Research Proposal Dan's sections draft 1

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1 Introduction

The research through Fort Hays with SAIC that we have both worked on has dealt with focusing on different part of the lab's main area of interest: laser bio effects. Between the two of us we have worked on a tool to generatie linear combinations of temperature profiles and evaluate damage thresholds based on the arrhenius integral, and dealt with solving the heat equation with various conditions in different geometries. The idea for this project came when Dan was thinking, as he often does, about cooking. He was thinking about how the heat equation might be used to model the cooking of chicken. He told Emily, and we began discussing the possibility of putting together a proposal for a research project based on modeling thermal effects in tissue, including potential applications for use of the arrhenius integral.

2 Why is this physically difficult

Modeling heat transfer in tissue presents several unique challenges, causing an analytic solution to problems to be impossible, or too computationally intense to use for multiple situations. Computational physics modeling offers a more versatile option that requires less set up time once a model is in place. The difficulties of this problem lie in 3 parts: the geometries, the unknown properties, and modeling diffusive heat transfer. The geometry of tissue is such that it is weakly homogenous, where it's properies vary within the medium based on position, but stay reasonably consistent. The next issue in characterizing the physical properties of some tissue-like thermal phantom. Finally, the temperature throughout the medium is location and time dependent, but it likely does not follow a simple heat transfer equation, based on it's weakly homogenous geometry it would follow some diffusive equation that deals with the unique situation biological tissue presents.

3 Methodology

Our plan is to create a 3D time-dependent thermal solver to measure heat flow in weakly homogenous media in C++, using existing libraries that Dr. Clark has developed. By applying a hyperbolic heat equation in conjunction with numerical techniques to deal with the unique geometry that weakly homogenous tissue presents. By working with the libraries Dr. Clark has created we save time in terms of developing frameworks for modeling 3D geometries, as well as having any work we may accomplish easily able to be furthered, such as through the use of LibArrhenius to calculate damage thresholds. In terms of the long term we also have an idea for using grocery store meat in order to have a relatively cheap, replicable thing to qualitatively compare

3.1 Equation ideas

hyperbolic/parabolic heat equation idk

3.2 Numerical Methods/Solvers

I do not know

4 Front propagation

Wat