# AbstractID: 6893 Title: To investigate the rate reproducibility of respiration motion using the concept of dominant frequency, power of dominant frequency and dominant bandwidth

Introduction: Dominant frequency(DF) can be defined as the frequency with the maximal power in a frequency spectrum. This concept has been used to analyze signals in various fields of science as diverse as music, cardiac and seismic signals. In the current study DF and related frequency analysis techniques were used to investigate the reproducibility of respiration motion.

Method: $X(\omega) = FFT[x(n)]$ where $X(\omega)$ is the respiration motion in frequency domain and $x(n)$ is respiration motion in time domain therefore

$$DF = \omega\big|_{\max[X(\omega)]}.$$

DF determines the prime rate of the respiration motion. The power of dominant frequency (PDF) shows the reproducibility of a signal.

$$PDF = \frac{X(DF)}{\sum_{\omega=0}^{2\pi} X(\omega)}$$

Dominant bandwidth (DB) was calculated as the frequency band around the DF which contained 50% of the total power. 24 lung cancer patient respiration motion signals acquired with free breathing(FB), audio coaching(A) and audio-visual biofeedback(AV) were analyzed in the frequency domain.

Results: The PDF of A and AV were significantly greater than FB ($p<0.05$). In addition, a negative correlation between DF and PDF with correlation coefficients of -0.23, -0.46 and -0.59 for FB, A and AV respectively was observed. Finally rate reproducibility (RR) was investigated against the visual training displacement parameter, which is set based on the average peak-to-peak motion during FB, revealed positive correlation with A and AV (0.59 and 0.67) when compared with FB (0.33).

DB is a more robust method to evaluate RR as compared to PDF, since the power distribution around the dominant frequency would be evaluated as opposed to a single peak. DB analysis displayed reduced values for A and AV compared to FB indicating a worse RR for FB.

Conclusion: In conclusion breaths-per-min of respiration motion is possibly inversely proportional to rate reproducibility. RR had a positive correlation with visual training displacement parameter. Finally DB provided a characterization of the frequency spectrum and revealed trends similar to PDF.