Purpose:

Using markers at patient body surface to predict the tumor location is a widely used approach in lung cancer radiotherapy with respiratory gating. The purpose of this work is to identify a sparse set of locations on the patient's external surface, which are most correlated with the tumor motion and hence can be used for tumor location predication effectively.

Methods:

Thoracic 4DCT scans with 10 phases are used for the study. For each phase, points on external surface (except for patient's back) are segmented and the correspondence of the points between phases is established via deformable image registration of the corresponding CT images. It is assumed that there is a linear relationship between the selected surface points and the tumor locations. The selection of the sparse locations on external surface and the linear dependence of these points to internal tumor motion are represented by a prediction matrix. Such a matrix is determined by solving an optimization problem, where the objective function contains a sparsity term about the number of surface points chosen. Bregman iteration is used to solve the optimization problem. To test our algorithm on realistic patient cases, we first solve our problem using the 9 out of 10 phases of the 4DCT images to identify surface points that are most correlated with the tumor locations and the prediction matrix. The 10th phase is then used to test the accuracy of the prediction.

Results:

The method is tested on 6 patient data. The average prediction error is under 1 mm. The number of locations selected on patient's external surface is under 7 in average.

Conclusions:

Our method can automatically select sparse locations on patient's external surface and estimates a correlation matrix of these locations with internal tumor motions based on 4DCT.