# AbstractID: 7057 Title: Periodic Autoregressive Moving Average model for the prediction of intrafraction respiratory motion.

**Purpose:**

The prediction of intrafractional tumor motion is required for the development of real-time motion managed radiation therapy. This work investigates the ability of a Periodic Autoregressive Moving Average (PARMA) algorithm to model and predict respiration motion.

**Methods and Materials:**

The PARMA algorithm models input signals as partially correlated time-series superimposed onto periodic waveforms. This investigation assessed the limitations of the PARMA method for accurately predicting signals with varying levels of non-periodic behaviour. A one-dimensional respiratory motion phantom was developed, which generates waveforms to simulate breathing patterns with randomized non-periodicity and noise. Multiple signals were analysed for each of 441 levels of non-uniformity in cycle-length and amplitude. These signals were approximately 200 seconds long with 50 inhale-exhale cycles on average.

**Results:**

Prediction errors were found to be dependent on prediction lag and the level of variation in the signal. At 0.5 s ahead of the input signal, the PARMA prediction was accurate to within 4.8±0.4% of the total motion extent when the respiration signals had a 14% standard deviation in cycle-length and 14% standard deviation in inhale-exhale amplitude. These errors increased to 9.4±0.8% for predictions made at 1.0 second ahead of the input signal. As the inter-cycle variation in the phantom signals increased to 34%, the prediction errors also increased to 11.6±1.4% at 0.5 second and 21.6±2.0% at 1.0 second.

**Conclusion:**

Our investigation showed the PARMA prediction algorithm can be used to predict respiration patterns within the lag-time required to make the mechanical adjustments to steer the treatment beam in-sync with the motion of the target. However, an assumption of a single harmonic component results in a strong dependence on the stability in cycle-length, with less dependence on the cycle-to-cycle amplitude of motion. As such, the PARMA algorithm may be used to predict resting respiration and well coached breathing patterns.