AbstractID: 7718 Title: Non-rigid registration based respiratory motion models of the lung using two parameters

Purpose:
Single parameter motion models based on the phase of a respiratory signal can model the motion over an average respiratory cycle. Two parameter models based on amplitude and gradient may also be able to model some of the inter-cycle variation. We present a method of constructing two parameter motion models and evaluate different functions for the model.

Method and Materials:
A reference CT volume is non-rigidly registered to free breathing CT data. A function is then fitted to each of the control point displacements that define the registrations, relating them to the respiratory parameter(s). Three different functions were evaluated on data from an example patient: a 1D cyclic b-spline function relating the displacements to phase, a 2D linear function, and a 2D 3rd order polynomial function, both relating the displacements to amplitude and gradient. Models built from each of the functions were used to produce transformations at the same parameter values as the registration results. Models were built both leaving out the target registration and including it. Sample points covering the entire region of interest were deformed using the model results and the registration results, and the differences in the displacements of the points were calculated.

Results:
The mean differences, when using all registrations and when leaving out the target respectively, were 0.53 mm and 0.67 mm for the 1D cyclic b-spline function, 0.59 mm and 0.71 mm for the 2D linear function, and 0.43 mm and 0.96 mm for the 2D polynomial function.

Conclusion:
These results suggest that the performance of the 2D linear function is comparable to the 1D b-spline function. The 2D polynomial function models the data more accurately but would appear to ‘over-fit’ the data.