI”, Workshop and presentation (01/2020)

North Central Chapter AAPM Annual Meeting: Intro to Deep Learning: Everything I wish I’d known sooner (11/2019)

Rice University ELEC/ COMP 576 Guest Lecturer Invitation: Introduction to Deep Learning (09/2019)

Nuclear Medicine Practical Seminar: Deep Learning in the Liver (05/2019)

**Other Experience and Professional Memberships**

Member, International Society for Optics and Photonics (SPIE) (2018)

Member, Medical Physicists for World Benefit (2017-present)

Member, American Association of Physicists in Medicine (2015 – present)

Member, American Nuclear Society (2012-present)

Internship, Shadowing of Medical Physicist, Catawba Valley Medical Center (2011)

C. Contributions to Science/Selected Peer-reviewed Publications

My contributions to science can be surmised in what I have done during my PhD work and my master’s thesis.

I first became interested in machine learning during my master’s work. The goal of my project was to create an autocontouring system which would accurately identify and differentiate cervical cancer nodes on non-contrast CT images. This work was important namely because 70% of the incidence and mortality burden of cervical cancer occurs in low- and middle-income countries where PET and contrast-CT images are not often available. It was particularly challenging due to the fact that non-contrast CT offers almost no distinctions between various tissues to try and distinguish the positively involved nodes. I’d never used machine learning before, or performed any kind of image analysis, so the project had a steep learning curve. Deciding my best approach to the problem took several iterations, and relied a lot on previous work for machine learning techniques in different sites, like the lungs. In the end, I aimed to reduce the search space as best I could, and identify unique characteristics of the cervical cancer nodes ellipsoidal or spherical shape. I gained experience using basic Demon’s based image registration to register a potential search space onto each patient. From there I used various features to classify the nodes and normal tissues, ultimately feeding the results into ensemble based machine learning models to identify the nodes.

Because of my master’s work, I was particularly interested in deep learning and modeling. My PhD work was initially focused on improving ablative treated liver disease using biomechanical modeling. There are two main aspects which we hoped to improve: 1) the localization of the ablative needle for treatment in the intra-procedural images is difficult in the current standard of care, and 2) there is no method of mapping the disease onto the post-treatment imaging which takes into account the deformation of the liver. I was curious to see if deep learning could facilitate the process, as the biomechanical modeling requires segmentation of the liver, which can be a labor intensive process. I attended a Deep Learning course at the nearby Rice University, and for my final project I applied what I’d learning to the creation of a convolutional neural network for liver segmentation. Since then, the model has been refined and is currently in submission. The segmentation software has been set up as a server where contours can be generated on contrast and non-contrast images for anyone who desires them. Ideally this will soon be available to anyone at the institution who needs the liver segmented. It was this deep learning work which led me to pushing for a larger part of my PhD work to be involved in deep learning. My project now includes segmentation of disease, ablative margins, internal vasculature, and individual liver segments. I’m really excited by what I think will be the biggest challenge, the creation of a biomechanical vector field created from a deep learning network.

**Workshops**

European Society of Interventional Radiology: Reliability in Percutaneous Tumour Ablation. (12/2019)

Rigor and Reproducibility: Gulf Coast Consortia workshop, instructing researchers on the importance of robust research with unbiased analysis and reporting of results. (10/2019)

BigData4Imaging: Conference and workshop for training in machine and deep learning (12/2018)

**Technical Notes**

**Anderson B.M,** Brock K *Simple Python Module for Dicom and RT: Conversions to Images and Masks, and Predictions to Dicom-RT Structures* Practical Radiation Oncology *In Submission 10/2020*

**Papers**

**Anderson B.M,** Lin Y-M, et al. *A novel use of biomechanical model based deformable image registration (DIR) for assessing colorectal liver metastases ablation outcomes* The International Journal of Medical Physics Research and Practice *Accepted* 07/2021

He Y, **Anderson B.M**, et al. *Geometric and Dosimetric Accuracy of Deformable Image Registration between Average-Intensity Images for 4DCT-Based Adaptive Radiotherapy for Non-Small Cell Lung Cancer* Journal of Applied Clinical Medical Physics *Accepted* 06/2021

Cazoulat G, **Anderson B.M,** et al. *Detection of vessel bifurcations in CT scans for automatic objective assessment of deformable image registration accuracy* The International Journal of Medical Physics Research and Practice *In Submission 04/2021*

Wahid K, He R, McDonald B, **Anderson B.M,** et al. *MRI Intensity Standardization Evaluation Design for Head and Neck Quantitative Imaging Applications* The British Institute of Radiology *In Submission 04/2021*

*Rigaud B,* **Anderson B.M*,*** *et al. Automatic segmentation using deep learning for online dose optimization during adaptive radiotherapy of cervical cancer International Journal of Radiation Oncology, Biology, Physics* 10/2020

