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Title: Elastic Functional Bayesian Model Calibration

Abstract: Functional data are ubiquitous in scientific modeling. For instance, quantities of interest are modeled as functions of time, space, energy, density, etc. Uncertainty quantification methods for computer models with functional response have resulted in tools for emulation, sensitivity analysis, and calibration that are widely used. However, many of these tools underperform when the model's parameters control not only the amplitude variation of the functional output, but also its alignment (or phase variation). We present a simple framework for Bayesian model calibration when the model responses are misaligned functional data. Our goal is to use a metric with appropriate invariance properties, to form objective functions for alignment and to develop statistical models involving functional data. While these elastic metrics are complicated in general, we have developed a family of square-root transformations that map these metrics into simpler Euclidean metrics, thus enabling more standard statistical procedures. From this metric we develop a Bayesian model calibration framework for mis-aligned functional data. We demonstrate the technique to emulate and calibrate a physical model that correspond to platinum experiments executed using Sandia's Z-machine.