Abstract ID: 15486 Title: Feasiblity of real time tumour tracking in lower field MRI - A Phantom Study

Purpose: Real time adaptive radiotherapy of lung tumours is a promising application of the proposed hybrid Linac-MR system. Several linac-MR designs use low magnetic field strength (0.2T and 0.5T) imaging. Rapid real time imaging is potentially challenging due to the limited available contrast to noise ratio (CNR), especially at low MR fields. The goal of this phantom study is to quantitatively evaluate our in-house tumour tracking algorithm with images of a moving lung tumour model with CNR equivalent to those obtained at 0.2T and 0.5T.

Methods: A chest phantom with a moving lung compartment capable of 1D programmable motion is built. The lung compartment is loaded with mixtures containing $MnCl_2$ and $CuSO_4$ that simulates lung tumour/ healthy lung tissue by mimicking their relaxation properties at 0.2Tand 0.5T in the available 3T scanner. CNR of the acquired images is scaled down to 0.2T and 0.5T by addition of Gaussian noise. Dynamic bSSFP images (4 frames/s) are acquired with the lung compartment undergoing a series of pre-programmed motion pattern based on patient data. An optical encoder is used to provide an independent reference measurement of phantom position while the lung compartment undergoes motion. In-house automatic tumour tracking software is used to contour the tumour off-line. The automatic contours are compared against user defined contours by evaluation of the centroid position error, and the Dice coefficient.

Results: The average RMS errors of the contour centroids are < 0.5 mm and < 0.8 mm in all of our motion patterns in 0.5T CNR and 0.2T CNR images, respectively. Agreement with the user defined contours is excellent, with a dice coefficient of > 0.9 at both CNR levels.

Conclusions: Our auto-contouring algorithm is able to accurately track a moving tumour with the limited CNR available from real time, low field MR sequences.