In our submission, we performed a clinical trial on porcine models to obtain the lung tidal volumes using wearable near-field radio-frequency (NFRF) sensors. The procedure was performed under the approved protocols of Cornell University IACUC Protocol #2021-0066 and #2018-0034. We employed the near-field backscatter electromagnetic theory to guide the design of our sensing system. NFRF capabilities were demonstrated by comparison with a reference spirometry during the stepped tidal volume controlled by a ventilator. System robustness was enhanced by the proposed adaptive algorithms to derive tidal volumes estimated by NFRF. We also demonstrated a novel capability of monitoring left and right lung volumes individually by using a bronchial blocker, followed by the procedure of continuous positive airway pressure (CPAP) for lung recruitment.

Our work is highly relevant to the areas of wearable health sensing and continuous vital-sign monitoring. The proposed NFRF sensors may be packaged into wearable devices for at-home health monitoring, assisting in early detection of adverse pulmonary conditions and improved remote health outcomes. NFRF sensors may also improve clinical outcomes by reducing the need for intubation to measure lung function. The proposed detection method of individual lung obstruction may be useful during surgical procedures where one-lung ventilation is necessary.

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