

LICENSING OPPORTUNITY: LUNG FLUID MONITOR AND MONITORING FLUID LEVEL IN A LUNG

DESCRIPTION

Problem

Pulmonary edema is a medical condition caused by the accumulation of excess fluid in the lungs. Monitoring the severity of this condition requires patients' access to medical facilities with typically expensive medical imaging systems. For patients without easy access to such facilities or those who might require continuous monitoring, this could be a problem.

Invention

This wearable device utilizes radio frequency technology to continuously sense and monitor fluid levels in the lungs. The resulting data from real-time monitoring enables early detection of pulmonary edema, allowing for timely medical intervention. Designed with non-invasive technology, it offers a comfortable and efficient alternative to traditional hospital diagnostics.

BENEFITS

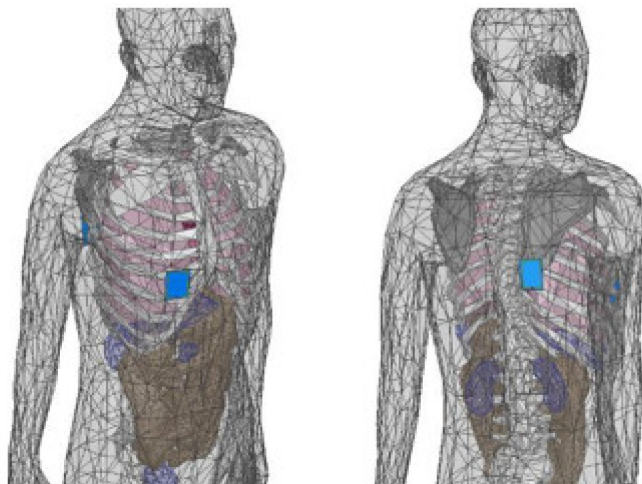
Potential Commercial Applications

1. Early detection and monitoring of excess fluid in the lungs;

2. Non-invasive, comfortable, and eliminates complex procedures like X-ray or CT scan;
3. Real-time monitoring and providing instant data to the users and potentially to healthcare providers;
4. Wireless and wearable, which allows for mobility and convenience.

Competitive Advantage

Unlike traditional hospital diagnostics that rely on costly and time-consuming tests, this wearable device offers continuous, real-time monitoring of lung fluid buildup in a non-invasive and cost-effective way. By enabling early detection and intervention, it helps prevent severe complications, reduce hospital visits, and improve patient outcomes.



Model of computational human body and the antenna placements.

Contact: licensing@nist.gov

NIST TECHNOLOGY PARTNERSHIPS
OFFICE

NIST Technology Partnerships Office
National Institute of Standards and Technology
100 Bureau Drive, Gaithersburg, MD 20899-2200



Meet **Kamran Sayrafian,**
Ph.D.

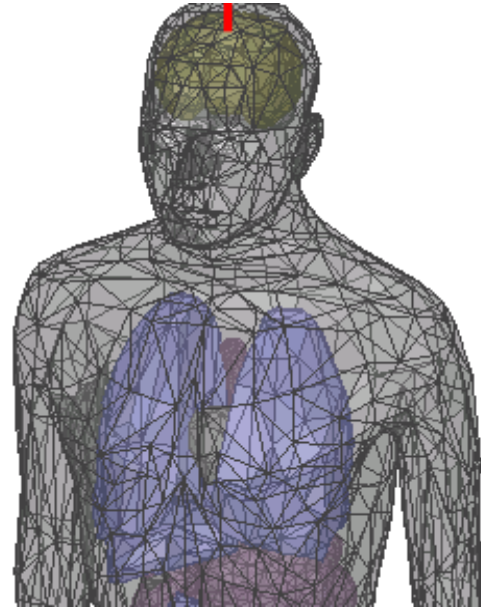
Senior Scientist, National Institute of
Standards and Technology

A Wireless Wearable System to Monitor Levels of Fluids in the Lungs

Kamran Sayrafian
Senior Scientist & IoT-Health Program Lead
Information Technology Laboratory
National Institute of Standards & Technology

What is Pulmonary Edema?

