

# **Machine Learning and Advanced Signal Processing in Nondestructive Testing of Concrete Structures**

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A comprehensive data processing platform has been developed, implementing advanced signal processing and Machine Learning for NDT methods of concrete structures. In particular, the methods included are ultrasonic pulse-echo, impact-echo, and ground penetrating radar (GPR). The effectiveness of the different analysis techniques is discussed. In particular, Machine Learning bears great potential in various applications of NDT of concrete structures. Analyzing the data collected with the mentioned NDT methods can be complex and requires experience. The expected benefit of Machine Learning applications in this context goes beyond the increase of efficiency obtained by automating the analysis process. While traditional analysis approaches are usually solely based on key features according to the basic principles, Machine Learning algorithms can consider the entire data content and reveal hidden correlations. An analysis tool has been developed for an organized approach to Machine Learning on NDT data. The tool provides a graphical user interface to manage and label training/test data and interactively define the Deep Neural Network architecture. In particular, Convolutional Neural Networks, as proven successful in various image recognition tasks, are implemented. The Machine Learning concepts are demonstrated in showcases, comprising ultrasonic and impact-echo applications. In particular, the relevance of targeted preprocessing is addressed, comparing the effectiveness of time-, frequency- and joint-time-frequency-representations.