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GRADUATE SCHOOL

Doctoral Dissertation Defense Announcement

Computational and Experimental Studies on Vascular Targeted Plasmonic Thermal Ablation of Solid Tumors

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Candidate for Doctor of Philosophy

Biomedical Engineering

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Ranjan Dash, PhD

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Guilherme Garcia, PhD

Date: Wednesday, May 15, 2024

Time: 1 PM (CST)

Defense Location: MEB Discovery Classroom, M3750

Zoom: https://mcw-edu.zoom.us/s/92948386095

Graduate Studies:

Advanced Computational Physics
Advanced Quantum Mechanics
Advanced Classical Mechanics
Advanced Statistical Mechanics
Advanced Electrodynamics
Advanced Optics
Solid State Physics
Scanning Electron Microscopy (SEM).
Physics of Magnetic Resonance Imaging (MRI)
Digital Image Processing
Machine Learning

Linear Algebra

Biostatistics

System Physiology

Statistical Learning

Advanced Machine Learning

Reading and Research

Research Ethics

Research Ethics Discussion Series

Doctoral Dissertation

Dissertation

"Computational and Experimental Studies on Vascular Targeted Plasmonic Thermal Ablation of Solid Tumors"

Currently, chemotherapy, radiotherapy, surgery, and local ablative therapies are the primary techniques for cancer treatment. However, often local ablative methods just delay the relapse of the cancer and critically depend on the physician's skills to achieve tumor control and reduce off-target treatment effects. Gold nanoparticle mediated photothermal ablation (PTA) has illustrated promising results in animal studies in the past few years. In this method low energy near infrared (NIR) laser illumination is delivered to the unhealthy tissue pretreated with nanoparticles designed to absorb NIR light. NIR plasmonic resonance bearing gold nanoparticles with enhanced optical absorption can be targeted to tumor and increase thermal energy delivery to the tumor, while sparing the healthy tissue. Image-guided PTA for precise positioning of laser source can potentially decrease the off-target damage of the treatment. Despite variety of proposed geometry and material compositions for gold-based nanoparticles, and success in the animal studies, the safety and tumor specific thermal therapy delivery of these nanoparticles in larger spatial scales encountered in human subjects have not been fully studied. Also, the germline inherited characteristics in tumor vasculature which affect nanoparticle delivery and distribution and the effects of tumor microenvironment have not been considered in treatment with PTA methods. In this study, we have designed and exploited computational and experimental models to investigate and understand the effect of tumor vascular microenvironment on the treatment outcome. Moreover, we will target the notch-DLL4 overexpression in the tumor microenvironment by nanoparticles to possibly increase the efficacy of nanoparticle distribution.

Mir Hadi Razeghi Kondelaji
Curriculum Vitae
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Education

Medical College of Wisconsin-Marquette University Milwaukee, WI, US
Biomedical Engineering, PhD, August 2017-current

Central Michigan University Mount Pleasant, MI, US
Physics, Master of Science, January 2015-August 2017

University of Zanjan Zanjan, Iran
Physics, Master of Science,

University of Tabriz Tabriz, East Azarbayjan, Iran
Physics, BSc.,

Research Experience

1. Optical NIR image processing and mathematical modeling of lung cancer and radiation injury.
2. Computational simulation of Microwave and nanogold-mediated photothermal ablation of liver tumors.
3. Drug delivery.
4. Design, modeling, and synthesis of gold-based nanoparticles for imaging and photo-thermal ablation, and
Multimodal optical-MRI contrast agent development.
5. Machine learning and deep learning methods for image processing.
6. Statistical analysis.
7. Lipid structures for drug delivery and cancer treatment.

Supervisors: Dr. Amit Joshi (2018-present)

Characterization of Bio-Degradable Polymers
Supervisors: Dr. Bingbing Li (2015-2017)

Geometry Optimization of Silicon Doped Carbon Nanotubes (CNT) Using Density Functional Theory (DFT) in Gaussian space
Supervisors: Dr. Veronica Barone (2015-2017)

Publications

- Retrospective validation of a simulation platform for benchmarking plasmonic thermal ablation of liver tumors against microwave ablation, **Mir Hadi Razeghi Kondelaji**, Abdul-Kareem Parchur, Sarah B. White, Amit Joshi, (Computers in Physics and Medicine, 2024). Under submission

- 2nd Window NIR Imaging of Radiation Injury Mitigation Provided by Reduced Notch-Dll4 Expression on Vasculature, **Mir Hadi Razeghi Kondelaji**, Guru Prasad Sharma, Jaidip Jagtap, Shayan Shafiee, Christopher Hansen, Tracy Gasperetti, Anne Frei, Dana Veley, Jayashree Narayanan, Brian L. Fish, Abdul K. Parchur, El-Sayed H. Ibrahim, Meetha Medhora, Heather A. Himburg, Amit Joshi, (Molecular Imaging and biology, 2023).