- ❖ Pulmonary edema (PE) is a medical condition caused by accumulation of excess fluid in the human lungs.
- ❖ This fluid can accumulate for many reasons including heart problems, pneumonia, exposure to certain toxins, as well as viruses such as COVID-19.
- ❖ Pulmonary edema is a common condition in elderly with about 1 in 15 people aged 75-84 and just over 1 in 7 people aged 85 years and above.
- ❖ X-ray, CT scan, and Electrical Impedance Tomography are typical technologies that are used to detect and measure fluid build-up in the lungs.



The Problem

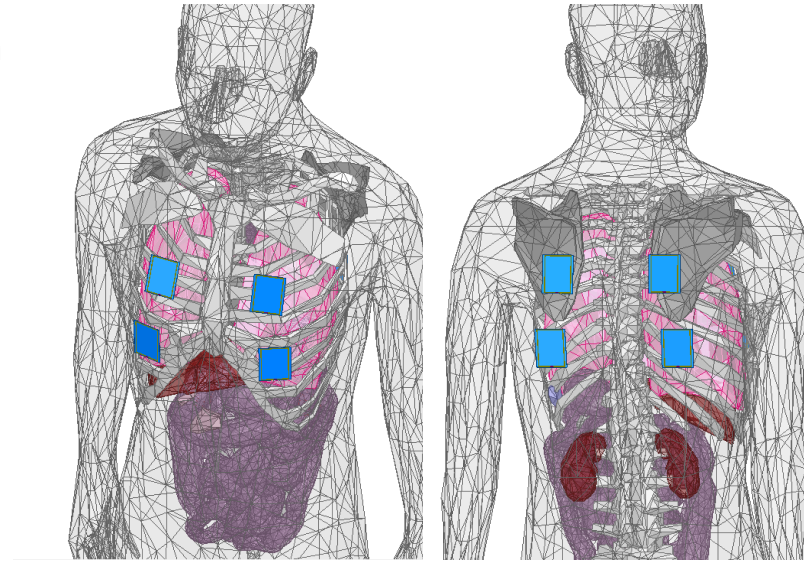
- ❖ Physical presence and access of the patient to healthcare facilities having relevant equipment are currently required for diagnosis and monitoring pulmonary edema.
- ❖ For patients living in remote areas or people who need to be continuously monitored, frequent access to such facilities might be difficult or costly.
- ❖ Also, during pandemics or other emergencies, resources at medical facilities are typically diverted to other critical tasks. Therefore, it is desirable to cut down the number of unnecessary visits by the patients during those times.

A Personal Mobile Monitoring Solution

- ❖ A simple personal device that can be used at home to monitor fluid accumulation in the lung can be a cost-effective complementary solution to existing methodologies that detect PE
- ❖ The ability of self-monitoring at home by using personal wearable devices can reduce the cost of healthcare services and ensure higher quality of life for the patients.
- ❖ In addition, consumer adoption of wearable devices is expected to create a fertile environment for businesses that offer remote monitoring of various health or physiological signals.

