Scientists develop multi-frequency ultrasonic endoscope

March 3 2021, by Zhang Nannan

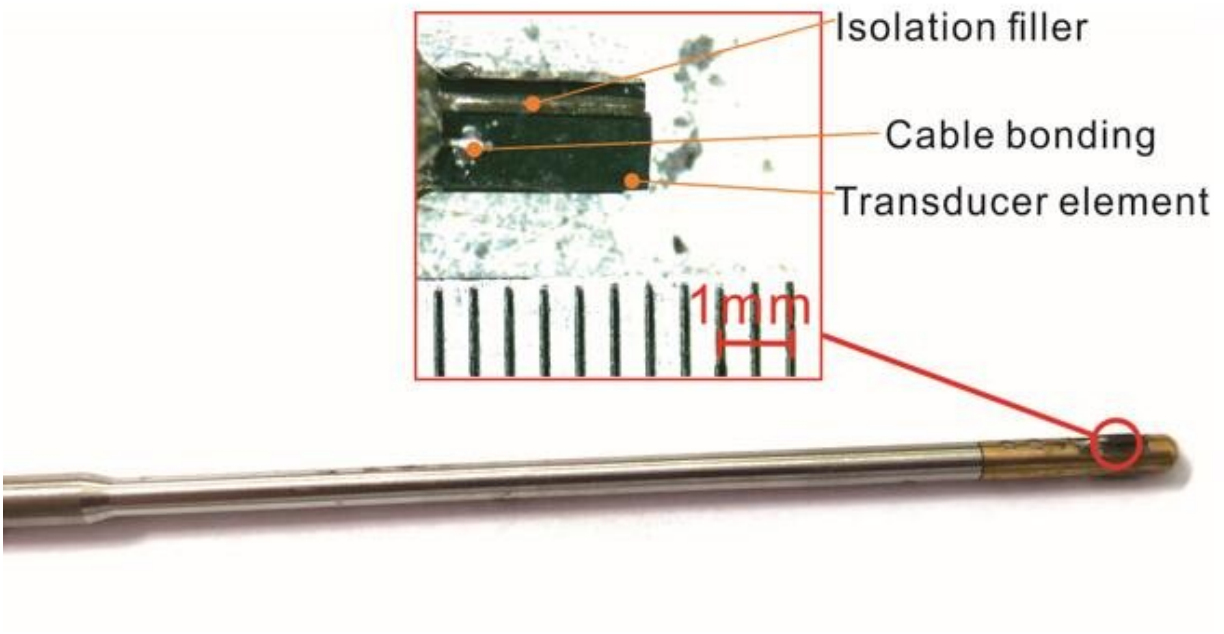

Figure 1. The triple-frequency transducer. Credit: SIBET

Endoscopic ultrasound (EUS) plays a vital role in the development of novel treatment and diagnostic methods of gastrointestinal diseases. The ultrasonic transducer is an essential component, whose working frequency determines the quality of ultrasonic images. In general, the higher the working frequency, the easier it is to obtain high-quality images. Nevertheless, increasing the frequency often leads to a decrease

in detection depth, which limits the imaging range and is unfavorable in clinical use.

Conventional EUS transducers generally work at a single frequency, ranging from 5 to 20 MHz. If an operator wants to alter the working frequency to obtain suitable depth, another probe must be employed, thereby causing inconvenience in clinical use and making patients suffer more. However, multi-frequency imaging and the matched image fusion technique have the potential to solve the issue that limits the performance of the EUS imaging system.

Recently, the medical ultrasound research team from the Suzhou Institute of Biomedical Engineering and Technology of the Chinese Academy of Sciences has developed a multi-frequency and large-bandwidth ultrasonic probe based on piezoelectric composite materials, which balances imaging resolution and imaging depth.

In this research, a triangle-structure triple-frequency transducer that can work at three different frequencies was presented, whose outer diameter is less than 1.5 mm. Static and transient models are built to assist its design.

Specifically, simulation results and sound field measurement results suggest that the three different frequency elements have excellent directivity, and the acoustic field interference among the elements is small. Pulse-echo results show that center frequencies of the elements are 13.17 MHz, 20.3 MHz, and 30.85 MHz respectively. Ultrasound imaging results of phantom indicate that the triple-frequency fusion imaging is better than the single-frequency imaging, and the fused image can achieve an excellent balance between image resolution and imaging depth.

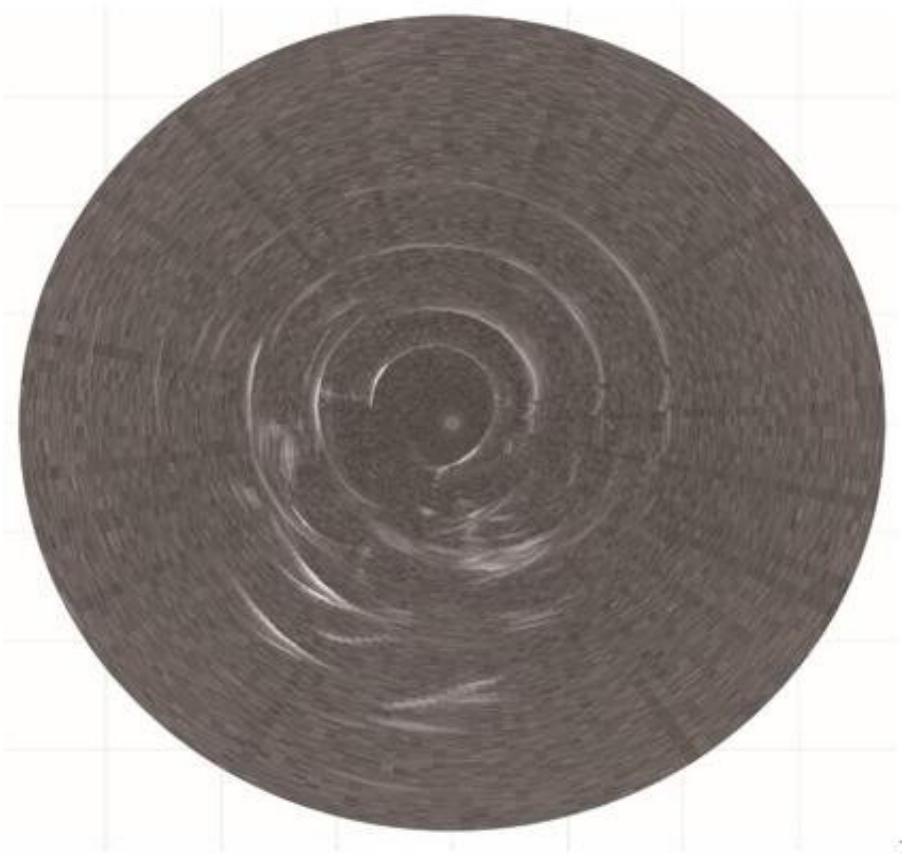

Figure 2. The fused ultrasound image of multi-layer mimicking phantom. Credit: SIBET

In short, this research proves the feasibility of a triple-frequency transducer in endoscopic imaging and shows its great potential in the diagnosis of gastrointestinal diseases.

The research article "A triple-frequency transducer for endoscopic imaging: Simulation design and experimental verification" has been published in *Sensors and Actuators A: Physical*.

More information: Longfei Yu et al. Topography-related controls on N2O emission and CH4 uptake in a tropical rainforest catchment,

Science of The Total Environment (2021). DOI: 10.1016/j.scitotenv.2021.145616