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Data Science, Time Complexity & Spacekime Analytics

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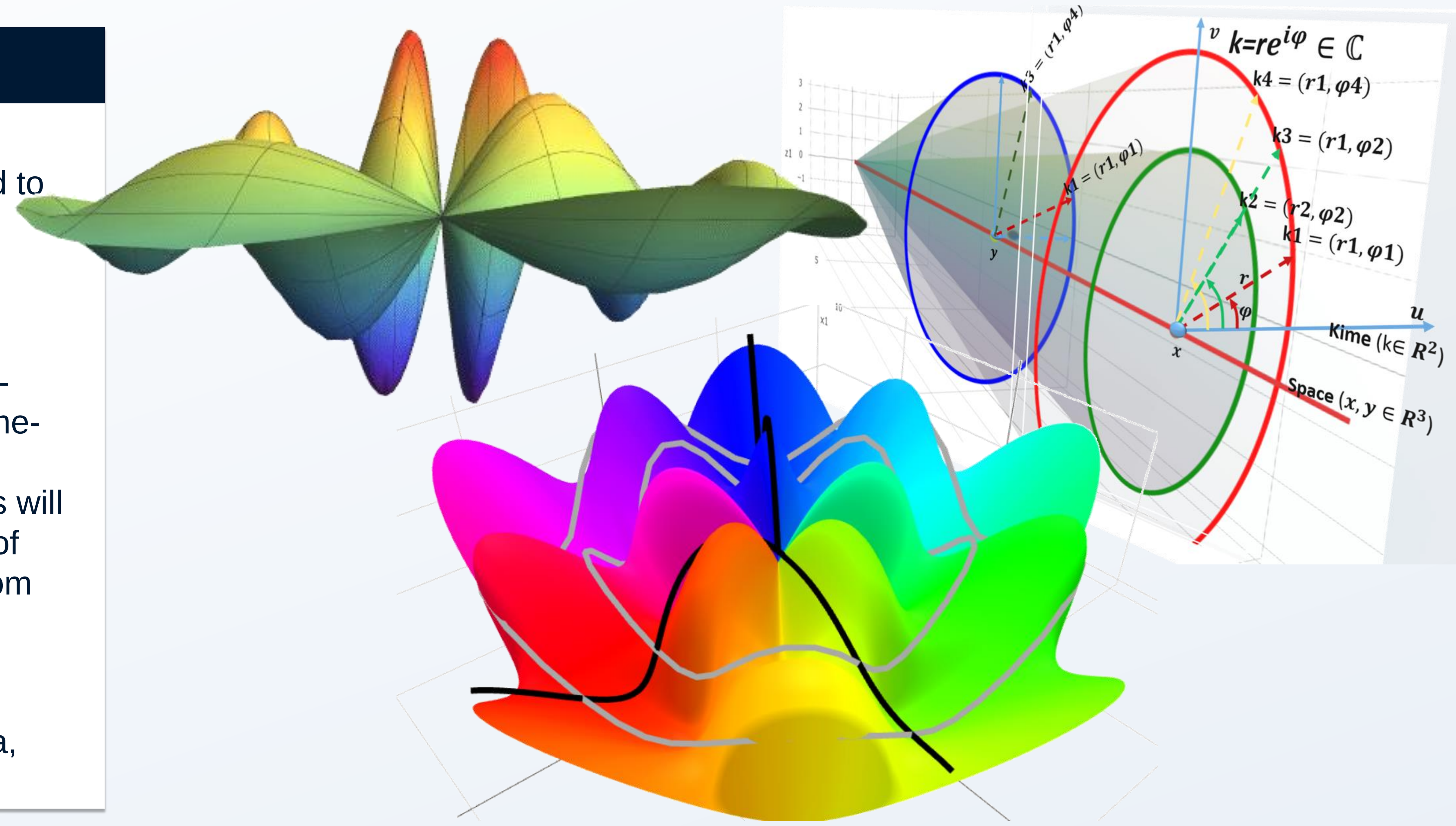
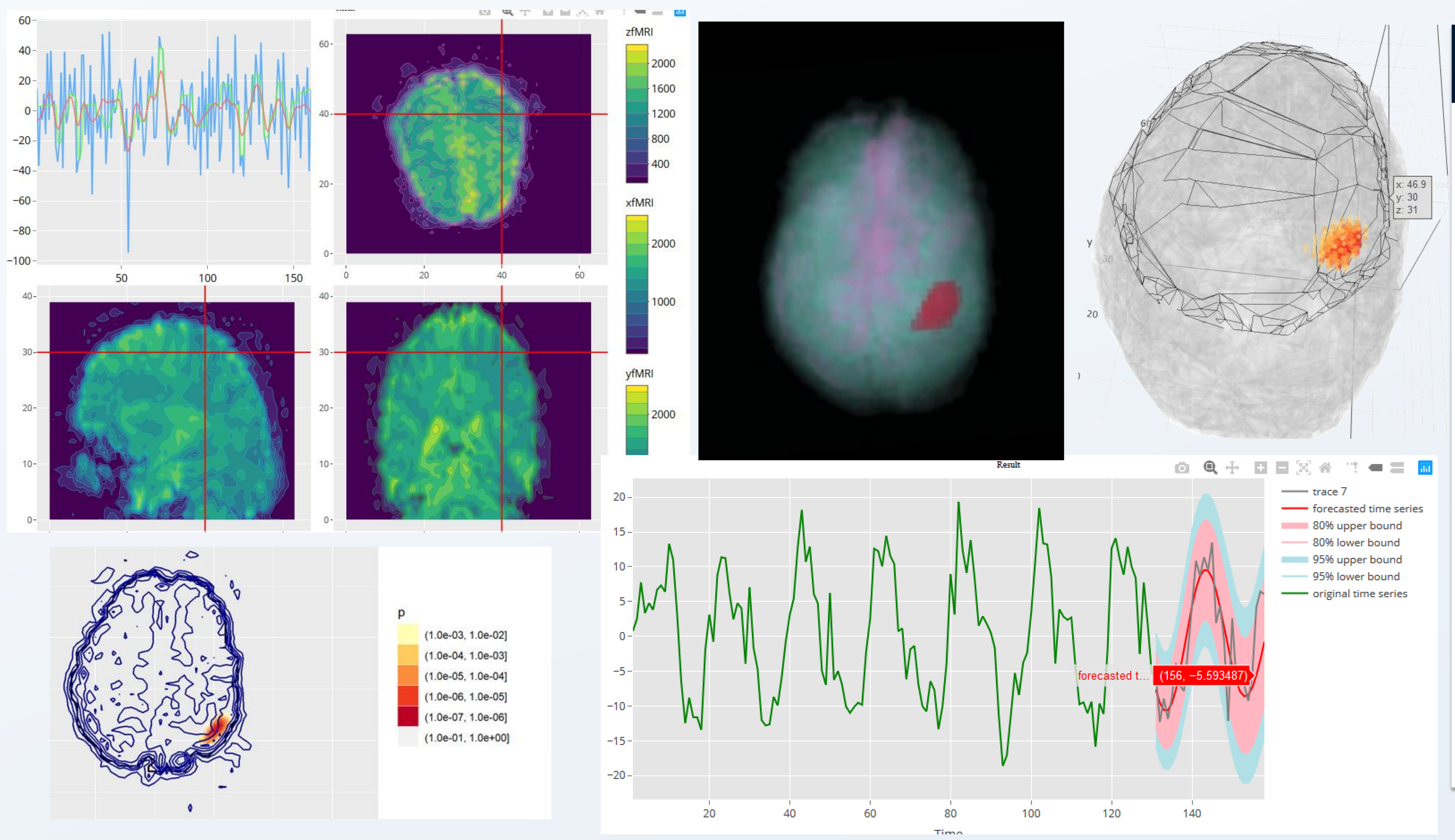
ABSTRACT

