Biosignatures for Treatment Response Based on Functional and Imaging Data

R. Todd Ogden
Columbia University, Department of Biostatistics, New York, NY, USA, to166@columbia.edu

Adam Ciarleglio
New York University, New York, NY, USA, Adam.Ciarleglio@nyumc.org
Eva Petkova
New York University, New York, NY, USA, Eva.Petkova@nyumc.org
Thaddeus Tarpey
Wright State University, Dayton, OH, USA, thaddeus.tarpey@wright.edu

In many biomedical applications it is of interest to use functional or imaging data as predictors in regression models as well as traditional scalar predictors. The ultimate goal is to predict a patient's outcome and make treatment decisions based on brain imaging data such as magnetic resonance imaging (MRI), functional MRI (fMRI), or electroencephalography (EEG) and scalar predictors (e.g. age, sex, etc.) obtained at baseline. The amount and complexity of patient-level data being collected in randomized controlled trials offers both opportunities and challenges for developing personalized rules for assigning treatment for a given condition. We will focus on some basic models and methods for estimating a treatment modifier based on functional and scalar data. In general, obtaining meaningful fits in such problems requires some form of dimension reduction while taking into account the structure of the data, a primary goal of functional data analysis. We propose an approach that both selects important prescriptive covariates and estimates a treatment decision rule when there are many candidate covariates. Performance is evaluated on simulated data in a variety of settings and we apply our method to data arising from the study of patients suffering from major depressive disorder (MDD) from whom baseline scalar and functional data are available.

Keywords: biosignature, functional regression, personalized medicine, variable selection.