**Anderson B.M,** Lin E., et al. *Automated Contouring of Contrast and Non-Contrast CT Liver Images with Fully Convolutional Networks (FCNs)* Advances in Radiation Oncology 05/2020

Cazoulat G., Elganainy, D., **Anderson B.M**, et al. *Vasculature-Driven Biomechanical Deformable Image Registration of Longitudinal Liver Cholangiocarcinoma Computed Tomographic Scans*. Advances in Radiation Oncology 03/2020

Jin Y, et al, “*Detection of Glioblastoma Subclinical Recurrence Using Serial Diffusion Tensor Imaging”* Cancers 02/2020

McCulloch M., **Anderson B.M**, et al. *Biomechanical modeling of neck flexion for deformable alignment of the salivary glands in head and neck cancer images* Physics in Medicine and Biology 07/2019

Kisling K. D.et al*., “A snapshot of medical physics practice patterns,”* J. Appl. Clin. Med. Phys., vol. 19, no. 6, pp. 306–315, (11/2018)

Cardenas, E.C, **Anderson B.M**, et al. *Auto-delineation of Oropharyngeal Clinical Target Volumes Using Three-Dimensional Convolutional Neural Networks* Physics in Medicine and Biology (Accepted 10/2018)

**Anderson B.M,** Brock K., et al. *Improvement of liver ablation treatment for colorectal liver metastases*. Medical Imaging 2018: Image-Guided Procedures, Robotic Interventions, and Modeling, 2018, p. 74.

McCulloch M.M, **Anderson B.M**, et. al *Deformable Image Registration for Modelling Neck Flexion in Head and Neck Cancer Patients.* Physics in Medicine and Biology 09/2019

Ger R.B, Cardenas E.C, **Anderson B.M**, et. al *Guidelines using Imaging Biomarker Explorer (IBEX) for Radiomics.* Journal of Visualized Experiments 01/2018

Court L.E, Kisling K, et al. *Radiation Planning Assistant – A streamlined, fully automated radiotherapy treatment planning system*. Journal of Visualized Experiments. 12/2017

Rubinstein, A. E., Ingram, S. W., **Anderson, B.M**, et al. *Cost-effective immobilization for whole brain radiation therapy*. Journal of Applied Clinical Medical Physics. 04/2017

**Oral Presentations (Presenting Author)**

**Anderson, B.M.**, McCulloch M., et al. *Closing the Variability Gaps on Liver Surgery: Deep Segmentation of Disease and Lobes* AAPM Annual Conference. (Virtual) Vancouver, Canada. 07/2020.

**Anderson, B.M.**, Cazoulat G., et al. *Deep Learning for Rapid Deformable Image Registration of Liver CT Scans* AAPM Annual Conference. San Antonio, TX. 07/2019.

**Anderson B.M**, Lin E., et al *Improving Colorectal Liver Metastasis Treatments with Biomechanical Modeling and Deep Learning* SIR Annual Conference. Austin, TX. 03/2019.

**Anderson B.M**, Lin E., et al. *Automated Contouring of Contrast and Non-Contrast CT Liver Images with Fully Convolutional Neural Networks* ASTRO Annual Conference. San Antonio, TX. 10/2018

Cardenas C, **Anderson, B.M**, et al. *A Comparison of Two Deep Learning Architectures to Automatically Define Patient-Specific Beam Apertures.* AAPM Annual Conference. Nashville, TN. 07/2018

**Anderson, B.M,** Cardenas C, et al. *Deep Learning for Head and Neck Segmentation in MR: A Tool for the MR-Guided Radiotherapy.* AAPM Annual Conference. Nashville, TN. 07/2018

**Anderson B.M, Lin E.,** et al. *Deep Learning and Biomechanical Models for Improving Treatment of Colorectal Liver Metastases*. SWAAPM Annual Conference. Houston, TX 04/2018

**Anderson, B.M**, Lin E., et al. *Improvement of liver ablation for Colorectal Liver Metastases* MDA Cancer Imaging and Intervention Conference. Houston, TX 04/2018

**Anderson, B. M.**, Cardenas, C. E, et al. *Computer-Aided Detection of Pathologically Enlarged Lymph Nodes of Non-Contrast CT in Cervical Cancer Patients for Low-Resource Settings* AAPM Annual Conference. Denver, CO. 07/2017.

