Using Neural Networks to Apply Intelligent Genre-Specific Equalization to Audio Masters

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Abstract

Recent trends in audio technology are pushing toward automating the mastering process, and as more artists are able to independently record music, the more appealing a streamlined, inexpensive mastering solution becomes. As audio engineers, we are direct witnesses of this trend affecting the independent music community and professional recording industry of Nashville alike. Skeptics question whether an algorithm can outperform a mastering engineer, but we believe using automation to at least augment mastering can importantly lower the barrier of entry to releasing professional-sounding music.

Mastering is an umbrella term for a number of processes, but for our purposes it is best to focus on the process of equalization, since it is applied to nearly every modern master and has unique associations to genre (i.e. hip hop and EDM having more intense bass frequencies than country music). We plan to use a supervised parametric neural network that uses the relative amplitude of 5 bands of frequencies (low, low mid, mid, high mid, and high) of an audio file as inputs to predict the likelihood of that music being a particular genre (pop, rock, classical, hip hop, and country). Our program could then adjust the relative amplitude of each frequency band to match a preset frequency response.

More frequency bands and genres could be added to make this network more accurate. However, this could also contribute to overfitting with increased correlation between genres. Creating an intermediary dataset and introducing backpropagation would help offset these accidental correlations further in our research.

Keywords

Audio, mastering, neural networks, machine learning, automation, music.

Annotated Bibliography

[1] Jay Lebeouf and Stephen Pope. 2015. Automatic Learning and Control of Audio Algorithms By Audio Recognition. (May 2015). Patent No. US 9,031,243 B2, Filed Sept. 28, 2010, Issued May 12, 2015.

This patent describes a sophisticated multi-stage audio analysis process that is used to attach high-level metadata to audio files. By doing so, audio can be intuitively and automatically categorized for use in further processing. The patent is assigned to the audio software company Izotope, Inc., which is well known for its intelligent mastering assistant plug-in suite Ozone. This patent discloses useful methods for automatically categorizing audio files, for our case into genres, that can then be used to apply the appropriate processing.

[2] Jonathan Sterne and Elena Razlogova. 2019. Machine Learning in Context, or Learning from LANDR: Artificial Intelligence and the Platformization of Music Mastering. *ACM* 51, 2, Article 2 (June 2019), 18 pages. DOI: https://journals.sagepub.com/doi/pdf/10.1177/2056305119847525

"Machine Learning in Context" deconstructs the intelligent mastering service LANDR. The authors question the validity of the company's claims that they fully automate the mastering process, suggesting that machine learning is only used in part of the process and conventional signal processing is truly the core of their service. Nevertheless, despite the ethical controversy of falsely claiming "AI" for its appeal as an industry buzzword, the article reveals useful methods for using machine learning to classify audio files. They claim LANDR simply uses machine learning to analyze sound and map it to a matrix of preset processing algorithms, instead of the full automation it claims. Even so, this methodology is useful for our research, because *complete* automation of mastering is not necessary for utility, and this partial automation is sufficient and achievable for our project.

[3] Thomas Birtchnell. 2018. Listening Without Ears: Artificial Intelligence in Audio Mastering. *ACM* 50, 1, Article 2 (Nov. 2018), 16 pages. DOI: https://journals.sagepub.com/doi/pdf/10.1177/2053951718808553

In "Listening without ears," Birtchnell explores the potential role of automation in the audio mastering field. In interviews with professional mastering engineers, Birtchnell asks how they perceive AI in their field, whether it is viewed as a tool or a threat. From this data and his knowledge of the history of mastering, he predicts several different hybrid scenarios in which AI could affect the mastering "workflow." These scenarios span from using AI as a reference tool, to humans acting as a "premium" upgrade from AI mastering, and AI simply being used as a data management tool outside of the creative part of mastering. This source is useful to our research in that it validates the importance of using machine learning to automate parts of the mastering process and combats skepticism by viewing its role through several lenses as an augmentation, not replacement, of human mastering.