

**Paper Title:** Monitoring COVID-19 Patients Using Cardio-Pulmonary Stethoscope RF Technology: Computer Simulation Study Using CT Scans of Patients

**Paper Link:** <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9895392>

### 1. Summary:

**1.1 Purpose of this study:** The authors of this paper develop a cardio-pulmonary stethoscope (CPS) to monitor COVID-19 patients using computer simulations. The CPS shows promise for detecting COVID-19 infections with high sensitivity, even in patients with severe edema. This study aims to innovate the detection and monitoring of COVID-19 infections through the use of capacitively coupled sensors (CPS). The researchers assert that traditional methods like CT scans and X-rays are costly, time-intensive, and radiation-exposing, while CPS offers a cost-effective, streamlined, and safer alternative for detecting and monitoring COVID-19 infections.

**1.2 Contribution:** The authors simulate the propagation of electromagnetic waves through a lung model with different levels of lung water content (LWC) and different sizes of COVID-19 infection. They find that CPS can detect infections as small as 5.45 mm in diameter, even in lungs with severe edema (60% LWC).

**1.3 Methodology:** The authors simulated the CPS's measurement of S-parameters in a digital human model with a lung infection ellipsoid placed in the lower peripheral lung area, typical of COVID-19 cases. They examined varying factors, including lung water content, inflammation size, distance to the sensor, inflammation's electrical properties, and the presence of multiple inflammations.

**1.4 Conclusion:** The authors concluded that the capacitively coupled sensor (CPS) is capable of detecting COVID-19 infections as small as 0.9 cm<sup>3</sup>, regardless of their location relative to the sensor or variations in electrical properties compared to the surrounding lung tissue.

### 2 Limitations

**2.1 First Limitation: Diversity of Human Models:** The research is limited to an average male model, and it emphasizes the need for additional simulations on a variety of human models, including males, females, and children of various ages, sizes, and Body Mass Index (BMI).

**2.2 Second Limitation: Assumption of Initial Imaging:** The study assumes that an initial CT or X-ray scan of the patient is available or can be obtained. The CPS device is considered complementary, monitoring changes in the patient's status, such as responses to medication and treatment, or the need for alternative and more urgent treatments.

**3 Synthesis:** The authors of the paper "Cardio-Pulmonary Stethoscope (CPS) for COVID-19 Detection and Monitoring" used computer simulations to show that CPS can detect COVID-19 infections as small as 5.45 mm in diameter, even in lungs with severe edema. They concluded that CPS is a promising technology for detecting and monitoring COVID-19 infections, but further research is needed to validate their findings and develop a CPS device for clinical use.