ACOUSTICS2008/867
ultrasonic vibrometer for tissue characterization

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Ultrasonic vibrometers are well suited to a variety of tissue-characterization tasks because they exploit the lateral resolution and depth of field available with diagnostic ultrasound systems for measurements at lower frequencies. In the past, ultrasonic vibrometers have been used to measure the motion of surfaces with high impedance contrast to their surroundings (otoliths, swim bladders, and lung tissue). New ultrasonic vibrometry techniques have been developed and tested that permit calibrated real-time (amplitude and phase) transduction of sub-nanometer-amplitude vibrations at audio frequencies. These can be configured using either analog or digital demodulation for carrier signals up to 10 MHz. In the fully digital configuration, the vibrometer offers better displacement resolution than has been previously reported for analog systems. It also has the capability to simultaneously distinguish between the displacements of multiple discrete vibrating scatterers or regions within a continuum of scatterers by exploiting a multi-sine carrier signal. Individual vibrating targets are separated by pulse compression and windowing. This reduces the problem of carrier drop-out or speckle noise that occurs when multiple reflections destructively interfere at the receiver of a narrow-band signal. The technique should permit the vibrometer a depth resolution comparable a typical pulse-echo ultrasound system. [Work supported by ONR]