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Parameterizing continuum models of heat transfer in heterogeneous living skin using experimental data

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In this presentation we consider a recent experimental dataset describing heat conduction in living porcine tissues. This novel dataset is important because porcine skin is similar to human skin, and improving our understanding of heat conduction in human skin is directly relevant to understanding burn injuries, which are common, painful and can require expensive treatments. A key feature of skin is that it is layered, with different thermal properties in different layers. Since the experimental dataset involves heat conduction in living tissues of anesthetized animals, an important experimental restriction is that the temperature within the skin is only measured at one location within the layered skin. Our aim is to determine whether this data is sufficient to infer the heat conduction parameters in layered skin, and we use a simplified two-layer model of heat conduction to mimic the experimental dataset. Using synthetic data at one location in the two-layer model, we explore whether it is possible to infer values of the thermal diffusivity in both layers. After this initial exploration, we then examine how our ability to infer the thermal diffusivities changes when we vary the location at which the experimental data is recorded, and in the hypothetical situation where we monitor two locations. Overall, we find that our ability to parameterize a model of heterogeneous heat conduction with limited experimental data is extremely sensitive to the location where data is collected, and our modelling results can be used to provide guidance about future experimental designs.

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