1-2020

Detecting Different States of Ventilation with a Wearable Device through Minute Ventilation

Yash Patel
Thomas Jefferson University, yash.patel@jefferson.edu

Michael Morano
Thomas Jefferson University, michael.morano@jefferson.edu

Marc J. Torjman, PhD
Thomas Jefferson University, marc.torjman@jefferson.edu

InduPriya Eedara, MS

Moeness Amin, PhD

Authors

Yash Patel; Michael Morano; Marc J. Torjman, PhD; InduPriya Eedara, MS; Moeness Amin, PhD; Channy Loeum; and Jeffrey I. Joseph, DO

Yash Patel

SI/CTR Abstract

Word count: 246 words

Detecting Different States of Ventilation with a Wearable Device through Minute Ventilation

Yash Patel, Michael Morano, Marc J Torjman, PhD, InduPriya Eedara, MS, Moeness Amin, PhD, Channy Loeum, and Jeffrey I Joseph, DO***

(*) indicates primary project advisor

(**) indicates another student who is declaring the same project as primary for SI

Introduction: Detecting changes in respiration are essential to monitoring a patient's vital signs. Few devices accomplish this in a non-invasive manner. We are developing a wearable Trachea Sound Sensor that measures respiratory rate (RR), tidal volume (TV), minute ventilation (MV = RR x TV). A prototypical Trachea Sound Sensor (TSS) was created and compared to a reference pneumotachometer. Both were used to record the sounds of breathing with research team members.

Methods: The TSS recording device was tested on six research team members and breath sounds were recorded. Simultaneously, the member's RR and MV was recorded using a calibrated pneumotachometer. The researchers were instructed to adjust their breathing rate and depth while intervals were recorded. Signal processing techniques were used to analyze and produce measurements of RR, TV, and characterize hyperventilatory or hypoventilatory states.

Results: Based on the results, we found that it is possible to obtain accurate measures of RR and identify breathing patterns through the TSS. Signal processing and analysis calculated RR, states of hyperventilation and hypoventilation with 98% sensitivity and specificity. Results obtained for measuring TV were less accurate (±100 mL).

Discussion: Our results suggest that it is viable to obtain accurate measures of RR and classify breathing sounds solely on measurements of breathing sounds from the TSS. The inaccuracy in TV measurements may be partly due to the systematic error from the pneumotachometer used. The prototypical TSS are suitable for upcoming NIH-funded clinical trials to test the TSS in volunteers and hospitalized patients.