

(Research Article)

Investigating the performance of machine learning-based methods in classroom reverberation time estimation using neural networks

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Abstract

Classrooms, as one of the most important educational environments, play a major role in the learning and academic progress of students. Reverberation time, as one of the most important acoustic parameters inside rooms, has a significant effect on sound quality. The inefficiency of classical formulas such as Sabin, caused this article to examine the use of machine learning methods as an alternative method for predicting the environment's reverberation time. In this research, firstly, by using methods based on geometrical acoustics and by using Odeon software, the collection of required data sets at frequencies of 500 and 2000 Hz is done. In this dataset, 4 classrooms with a rectangular space, along with elements such as desks and chairs, windows, and doors, were used. After that, to provide a system based on machine learning, multilayer perceptron neural network and neural network based on radial basis functions along with K-means clustering algorithm and also convolutional neural network has been used. These models consider the characteristics of the environment and finally estimate the values of reverberation time as a function of frequency. In this research, by using the multi-layer perceptron neural network, the determination coefficient was 93% for the frequency of 500 Hz and 95% for the frequency of 2000 Hz. Also, by using the neural network based on radial basis functions, for the frequency of 500 Hz, the coefficient of determination was 82% and for the frequency of 2000 Hz, the coefficient of determination was recorded as 89%. Also, by using a one-dimensional convolutional neural network, a determination coefficient of 94% was recorded for the frequency of 500 Hz, and a determination coefficient of 96% for the frequency of 2000 Hz.

Keywords: Classroom acoustic, Reverberation time, Multilayer perceptrons, Radial basis function, 1D Convolutional.

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