Highly Sensitive Phased Array Probes based on Capacitive Micromachined Ultrasonic Transducers

Uwe Voelz[1], Marco Kircher[1], Sandro Gottfried Koch[1], Marcel Krenkel[1]

[1]Acoustic Sensors and Systems, Fraunhofer IPMS, Germany

Capacitive Micromachined Ultrasonic Transducers (CMUTs) offer a wide freedom of design for ultrasonic phased arrays. They are characterized, in comparison to piezoelectric transducers, by a higher sensitivity in receiving and a wider bandwidth based on their physical properties. Especially in combination with integrated preamplifiers the high receiving sensitivity compensates or rather overcompensates the lower transmission power of the CMUT in single probe applications with pulse-echo technique. This asymmetric behaviour opens new opportunities in the application. In medical diagnostics it allows to meet the maximum permissible ultrasonic radiation force with the best sensitivity. In nondestructive testing the transmission power can be increased by the combination of a piezoelectric probe for transmitting and a CMUT probe for receiving. Especially in double probe techniques, such as pitch-catch or time-of-flight diffraction (TOFD), this is an efficient extension of the conventional approach with two piezoelectric transducers. The CMUT array probes developed by Fraunhofer IPMS with integrated preamplifier and bias voltage converter powered by a standard USB-A connector can be applied as one to one substitute for piezoelectric phased arrays with commercially available ultrasonic devices without adaption or additional electronics. The CMUT arrays are best suited for immersion technique and medical sonography because of their natural matching to water-like materials. They are applicable as well for solid surfaces with a special coating. We present the first results of ultrasonic imaging with our CMUT array probes in comparison with a commercially available piezoelectric phased array probe.