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An ultrasonic anemometer for Mars

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Ultrasonic anemometers are often used for studies of 3-D atmospheric turbulence on Earth, due to their robust calibration and fast operation (>10 Hz). The same qualities make ultrasonic anemometry attractive for use on Mars, where similar atmospheric turbulence is found. The low density of Martian atmosphere - a hundredth that of the Earth's - is problematic, because of the large acoustic impedance mismatch between the atmosphere and piezoelectric transducers. One solution to this problem is to use piezoelectric transducers with a hornlike resonator bonded to their front surface. Another solution is to use a capacitive membrane transducer instead. We report on performance of various ultrasonic transducers in carbon dioxide Martian pressures, and present an instrument design capable of meeting the stringent mass, power, and environmental requirements of the European ExoMars lander.