Thin waveguide buffer for insulating an ultrasonic probe from hot and cold temperature

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Due to their structure, phased array probes and water immersion probes cannot be used at high temperatures above 60°C or low temperatures below 0°C. In these cases, buffer rods are often used to insulate the ultrasonic probe from the high and low temperatures. However, ultrasonic waves incident on the probe spread inside the buffer rod and reflect at the walls, resulting in complicated propagation behavior, which makes us difficult to focus an ultrasonic beam by phased array using buffer rods. Therefore, we propose a buffer structure using thin waveguides attached to each element of phased array probe independently as a device that can both control the ultrasonic beam and provide temperature insulation as a buffer rod. When a longitudinal wave is incident into the end of a thin waveguide, longitudinal vibration modes with small velocity dispersion propagate in the waveguide. Since these longitudinal vibration modes propagate with the same velocity when the cross-sectional shape and material of the waveguide are the same, the wave propagates with the delay maintained until the exit of the waveguide by delaying the incident waves with a phased array probe at the end of the waveguide, and thus waveform control by the phased array probe can be realized even after the buffer structure is penetrated. This study investigates the effectiveness of the proposed buffer structure using numerical simulations.