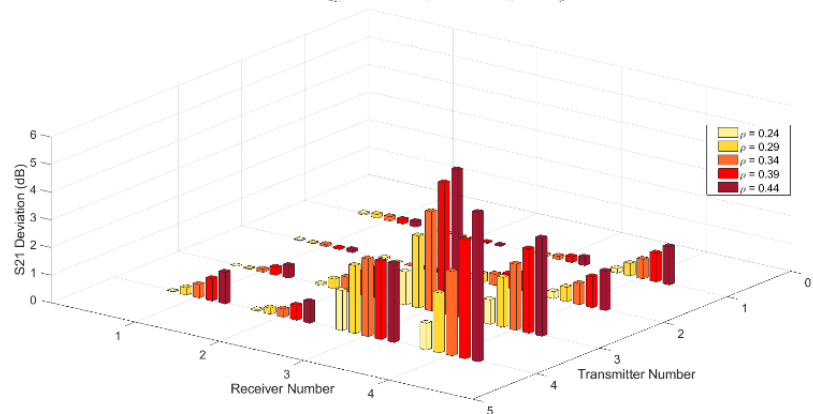
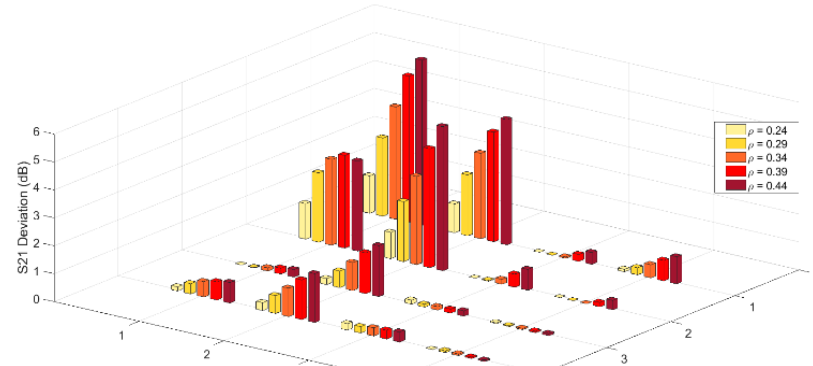
The Methodology

- ❖ Wearable transmitting and receiving antennas are placed on the chest and the back side of the patient covering the left/right or both lungs as needed.
- ❖ A signal at MedRadio frequency band is transmitted between pairs of selected antennas.
- ❖ With proper antenna design, there will be multiple RF propagation paths through the lungs.



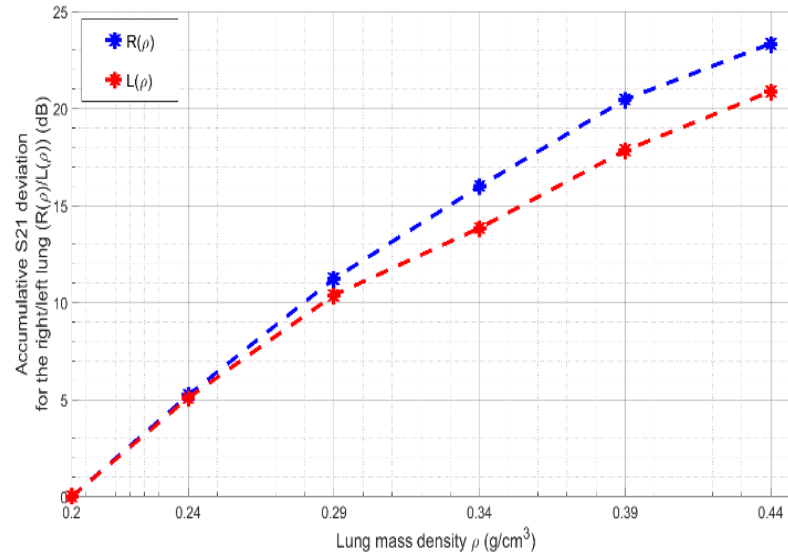
Correlation of the Wireless Channel Response with the Excess Fluid

- ❖ The composition of the lung with excess fluid would provide a different effective dielectric properties for the wireless signal passing through the lungs.
- ❖ Mass density of the lung is an increasing function of the excess fluid.
- ❖ With increasing/decreasing mass density of the lung, the magnitude of the forward transmission coefficient of the channel is monotonically decreased/increased.



Monitoring Excess Fluid in the Lungs

- ❖ With proper combination of channel responses, an indicator of the level of excess fluid can be formed.
- ❖ Using multiple antennas for each lung increases the monitoring sensitivity to detect smaller changes in the amount of excess fluid in each lung.



Conclusions

- ❖ Our Research demonstrates the feasibility of a simple wearable wireless device for monitoring pulmonary edema.
- ❖ The wearable electronics could be applied as a patch or integrated in the fabric of a vest, fitted T-shirt or an elastic band around the chest.
- ❖ In addition to self-monitoring, the information provided by the wearable device can potentially be transmitted through a telemedicine network for remote monitoring.
- ❖ We seek CRADA partnership to extend this study, develop a prototype and plan for human subject trial