AbstractID: 13180 Title: aDiver: a respiratory physiology based motion phantom for evaluating radiotherapy motion management

Purpose: Most phantoms for evaluating breathing-motion management execute motions from a pre-defined function or a stored profile. We have developed a phantom (aDiver) that models human respiratory physiology so that it responds to its respiration history. This is valuable in evaluating motion management methods that modify the breathing pattern of patients. **Method and Materials:** aDiver is based on a servo-motor controlled linear actuator. Software is downloaded to the micro-controller which drives the actuator to the programmed position. We developed the software so that multiple segments of a breathing cycle can be combined to construct profiles of different amplitudes, shapes and periods. It calculates the real-time concentration of carbon dioxide according to the executed profile. It assumes that the metabolic output rate of carbon dioxide is constant and there is perfect mixing of the different gas components. At the beginning of each inhalation, it will determine the inhalation depth based on the current concentration of carbon dioxide. aDiver accepts an input signal to hold the breath immediately and an input to execute a deep inhalation. It can also set a panic output when the carbon dioxide concentration is above a set level. **Results:** aDiver can 'breathe' practically indefinitely, responding to input to hold the breath, breathing deeper after a breath hold, responding to input to take a deep breath, and setting the panic signal when needed. We have demonstrated that it can produce a regular breathing profile at tidal volume for respiratory gating, it can take deep breaths and hold the breath for Active Breathing Control (ABC) repeatedly, and it can hold the breath in every (or every other) breathing cycle for Audio-gated Radiotherapy (ART) or Gated Breathing Synchronizer (GBS). **Conclusion:** aDiver simulates the breathing pattern of a human under different commands automatically. Supported in part by NIH P01-CA59827.