**Abstracts**

Rigaud, B., et al *Evaluation of Deep Learning-Based Automatic Segmentation of the Pancreas* AAPM Annual Conference. Virtual, 07/2021

McCulloch, M.,**.**, et al *Use of Deep Learning Segmentation and Biomechanical Models to Improve Dose Accumulation Accuracy in GI Structures* AAPM Annual Conference. Virtual, 07/2021

Reber, B., **Anderson, B.M.**, et al *Predicting Osteoradionecrosis From Head and Neck Radiotherapy Using a Residual convolutional Neural Network* AAPM Annual Conference. Virtual, 07/2021

Brock, K., **Anderson, B.M.**, et al *Anatomical Modeling to Improve the Precision of Image Guided Liver Ablation* Image-Guided Therapy Workshop Rockville, MD. 04/2020

Owens, C., Gupta, A., Shrestha, S., **Anderson, B.M.**, et al *Development of a colon model for colon dosimetry in late effect studies* International Society of Radiation Epidemiology and Dosimetry, Sitges, Spain. 05/2020

Elhalawani, H., et al. *Longitudinal and Dose Dependent Analysis on White Matter Injury in Glioblastoma Radiation Therapy* ASTRO Annual Conference, Chicago, IL. 09/2018

McCulloch M., Elhalawani H., **Anderson B.M**, et. al *Biomechanical model-based Deformable Image Registration for OARs in Glioma Patients* RSNA Annual Conference, Chicago, IL. 11/2018

Lin E.Y., **Anderson B.M**, et al. *Application of a biomechanical deformable registration image method for assessing ablation margins in colorectal liver metastases*. CIRSE Annual Conference. Barcelona, Spain (09/2018)

Kisling K., et al. *Broadening the Graduate School Experience: Paper-In-A-Day* AAPM Annual Conference. Nashville, TN. 07/2018

Sen A, **Anderson B.M**, et al. *A Comparison of Deformable Registration Techniques for Pre and Post-Treatment Cholangiocarcinoma CT Images.* AAPM Annual Conference. Nashville, TN. 07/2018

Cazoulat G, Chaudhury B, **Anderson B.M**, et al. *Use of Vasculature Information in Biomechanical Model-Based Registration of Longitudinal Liver Cancer CT Scans.* AAPM Annual Conference. Nashville, TN. 07/2018

D. Research Support/Scholastic Performance

I am receiving funding for my research from the Society of Interventional Radiology Allied Scientist Grant and from my PI, Dr. Kristy Brock from her institutional funding

| Year | Class | Grade |
| --- | --- | --- |
|  | | |
|  |  |  |
| 2017 | Intro to Deep Learning (Rice) | A |
| UT MD Anderson Cancer Center | | |
| 2017 | Fundamental Biological Principals of Molecular Imaging | A |
| 2017 | Therapy Physics Rotation | P |
| 2016 | Imaging Physics Rotation | P |
| 2016 | Radiation Biology | B |
| 2016 | Intro to Radiation Protection | B |
| 2016 | Physics in Nuclear Medicine | A |
| 2016 | Intro to Medical Physics III (Therapy) | A |
| 2016 | Intro to Medical Physics II (Imaging) | A |
| 2016 | Radiation Detection | B |
| 2015 | Electronics for Medical Physics | A |
| 2015 | Applied Math in Medical Physics | A |
| 2015 | Anatomy and Oncology for Medical Physics | B |
| 2015 | Intro to Medical Physics I | A |
| Georgia Institute of Technology | | |
| 2015 | NRE Design | A |
| 2015 | Radiation Physics Lab | B |
| 2014 | Stellar Astrophysics | A |
| 2014 | Engineering Ethics | B |
| 2014 | Special Problems | A |
| 2014 | Radiation Sources and Applications | A |
| 2014 | Nuclear Reactor Physics II | B |
| 2014 | Radiation Protection Engineering | A |
| 2014 | Nuclear Reactor Physics I | B |
| 2014 | Diagnostic Imaging Physics | B |
| 2014 | Science Foundation of Health | A |
| 2013 | Special Topics | B |
| 2013 | Plasma Physics and Fusion Engineering | B |
| 2013 | Reactor Engineering | B |
| 2013 | Radiation Detection | A |
| 2013 | Engineering Economics | A |
| 2013 | Intro to Modern Physics | B |
| 2013 | Radiation Physics | A |
| 2013 | Heat Transfer | A |
| 2013 | Instrumentation and Electronics Lab | B |
| 2013 | Electromagnetics | B |
| 2012 | Intermediate Spanish I | B |
| 2012 | Principle and Applications Engineering Materials | A |
| 2012 | Fluid Mechanics | C |
| 2012 | Circuits and Electronics | A |
| 2012 | Deformable Bodies | A |
| 2012 | Thermodynamics | A |
| 2012 | Statistics and Applications | A |
| 2012 | Elementary French I | A |
| 2012 | The Global Economy | A |
| 2011 | Social Psychology | A |
| 2011 | Intro to Physics II | A |
| 2011 | Differential Equations | A |
| 2011 | Principles of Microeconomics | B |
| 2011 | Statics | B |
| 2011 | General Psychology | A |
| 2011 | Intro to Physics I | A |
| 2011 | Intro to NRE | B |
| 2011 | Calculus III | B |
| 2011 | Computing for Engineers | A |
| 2010 | Linear Algebra for Calculus | B |
| 2010 | The United States to 1877 | A |
| 2010 | Freshman Seminar | A |
| 2010 | English Composition II | B |
| 2010 | General Chemistry | A |