In recent years, thermal therapies have seen increased use in the treatment of a variety of diseases, particularly in cases of soft tissue cancers. Thermal therapies can be classified into two types: hyperthermia and thermal ablation. The former, hyperthermia, is commonly defined as heating tissues several degrees above body temperature for tens of minutes. The latter, thermal ablation, employs more extreme temperatures over a shorter period to induce rapid and localized tissue destruction. In both, thermal monitoring is necessary to ensure the accuracy of both treatment location and thermal dose. As such, a number of different methods of varying complexity have been reported. The current state of the art in monitoring employs Proton Resonance Frequency Shift (PRFS) Magnetic Resonance Thermal Imaging (MRTI), but the expense and complexity of using MRI limits its use. With the goal of addressing the limitations of the various existing thermal monitoring methods, we previously reported on a real-time microwave imaging method for non-invasive temperature monitoring and validated that method using simple phantoms in a prototype system.

Due to limitations in the forward modeler, the microwave thermal monitoring system reported above was restricted to static cases whose geometries could be manually modeled. Here, we will report on recent progress in real time microwave imaging for thermal therapy monitoring to address those and other limitations in the earlier system. In particular, this will include recent developments in integrating fast forward modeling methods. Finally, results will be shown demonstrating real time microwave thermal monitoring for synthetically generated thermal maps in anatomically realistic numerical phantoms.