Non-destructive Testing of CIPP Defects Using Machine Learning Approach

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In the field of civil engineering, retrofitting actions involving repairs to pipes inside buildings and in extravehicular locations present complex and challenging tasks. Traditional repair procedures typically involve disassembling the surrounding structure, leading to technological pauses and potential disruptions to the working environment. An alternative approach to these procedures is the use of "cured-in-place pipes" (CIPP) technology for repairs. Unlike standard repairs, CIPP repairs do not require disassembly of the surrounding structures; only the access points at the beginning and end of the pipe need to be accessible. However, this method introduces the possibility of different types of defects [1].
The objective of this research is to observe a defects between the host pipe and the newly cured pipe inside it. However, the presence of holes, cracks, or obstacles prevents the attainment of this desired close fit state, ultimately reducing the life expectancy of the retrofitting action. This paper focuses on the non-destructive observation of these defects using the NDT Impact-Echo (IE) method. The study specifically applies this method to CIPP composite pipe segments inside concrete host pipes, forming a testing polygon. Previous results have indicated that the mechanical behavior of cured CIPP composite pipes can vary in stiffness depending on factors such as the curing procedure and environmental conditions [2]. The change of stiffness can be described by the change of acoustic parameters such as resonance frequency, attenuation and other features of typical IE signals.
This paper presents a comparison of different sensors used for IE proposed testing, namely piezoceramic and microphone sensors, and evaluates their ability to distinguish between different defects present in the body of the CIPP via machine learning approach using random tree classifiers.

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