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# Development and Implementation of Physics Informed Neural Network for Nuclear Magnetic Resonance-guided Clinical Hyperthermia

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The management of human diseases is transitioning from traditional methods toward personalized medicine, with thermal therapy—comprising clinical hyperthermia and therapeutic hypothermia—becoming a focal point of research. However, both therapies face challenges in clinical trials due to difficulties in monitoring temperature and delivering precise heat to targeted tissue areas. This thesis aims to address these issues by integrating the principles of magnetic resonance relaxation with the Bioheat transfer phenomenon using Physics-Informed Neural Networks (PINN) for Nuclear Magnetic Resonance (NMR)-guided clinical hyperthermia. NMR-guided hyperthermia is a non-invasive technique that leverages MRI to guide the heating process and monitor body temperature distribution.

PINN is a type of neural network that incorporates model equations, such as partial differential equations (PDEs), into its structure, enabling it to learn from limited data while adhering to the underlying physics of the problem. In this work, a deep learning-based PINN was developed using the 1D Pennes' Heat Equation to train an AI model that respects the physical laws governing heat diffusion in tissues. The model, implemented using Python 3.8 on a 64-bit operating system with Jupyter Notebook, is designed to enhance the precision, safety, and efficiency of clinical hyperthermia when integrated into clinical RF devices.

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