The immersion of Big Data in all human experiences presents important challenges of managing, modeling, analyzing, interpreting, and visualizing complex information. There is a substantial need to develop, validate, productize, and support novel mathematical techniques, advanced statistical computing algorithms, transdisciplinary tools, and effective artificial intelligence apps.

Spacekime analytics is a new technique for modeling high-dimensional longitudinal data. This approach relies on extending the notions of time, events, particles, and wavefunctions to complex-time (kime), complex-events (kevents), data and inference-functions. We will illustrate how the kime-magnitude (longitudinal time order) and kime-direction (phase) affect the subsequent predictive analytics and the induced scientific inference. The mathematical foundation of spacekime calculus will reveal various statistical implications including inferential uncertainty and a Bayesian formulation of spacekime analytics. Complexifying time allows the lifting of all commonly observed processes from the classical 4D Minkowski spacetime to a 5D spacetime manifold, where a number of interesting mathematical problems arise.

Direct data science applications of spacekime analytics will be demonstrated using simulated data, clinical observations (e.g., UK Biobank), and environmental air quality data.





LONGITUDINAL DATA TRANSFORM: TIME-SERIES → KIME-SURFACES

In 4D spacetime, classical time-series are represented as real-valued functions defined over the positive real time domain. In the 5D spacekime manifold, time-series (curves) extend to kime-series, which are represented geometrically as surfaces. Examples of a surface corresponding to one such kime-series at a fixed spatial location. At any given kime, i.e., for a pair of arguments kime-magnitude (t) and the kime-phase (φ), the height of the kime-surface represents the intensity of the kime-series and is coded in rainbow color. Notice the 2D parametric kime grid superimposed on the surface of the kime-series. These kimesurfaces that can be modeled, interpreted, analyzed, and predicted using advanced spacekime analytics.

Spacekime allows novel interpretations of Heisenberg uncertainty principle and alternative approaches to large sample theory, where a few spacetime observations can be amplified by a series of derived, estimated, or simulated kime-phases. Newton-Leibniz calculus of integration and differentiation is extended to the spacekime manifold. Classical 4D spacetime mathematical equations describing natural laws of physics, as well as, statistical articulation of spacekime analytics in a Bayesian inference framework can be described in the 5D spacekime manifold.

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DEMOS, CODE, WEBAPPS

Spacekime https://Spacekime.org

Time Complexity and Inferential Uncertainty (TCIU)
https://TCIU.predictive.space

Statistics Online Computational Resource: www.SOCR.umich.edu | statistics@umich.edu