

Abstract: Motivated by longitudinal imaging data which possesses inherent spatial and temporal correlation, we propose a novel procedure to estimate its mean function. Functional moving average is applied to depict the dependence among temporally ordered images and flexible bivariate splines over triangulations are used to handle the irregular domain of images which is common in imaging studies. Both global and local asymptotic properties of the bivariate spline estimator for mean function are established with simultaneous confidence corridors (SCCs) as a theoretical byproduct. Under some mild conditions, the proposed estimator and its accompanying SCCs are shown to be consistent and oracle efficient as if all images were entirely observed without errors. The finite sample performance of the proposed method through Monte Carlo simulation experiments strongly corroborates the asymptotic theory. Finally, the proposed method is illustrated by analyzing daily sea water potential temperature data.

Key words: bivariate splines, functional moving average, oracle efficiency, simultaneous confidence corridor, triangulation