

Lamb Waves Wireless Communication in Healthy Plates Using Coherent Demodulation

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Abstract : Guided ultrasonic waves are used in Non-Destructive Testing (NDT) and Structural Health Monitoring (SHM) for inspection and damage detection. Recently, wireless data transmission using ultrasonic waves in solid metallic channels has gained popularity in some industrial applications such as nuclear, aerospace and smart vehicles. The idea is to find a good substitute for electromagnetic waves since they are highly attenuated near metallic components due to Faraday shielding. The proposed solution is to use ultrasonic guided waves such as Lamb waves as an information carrier due to their capability of propagation for long distances. In addition to this, valuable information about the health of the structure could be extracted simultaneously. In this work, the reliable frequency bandwidth for communication is extracted experimentally from dispersion curves at first. Then, an experimental platform for wireless communication using Lamb waves is described and built. After this, coherent demodulation algorithm used in telecommunications is tested for Amplitude Shift Keying, On-Off Keying and Binary Phase Shift Keying modulation techniques. Signal processing parameters such as threshold choice, number of cycles per bit and Bit Rate are optimized. Experimental results are compared based on the average Bit Error Rate. Results have shown high sensitivity to threshold selection for Amplitude Shift Keying and On-Off Keying techniques resulting a Bit Rate decrease. Binary Phase Shift Keying technique shows the highest stability and data rate between all tested modulation techniques.

Keywords : lamb waves communication, wireless communication, coherent demodulation, bit error rate

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