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Abstract

Tumour characterization from Positron Emission Tomography imaging data

This work focuses on the development of statistical methods for the analysis of cancer imaging data. We consider in particular problems related to the assessment of prognosis, staging and disease recurrence, mainly from Positron Emission Tomography (PET) imaging data but also from MRI and CT modalities. In particular, spatial heterogeneity of the 18F-fluorodeoxyglucose uptake pattern in PET has been established as a strong prognostic indicator for sarcoma, lung, breast and other cancers. Our approach consists in developing new quantification methodologies for characterization of tumour metabolism and structure. Spatial models of the volumetric distribution of PET tracer uptake within the volume of interest are used to extract relevant metabolic and structural descriptors of the tumour. These variables are then considered for the assessment of prognosis and therapeutic response. This work involves a number of technical aspects from various areas including nonparametric estimation, regularization and statistical learning. The main application of this research is cancer patient-adaptive treatment, but it also links with problems found in other biomedical and actuarial applications.