Ultrasound technology made to measure

January 6 2015

Modular ultrasound platform for medical applications. Credit: Fraunhofer IBMT

The range of uses for ultrasound is gigantic; the applied technologies are just as diverse. Researchers are now covering a wide range of applications with a new modular system: From sonar systems to medical ultrasound technologies and all the way to the high frequency range – such as for materials testing.

Ultrasound technologies make visible what remains hidden from our naked eyes: Physicians study tissue changes in our bodies with the aid of sonography; submarines equipped use sonar systems to get their bearings in the darkness of the deep sea; and for materials and components testing, ultrasound provides a non-destructive alternative to costly technologies that are not real-time capable. Depending on the application, a variety of technologies can be used. "Complete systems are typically developed, based on unique customer specifications. Within this context, that only allows them to be used for a very limited area, however, the development expenditure is really quite high," explains Steffen Tretbar of the Fraunhofer Institute for Biomedical Engineering IBMT in St. Ingbert.

Tretbar and his team therefore are taking a new path: The scientists have developed a multichannel ultrasound platform that uses a modular configuration so that it can be adapted to a set of applications that are entirely different from each other, such as real-time treatment monitoring. "This way, we can both quickly respond to customer requests for the widest array of applications, and also offer money-saving solutions," says Tretbar. The system uses basic components, like main board, power supply, and control software that always stays the same. "Then we put application specific components – the front-end boards – into this main board, like with a building-block system," explains Tretbar.

In order to adapt an application, the frequency range of the ultrasound waves is a key regulating screw. Sonar systems typically move within the low-frequency range (from the kilohertz range to about two MHz). This way, you admittedly do not get a high spatial resolution of the images; however, you can "see" up to several hundred meters deep. Unlike with its use in medicine: Here the physician needs records with the highest possible resolution. For this purpose, the sound waves do not have to traverse any long stretches, but instead just penetrate a couple of

centimeters into the body. For this reason, medical ultrasound typically hovers within a frequency range of between 2 to 20 MHz. Very high frequencies, up to the 100 MHz range, enable resolutions in the µm-range, e.g., for materials testing or the imaging of small animals that is needed with the development of new technologies. The researchers developed coresponding front-end boards for all three areas.

Swift interfaces to the computer

In order to fine-tune the system, you merely need to configure the software accordingly. "We have realized very fast interfaces to the PC. This way, we can control the systems in real time, enable very swift signal processing with repeat rates in the kHz/range, and simply implement new software algorithms that have been adapted for various applications," explains Tretbar. Another advantage of the ultrasound platform: Scientists can refer back to not only classic image data, but also to the unprocessed raw signals of each element in the ultrasound array. This allows them to develop completely new technologies.

The various modules are ready for deployment – primarily corporation from the medical field have signaled their interest in such developments. In order to turn the technology into concrete products, the experts from IBMT offer two approaches: Either they apply software interfaces to the ultrasound systems that are integrated directly into the customer's system. Or the second option is to integrate the customer's application into the software of the ultrasound system and then realize a software product for the entire application. As part of the research platform, IBMT's development expertise covers all technology components – from ultrasound transducers and new ultrasound technologies to complete systems and their certification or approval as a medical product.

Provided by Fraunhofer-Gesellschaft