

Ultra-wideband localization of pulmonary nodules during thoracoscopic surgery

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Lung cancer is one of the most common causes of cancer-related death worldwide.^[1] It is usually detected by CT or MRI and removed through thoracoscopic surgery. However, during the surgery, the lung collapses and a new determination of the position of the pulmonary nodule is necessary which is particularly challenging in the case of minimally invasive surgeries when palpation is not possible.

In this contribution, ultra-wideband (UWB) radio technology, which employs a short burst of high-frequency electromagnetic waves, is studied to localize the pulmonary nodule. In short, an antenna in close proximity with the lung surface produces a signal and the echo coming from discontinuities in the lung tissue, i.e. the pulmonary nodule, is used for the localization. A similar approach was already proposed for breast cancer.^[2]

Simulations were used to explore the relationship between frequency range and penetration depth and showed that shallow nodules, below 2 cm in depth, are difficult to resolve because the echo directly interferes with the propagating signal. On the other hand, given the strong electromagnetic attenuation of lung tissue, echo coming from near organs is suppressed and frequency-band tuning can be employed to range the depth of the investigation.

Ultimately, this contribution shows how to employ and design UWB technology to localize deep pulmonary nodules through a minimally invasive approach.

References

[1] R. L. Siegel, K. D. Miller, A. Jemal, *CA: A Cancer Journal for Clinicians* **2016**, 66, 7–30.

[2] N. K. Nikolova, *IEEE Microwave Magazine* **2011**, 12, 78–94.