

Capacitive Micromachined Ultrasound Transducers for Acoustic Anemometry on Mars

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An acoustic anemometer is under development for measuring wind speeds on Mars. Acoustic anemometry allows simultaneous measurement of wind speed and the speed of sound by measuring the acoustic time of flight in the forward and reverse directions. Acoustic anemometry avoids some sources of measurement error that plague other techniques for measuring winds in planetary atmospheres, such as hot wire measurements, or laser based tracking of scattered light from dust. The particular focus of this paper is the ultrasound transducers needed for the instrument. Capacitive micromachined ultrasound transducers (CMUT) fabricated at Tufts University have previously been described for atmospheric pressure operation (ASA Fall Meeting 2012). In this work the transducers have been modified and tested under low pressure conditions similar to the atmospheric conditions expected on Mars (4.5 Torr). We describe a comparison between the modeled and measured transducer frequency response. The CMUT resonant frequency decreased from 204 kHz at 760 Torr to 116 kHz at 1 Torr. This is predicted by the models. The quality factor increased with decreasing pressure as expected, and is accurately modeled above 50 Torr. However, at pressures below 50 Torr, unmodeled damping mechanisms dominate acoustic losses, and a purely acoustic model underpredicts damping.