AbstractID: 3019 Title: Long term prediction of respiratory motion with artificial neural network based adaptive filtering techniques

Purpose: Respiratory motion prediction is a key component affecting the accuracy of respiration gated and tumor tracking radiotherapy. The aim of this research was to investigate ways to improve long term prediction of respiratory motion with artificial neural network based adaptive filtering techniques.

Method and Materials: An artificial neural network (ANN) based adaptive linear filter was used to predict respiratory motion for 30 motion traces (4 mins duration each) obtained from 7 patients both with (audio-visual biofeedback) and without breathing training. Sequential training of the network was implemented using the Widrow-Hoff training algorithm after proper determination of the maximum stable learning rate. A signal history of 5000 msec was used for training. The errors from prediction were compared to those obtained with a simplistic adaptive linear filter from earlier work. The effect of breathing training on the predictive ability of the ANN based was also determined.

Results: Magnitude of geometric errors from prediction for the ANN based adaptive linear filter (~ 2 mm - 1σ) were less than 50% of the magnitude of respiratory motion (5 mm - 1σ), especially for longer response times (> 600 msec). This represented a 40 % improvement in accuracy over a simple adaptive linear filter without any learning features. Breathing training with audio-visual biofeedback resulted in a slight reduction in errors from prediction.

Conclusion: Artificial neural networks offer unique features that can help improve the adaptive capabilities of predictive filters. Further improvements in prediction of respiratory motion are possible with further developments using such a framework.

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