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# 503 A NON-CONTACT METHOD FOR THE ACQUISITION OF BREATHING SIGNALS THAT ENABLE DISTINCTION BETWEEN ABDOMINAL AND THORACIC BREATHING

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For adaptive radiotherapy of lung cancer, it is crucial to acquire a meaningful breathing signal in order to build 4D-CT models and to gate or track radiation delivery. Current methods are: spirometry, tracked marker on the patient's skin, or both combined. We propose an alternate method based on the acquisition of stereoscopic video images of a patient's breathing torso. This work establishes its equivalence to spirometry and demonstrates several advantages.

A stereoscopic system acquiring video images of the patient's torso (Vision RT) was used to capture dynamic surfaces of the subject's skin (reconstructed by the Vision RT system). Spirometric data was simultaneously captured (Micro Medical). 5 volunteers underwent this study each breathing : 1 minute freely; 1 minute thoracically; 1 minute abdominally. Volumetric information is derived from the surfaces by computing at each capture time the volume between the couch and the portion of the stereoscopically acquired surface included in a predefined bounding-box. A global volumetric signal is thus extracted. Flow information is then computed by differentiation of the volumetric signal. Abdominal and thoracic components are similarly obtained by splitting the bounding- box in two along the inferior part of the rib cage. Correlation between the spirometer and surface-based signals, Fourier transforms of the signals, and proportions of abdominal and thoracic breathing were investigated.

A statistically significant good agreement between the simultaneous spirometric signals and the surface-based signals was observed (Kendall's $\tau$ : flow : 0.69—0.87; volume : 0.45—0.85 – outlier 0.28; max p-values : flow : 1.69E-87; volume : 7.29E-10). Furthermore, all the signals except the spirometric volume signal exhibited the same period and were synchronous; the spirometric volume usually showed a drift, which induced a longer period. Contributions of thoracic and abdominal components per breathing cycle were also quantified. The surface-based flow data was hence found to be equivalent to the spirometric flow data and exhibited the advantage over spirometry of outputting a drift-free volumetric signal. This surface- based acquisition of respiratory signals also shows advantages over the marker-based approach. It is global and bears extractable information on abdominal and thoracic components.

We present a non-invasive non-contact method for acquiring acquiring respiratory signals that : (1) provides information equivalent to spirometry, (2) is drift-free and (3) is decomposable in abdominal and thoracic components. Acknowledgements : Vision RT, Micro Medical.