ACCObeam technology produces novel collimated sound beam

August 20, 2018

A team of scientists has created the Acoustic Collimated Beam (ACCObeam), a novel high-power, low-frequency, collimated sound beam that penetrates deeply and in high resolution for applications such as borehole imaging, explosives threat evaluation, underwater communication and biomedical imaging.

Ultrasonic imaging tools typically use high frequency transducers to monitor the integrity of boreholes drilled for oil and gas production. These tools can evaluate metal casing used in boreholes but cannot image deep into cement or the geologic formation beyond the casing wall. This is because high frequencies attenuate significantly in cement and geological formations.

By simply clamping the circumference of a piezoelectric disc inside a hard material and exciting concentric ring-like ripples in the disc, the team determined that it could produce a highly collimated, powerful sound beam that also minimizes unwanted side lobes.

The resulting device, called ACCObeam, operates at a low frequency of 10–250 kHz, so the sound it produces does not attenuate significantly in any medium. In fact, ACCObeam is capable of imaging underground in almost any medium and has been shown to image two to three meters of rock without compromising image resolution.

The team is led by Cristian Pantea, Dipen Sinha, and Vamshi Chillara all of the Materials Synthesis and Integrated Devices group.

This breakthrough in collimation is the result of almost 30 years of extensive research by the team, which has resulted in four previous R&D 100 awards, almost a dozen U.S. and European patents and numerous publications.

DOE's SubTer (Subsurface, Technology and Engineering Research, Development, and Demonstration) program sponsored the development of ACCObeam to image the underground environment around wellbores. ACCObeam can also operate in opaque and highly attenuating media, such as drilling mud.

The team is exploring a range of additional applications using the technology. Los Alamos has been testing ACCObeam's functionality in high explosives; there is currently no method to remotely image the temperature field in a potential bomb. Using mock material, the team has proven that ACCObeam can noninvasively establish the 3-D thermal field inside a closed container. ACCObeam's portability could significantly change how emergency responders analyze explosive threats.

ACCObeam could be easily calibrated for underwater functions. The tight beam collimation makes it an attractive candidate for long-range undersea communications, deep-sea imaging, and video transmission beneath oceans with reduced chance of interception.

In the field of biomedical imaging, the team envisions that ACCObeam could precisely send energy to specific regions of interest, enabling it to remotely charge batteries or to power internal medical devices such as pacemakers. The combination of deep penetration and high resolution means ACCObeam might potentially image tumors and various organs in humans.

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