Report Hugo Aerts

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Subject:

Paralleling the diversity of biological behaviours, pathologic human tissues also exhibit diverse imaging features. In this project we test the hypothesis that imaging traits extracted from non-invasive CT-PET images systematically correlate with outcome parameters in lung cancer patients. To decode these traits from CT-PET images we need to define “unit of distinctiveness” termed “traits” of qualitative imaging features and likewise define outcome variables such as survival at 2 years, risk of pneumonitis in lung cancer patients. The imaging traits are likely to correlate with biological phenotypes in a complex manner. The key questions will be: can we predict outcome with imaging traits? Can we improve existing predictors with new imaging features? If yes can we validate this finding on independent dataset?

Methods:

To address these challenges we followed a three step strategy to create an association map between imaging features on CT-PET and outcome parameters of more than 100 lung cancers patients. Here datasets of CT-PET images before sequential radiotherapy were available. First we defined and quantified as many distinctive imaging traits as possible present in one or more tumours. Second, we identified the most informative traits were we will filter traits based on their frequency and prominence in the data and independence from other traits. The most relevant imaging traits will be extracted by these criteria. Third, we will use the most relevant image traits for statistical analysis for predicting outcome parameters. Multiple imaging traits can be related to outcome parameters using combinatorial and conditional logical relationships.

Results:

Using advanced image analysis methods we have shown that it is possible to extract more information from conventional CT-PET imaging. The features were extracted from the image histogram, like first order statistics, entropy, energy, as well as gradient based techniques, like run-length of grayscale pixels. Features like heterogeneity, gray level attributes, and volume of tumor tissue showed to be important predictive factors for residual disease after treatment. Eventually, the prediction of residual disease in cancer patients may assist clinicians with clinical decision making and offers the possibility of treatment individualization

New knowledge Toronto

In Toronto I have improved my skills in image analysis, where we have looked at using information of the imaging histogram, as well as from gradient based techniques from CT-PET imaging. This was very successful, as we found new traits that had a high predictive power, like entropy, energy, run-length and size based features. Also, the PMH made a large dataset of NSCLC patients available for our further research at MAASTRO Clinic.

Implementation of Results

These newly developed techniques can be used for building predictive models (like the CAT project of MAASTRO Clinic), which have to be implemented in multiple projects in the Netherlands like the CTMM projects and the EuroCAT project. These systems can help to individualize decision support for clinicians, selecting the optimal treatment for each individual patient.