- Photoactivated HPPH-Liposomal Therapy for the Treatment of HPV-Negative Head and Neck Cancer, Joseph Zenga, Musaddiq Awan, **Mir Hadi Razeghi Kondelaji**, Christopher Hansen, Shayan Shafiee, Anne Frei, Jamie Foeckler, Rachel Kuehn, Jennifer Bruening, Becky Massey, Stuart Wong, Amit Joshi, Heather A. Himburg, (Journal of Oral Oncology, 2023)

- X-ray and MR contrast bearing nanoparticles enhance the therapeutic response of image guided radiation therapy for oral cancer, Gayatri Sharma, **Mir Hadi Razeghi Kondelaji**, Abdul K. Parchur, Shayan Shafiee, Jaidip M. Jagtap, Brian Fish, Meetha Medhora, Carmen Bergom, Eric Paulson, William A Hall, Amit Joshi, (Technology in Cancer Research and Treatment, 2023)

- A rapid dynamic in vivo near-infrared fluorescence imaging assay to track lung vascular permeability after acute radiation injury, Jaidip Jagtap, SaidAudi, **Mir Hadi Razeghi-Kondelaji**, Brian L. Fish, Christopher Hansen, Jayashree Narayan, Feng Gao, Gayatri Sharma, Abdul K. Parchur, Anjishnu Banerjee, Carmen Bergom, Meetha Medhora, and Amit Joshi, American Journal of Physiology-Lung Cellular and Molecular Physiology 2021 320:3, L436-L450

- Recent Advances in Electrospun Poly (epsilon-caprolactone)-Based Materials and their Biomedical Applications, LinWang, Reem Ghubayra, Adam J. P. Bauer, **Mir. H. R. Kondelaji**, Bingbing Li, springer, Dec 2017 (book chapter).

Conference Presentations

- **Mir Hadi Razeghi Kondelaji**, Joseph Zanga, Christopher Hansen, Anne Frei, Heather A. Himburg, Amit Joshi, Validation of nanoparticle mediated photodynamic therapy for drug resistant patient derived Head and Neck Cancer xenograft models (Oral Presentation, Accepted for BMES annual seminar, Seattle, October 2023)

- **Mir Hadi Razeghi Kondelaji**, Guru Prasad Sharma, Jaidip Jagtap, Shayan Shafiee, Christopher Hansen, Tracy Gasperetti, Anne Frei, Dana Veley, Jayashree Narayanan, Brian L. Fish, Abdul K. Parchur, El-Sayed H. Ibrahim, Meetha Medhora, Heather A.

Himburg, Amit Joshi, NIR 2nd window imaging to assess the impact of inherited Notch-DLL4 expression on pulmonary radiation injury,World Molecular Imaging Conference, Miami Beach, FL 2022 (Oral Presentation)

- **Mir Hadi Razeghi Kondelaji**, Venkat Gogineni, Sarah B White, and Amit Joshi, Virtual platform for assessing liver tumor ablation margin: Microwave ablation vs Intravascular Plasmonic Photothermal Ablation, Society of Interventional Oncology conference, San Francisco, CA 2022 (Oral Presentation)

- **Mir Hadi Razeghi Kondelaji**, Venkat Gogineni, Sarah B White, and Amit Joshi, Retrospective validation of a virtual platform for personalized thermal ablation planning of liver tumors: Microwave ablation vs Intravascular Plasmonic Photothermal Ablation, Radiological Society of North America (RSNA), Chicago, IL, 2021.

- **Mir Hadi Razeghi Kondelaji**, Abdul Kareem Parchur, and Amit Joshi, Simulation Guided Design of Multimodal MRI-Optical-Photothermal Gold Nano constructs, BMES, Atlanta, GA (October 2018 Conference)

- **Mir Hadi Razeghi Kondelaji**, Abdul Kareem Parchur, Venkat Gogineni, Sarah B White, and Amit Joshi, Feasibility of Ablating Colorectal Cancerous Liver Metastasis via Site-Specific Image Guided Magneto-Plasmonic Nanoparticle Delivery and Photothermal Ablation, BMES, Atlanta, GA (October 2018 Conference)