

Evaluation of statistical distance metrics between longitudinal scans for predicting early tumor therapy response

Jose George^{1,5}, Kathleen Vunckx², Sabine Tejpar³, Christophe M. Deroose², Johan Nuyts², Dirk Loeckx^{1,4,5} and Paul Suetens^{1,5}

¹*K.U.Leuven - ESAT/PSI/MIC*

²*K.U.Leuven - Nuclear Medicine*

³*K.U.Leuven - Gastroenterology*

⁴*icoMetrix NV*

⁵*IBBT-K.U.Leuven Future Health Department*

Efficient and early therapy response prediction requires robust perception of response change in longitudinal scans. Here, we investigate the influence of various statistical distance metrics computed from normalized longitudinal tumor lesion histograms of ¹⁸F-FDG PET images.

15 patients suffering from metastatic colorectal cancer and treated with cetuximab were studied. Baseline (BS) and follow up (FU) were scanned prior to and at 1 week after 1st dose of treatment resp. 1-5 lesions/patient were expert identified. BS lesions were delineated using state-of-the art methods (GDM, ATM, FLAB, T30, T40, T50, T60, T70). BS delineation was placed on FU and rigidly moved to extract FU delineation which maximized the total FU activity under it; thereby efficiently quantifying activity change in cases where virtually no FU lesion was left. 15 different divergence measures and statistical distance metrics were employed for quantification. The continuous statistical distance was related to the continuous time to progression (TTP) using the concordance (C_T) computed from time dependent ROCs in each of the investigated scenarios. The averaged (AV), minimized (MN) and maximized (MX) distance were studied as final markers in case of multiple lesions.

KS distance was found to give the best C_T among all statistical distances, irrespective of BS delineation, rebinning and smoothing. For KS distance with 64 bins and Epanechnikov kernel, GDM, ATM, FLAB, T30, T40, T50, T60 and T70 gave C_T (0.69, 0.56, 0.71), (0.69, 0.67, 0.66), (0.72, 0.61, 0.71), (0.65, 0.61, 0.64), (0.62, 0.60, 0.62), (0.71, 0.60, 0.73), (0.67, 0.64, 0.71) and (0.62, 0.62, 0.67) for (AV, MN, MX) resp. % change in SUVmax gave C_T (0.63,0.65,0.60).

The C_T estimates indicated that the KS distance has the potential to better represent the response change compared to other statistical distances consistently.