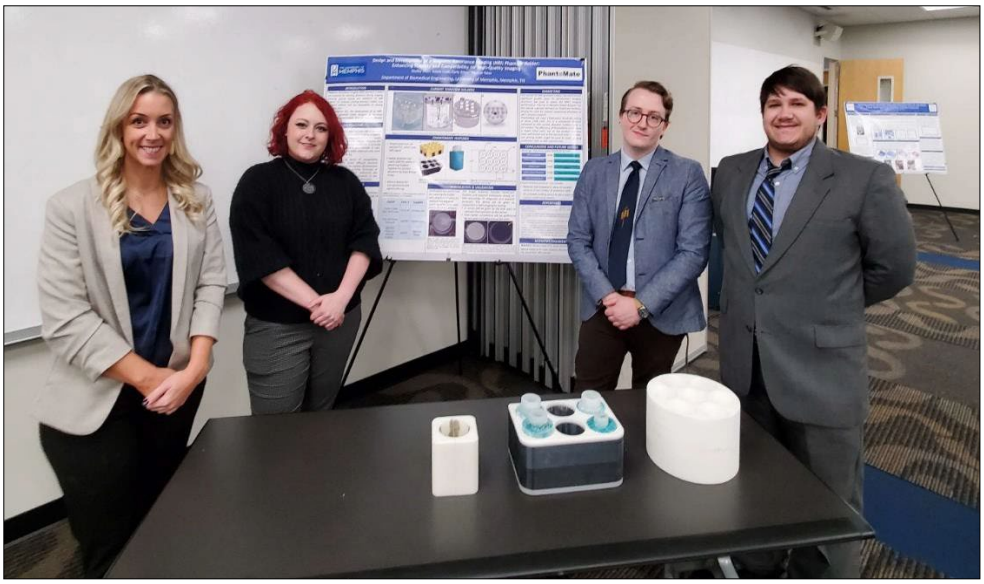
3rd Place Award for Fall 2023 Outstanding Biomedical Engineering Senior Design Project

Team: PhantoMate

Student Team Members**:** (L to R) Carly Ritter, Shelby Allen, Adam Cook, Thomas Yates



Team Advisor**:** Dr. Aaryani Sajja, Assistant Professor, Department of Biomedical Engineering, The University of Memphis

Problem Statement**:**
A phantom is a device that is used as a substitute for tissues to evaluate, analyze and adjust the performance of medical imaging machines like magnetic resonance imaging (MRI) systems. Existing MRI phantom holders may introduce artifacts and lack adaptability to varying specimen sizes. Challenges persist in terms of compatibility, stability, adaptability across different phantom types. A new phantom device is needed that provides adaptability for use to assess performance, quality and imaging capabilities across the evolving landscape of MRI technology.

Brief Description of Design:
The phantom device, PLA-Mate, was constructed from 3-D printed poly-lactide (PLA) filament, with additional silicone sleeves for size adjustment and signal buffering (Figure). These materials do not contribute or introduce artifacts in the MRI signals. The device can be manufactured to be modular to accommodate up to 12 phantoms in a range of sizes based on size of silicone sleeves.

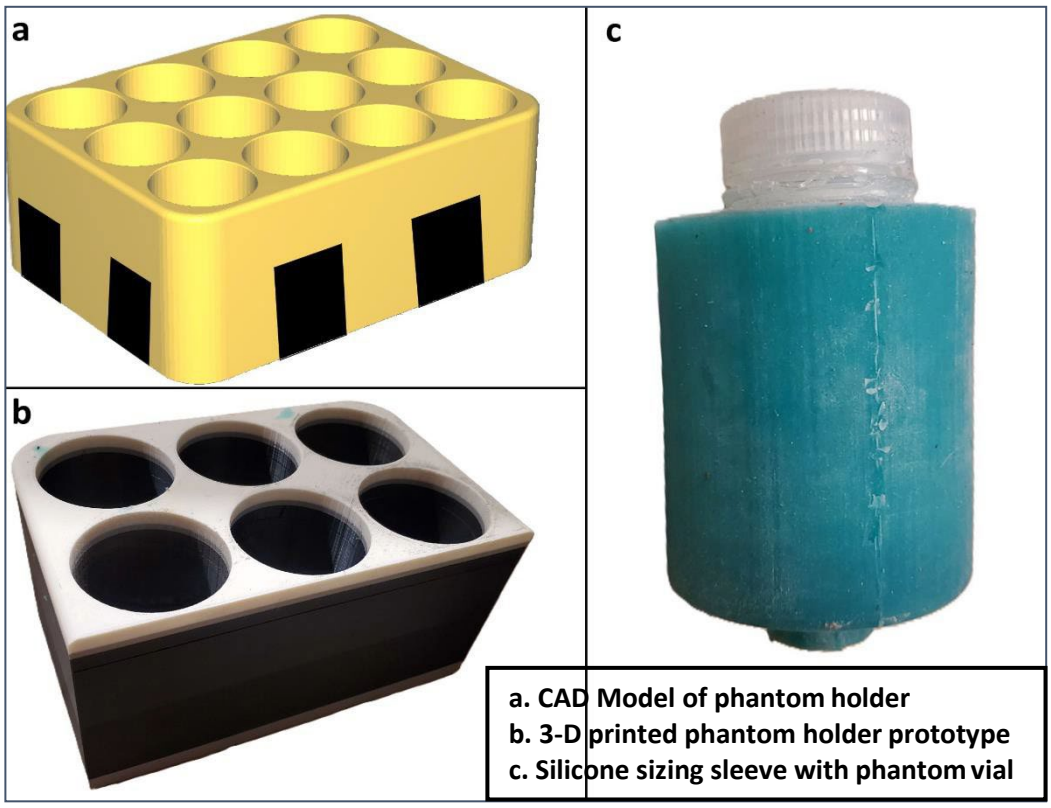


Figure 1: A picture of PLA-Mate modeled in CAD, 3D printed and its silicone sizing sleeves.

Statement of Project Impact: PLA-Mate holds the promise of amplifying the impact of MRI technology in academic and clinical research settings. By enabling precise and reproducible imaging conditions, this compatible MRI phantom holder facilitates the standardization and validation of imaging protocols, supporting rigorous research methodologies and the generation of high-quality data. As a result, PLA- Mate will empower researchers to conduct more robust and reliable studies and drive MRI manufacturers to deliver quality assurance results. These developments will advance our knowledge of diseases, the creation of novel treatments, and the general effectiveness of medical interventions.

Lessons Learned: The development of PLA-Mate, an MRI compatible phantom holder has been a collaborative effort guided by a deep commitment to innovation, excellence in design, and a comprehensive understanding of the various requirements of medical facilities, researchers, and practitioners who are primarily interested in MRI. This innovative device represents the culmination of extensive research, engineering expertise, and a user-centered approach that acknowledges the critical role of human factors and operational efficiency in medical imaging technology.

Our design journey has been highlighted by a commitment to innovation and pushing the boundaries of what is possible in the realm of medical imaging technology. Leveraging conventional materials, manufacturing processes, and meticulous attention to detail, we have engineered the PLA-Mate to deliver reliability, adaptability, and enhancement in diverse medical imaging environments.

We would like to give a special thank you and acknowledgments to the BME Department at the University of Memphis. Our sincerest appreciation goes to Dr. Aaryani Sajja for her valuable support and guidance as our advisor throughout this significant endeavor. Additionally, we wish to express our appreciation to St. Jude Research Hospital for graciously granting us after-hours access to their MRI machine, a vital contribution that

significantly facilitated the development and testing of PLA-Mate.