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Image Quality Assessment: Vibro-acoustography versus B-mode

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Vibro-acoustography (VA) is based on conversion of ultrasound energy from high frequency to a low frequency. This conversion, which results from the nonlinear nature of wave equation, gives VA some key advantages over linear ultrasound imaging such as B-mode. Two key features of VA are analyzed: lack of speckle noise, and angle-independency, which is the ability of imaging specular reflectors regardless of their orientation. Both the speckle noise and angle dependency are major artifacts in B-mode. Lack of speckle noise results from the fact that VA images are constructed from the low frequency acoustic signal. Using an acoustical model, it is shown that the random scatterers within soft tissue do not promote speckle noise in VA as they do in B-mode; thus VA generally produces high contrast images. Angle-independency results from the broad beam pattern of the low-frequency acoustic field. A model is constructed describing the amplitude of the acoustic signal versus object orientation angle. It is shown that the signal amplitude is relatively insensitive to object orientation; thus VA may be suitable for imaging specular objects such as implants. It is concluded that VA may be advantageous in applications where speckle noise and angle dependency are of concern.