AbstractID: 1694 Title: The application of the sinusoidal model to lung cancer patient respiration

Accurate modeling of the respiratory cycle is important to account for the effect of organ motion on dose calculation for lung cancer patients. The aim of this study is to evaluate the accuracy of a tumor respiration model for lung cancer patients with and without breathing coaching. A widely used model to describe organ motion due to respiration is

$$f(t) = z_0 + b(\cos^n(\pi t / \tau)),$$

where t is the time in seconds. This model assumes that the mean cycle-cycle position z_0, the amplitude b, and period τ, do not vary between and within breathing cycles. In this study first the correlation of breathing traces with the model $f(t)$ as a function of the parameter n (n=1,4,6) was undertaken. Since $\cos^1$ and $\cos^4$ had similar correlation coefficients, both of which were higher than $\cos^6$, the $\cos^1$ value was used for further analysis. The variations in mean position (z_0), amplitude (b) and period (τ) with and without breathing coaching were investigated. The $\cos^1$ model was fit to each breathing cycle within 300 respiration traces of four minutes duration each, acquired from 23 lung cancer patients using three coaching types – free-breathing, audio and audio-visual coaching. For all coaching types z_0, b and τ exhibited significant cycle-to-cycle variations. Audio-visual coaching showed the least variation for all three parameters (z_0, b, τ). The significant cycle-cycle variations demonstrate that realistic respiratory motion cannot be modeled with a simple sinusoidal model with time independent parameters. Supported by NIH R01 CA93626