Dual-energy cone beam CT for proton therapy

Gloria Vilches Freixas, supervised by S. Rit and J-M. Létang, 2014

Protons present an inversed depth-dose distribution compared to x-rays: low entrance dose, a maximum dose deposit in depth as a function of the initial energy, and a sharp dose fall-off which determines a “finite” range of penetration. One of the main advantages of proton therapy, with respect to conventional radiotherapy, is the possibility to treat deep tumors while reducing the dose to surrounding normal tissues. One drawback of proton therapy is the presence of uncertainties in the determination of proton range in patient, which must be incorporated in the treatment planning margins around the target volume. In order to account for tissue inhomogeneities, a calibration curve establishing the relationship between CT-values (Hounsfield Units) and stopping power ratios is done. It is currently done using a single-energy CT which requires an additional margin of about 3% of the proton range. The primary objective of the PhD project is to obtain a more precise material segmentation using the dual-energy cone beam CT method for Monte Carlo dose calculations, and thus to achieve a better estimation of proton range in patient and reduce planning margins.