A Hitchhiker's Guide to Temporal Complexity for Resting State fMRI Analysis

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Abstract

Cognitive and clinical neuroimaging have increasingly drawn on tools from complexity science to characterize the nonlinear dynamics of the brain. Temporal complexity metrics reflect a range of approaches to complexity in time series, including describing the system's regularity and irregularity, predictability and unpredictability, information compressibility, and long-term memory. In functional magnetic resonance imaging (fMRI), applications of temporal complexity are scattered across siloed literatures with varying clarity, which limits accessibility and therefore prevalence. This review aims to bridge this gap by communicating the basics of temporal complexity to fMRI scientists. We offer a comprehensive guide to temporal complexity in fMRI, including an overview of fMRI temporal complexity metrics—Shannon entropy, variations of (multi-scale) sample entropy, Lempel-Ziv complexity, avalanche measures, and Hurst—followed by a comprehensive review of extant applications in fMRI.

Keywords: temporal complexity, complexity, entropy, sample entropy, hurst exponent, fractal dimension, fractal, functional magnetic resonance imaging, resting-state, nonlinear dynamics, neuroscience, brain, blood-oxygen level dependence, predictability, irregularity, long-range temporal correlations, long-term memory, scale-invariance, power-law

1. Introduction

Hello [1]

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