

ACOUSTICS2008/70 Zero-group velocity modes and local vibrations of an elastic plate

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Elastic plates or cylinders can support guided modes with zero group velocity (ZGV) at a nonzero value of the wave number. The conditions required for the existence of ZGV Lamb modes in isotropic plates are discussed. It is shown that these modes appear in a range of Poisson's ratio over the value for which the cut-off frequency curves of modes belonging to the same family intercept, i.e for a bulk wave velocity ratio equal to a rational number. An interpretation of this phenomenon in terms of a strong repulsion between a pair of modes having a different parity in the vicinity of the cutoff frequencies is given. Using laser-based ultrasonic techniques, we experimentally investigate some properties of these ZGV Lamb modes: resonance, backward wave propagation, interference between backward and forward waves. Experiments performed with materials of various Poisson's ratio demonstrate that the resonance spectrum of an unloaded elastic plate, locally excited by a laser pulse, is dominated by the ZGV Lamb modes. From these local resonance frequencies, thickness variations can be measured accurately and material properties like the Poisson's ratio, bulk acoustic wave velocities or material attenuation can be determined without any mechanical contact.