**Peer Review of "AI-Driven Audio Equalization" by Dylan Bartness**

**My Breakdown of the Research Paper**

**Summary**

This paper describes the way in which AI can be used in audio equalization. The author discusses and important terms like frequency, bit depth, discretization, and important mathematical equations surrounding this topic. More is described with sampling and how certain algorithms can adjust the audio equalization like a Fourier transform but with a better complexity. Further discussion describes the filtering of these input samples fed through the algorithm and then produced through various outputs. At the end, a brief description of using AI for this purpose is provided. The paragraph loosely describes convolutional neural networks and their makeup while finishing off on a note that states CNNs are used for equalization by being trained on equalization parameters and outputting to a digital filter.

Strengths:

* **Structure and Flow** – The overall structure and flow of this paper is good for the current information it holds. The ideas flow in a straightforward manner and do not bounce around.
* **Definition Explanations** – Whenever terms are stated, they are also defined in a easily understandable manner, allowing for the reader to keep up with the technical terms within the article itself.
* **Enough Words, No More** – the paper clearly aligns without class motto. There isn’t any noticeable repetition or large amounts of unnecessary jargon throughout that distract the reader from the paper.

Areas for Improvement:

* **Further Depth and Breadth** – The paper has limited technical depth at the moment, as it only really describes the background of the topic and a small paragraph about how CNNs can be used for this subject. Consider going into more detail on current applications in the real-world.
* **Add a Formal Conclusion** – Currently, there is no conclusion to the paper which is a major takeaway since there is no connection of ideas or synthesis of what was described.
* **Format the Paper in the Proper Manner** – The current state of the paper has no structure. It goes through ideas in a straightforward and sequential manner, but it is hard to follow since there are no section headers, title of the paper, or author on the document itself. It also should be implemented using Overleaf and LaTeX format instead of a plain document to adhere with the class guidelines for this paper.
* **Use Citations Throughout** – Alongside the previous idea, the paper currently uses no citations to verify/back any of the points the author makes. Clear citations are key throughout and vital to being an academic document.
* **Find/Implement Figures** – The author uses some equations throughout, but there are no visual figures to help the reader understand and grasp the key concepts behind using CNNs for audio equalization.
* **Think About Limiting Scope** – When the author gets around to formalizing the discussion on AI and its current usages in the field, they should think about limiting their scope to look at one (or a few) things that the AI models have been found to help with. This could be based on the Fourier Transforms, pieces of the equalization techniques or something else the AI can work with in terms of I/O.

**--------------------------------------------------------------------------------------------------------------------**

**AI Review of the Research Paper**

**Summary**

The paper explores the role of artificial intelligence (AI) in modern audio equalization, a process used to adjust frequency bands within an audio signal. Traditionally performed manually using hardware or software equalizers (EQs), AI-based methods are now being integrated to optimize sound processing with greater precision and automation. The paper explains the fundamentals of equalization, covering key concepts such as sampling, Fourier transformation, and digital filtering. It then discusses how AI, particularly convolutional neural networks (CNNs), can be used to train digital filters to automate and enhance equalization, making professional-quality sound engineering more accessible to non-experts.

The methodology section details how CNNs are used for equalization by learning patterns in frequency data and optimizing filter responses accordingly. The author explains the underlying principles of signal processing, including sampling theory, fast Fourier transform (FFT), and the differences between finite impulse response (FIR) and infinite impulse response (IIR) filters. Additionally, the paper outlines the advantages of AI-based equalization, such as its ability to dynamically adjust sound for different environments and devices. The study concludes by emphasizing AI’s potential to revolutionize sound engineering but also acknowledges challenges such as computational complexity and model interpretability.

**Strengths**

* **Comprehensive Technical Breakdown** – The paper provides a thorough explanation of equalization fundamentals before diving into AI applications. The sections on Fourier transformations, digital filters, and CNN architectures demonstrate a solid understanding of both traditional and modern approaches to audio processing.
* **Clear and Logical Structure** – The progression from basic concepts to AI implementation is well-organized. The paper first introduces the need for equalization, then explains signal processing techniques, and finally explores AI’s role, making it easy for readers to follow.
* **Relevance and Practical Applications** – The discussion on AI-driven equalization is timely and relevant, especially as AI-assisted audio tools become increasingly prevalent in music production and sound engineering. The paper does well in highlighting AI’s ability to enhance equalization efficiency while lowering the barrier to entry for novice users.
* **Strong Use of Technical References** – The paper cites multiple relevant sources from academic literature, including studies on AI-based equalization, digital filters, and signal processing. This lends credibility to its claims and demonstrates awareness of current advancements in the field.

**Opportunities for Improvement**

* **Expand the Discussion on AI Model Training and Performance** – While the paper explains how CNNs are used for equalization, it does not provide details on how these models are trained. Information about dataset selection, loss functions, evaluation metrics, and potential model benchmarks (e.g., comparing CNN-based equalization to traditional methods) would make the AI discussion more robust.
* **Clarify the Practical Implementation of AI Equalization** – The paper effectively describes how AI-based equalization works in theory, but it lacks concrete examples of real-world applications. Including case studies or examples of AI-driven equalization in commercial audio software would provide a more practical perspective.
* **Address Computational Constraints and Model Optimization** – CNNs, while effective for pattern recognition, can be computationally intensive. A discussion on how to optimize AI models for real-time equalization (e.g., reducing latency, using lightweight models, or leveraging hardware acceleration) would strengthen the feasibility aspect of AI-based solutions.
* **Improve Conclusion by Suggesting Future Research Directions** – The paper concludes by emphasizing AI’s potential in equalization but does not suggest specific areas for further research. Exploring hybrid approaches (e.g., AI combined with traditional DSP techniques), advancements in explainable AI for audio processing, or real-time AI-driven equalization could provide valuable insights for future work.

**--------------------------------------------------------------------------------------------------------------------**

**Analysis of the AI Breakdown**

The AI review went into much greater depth than I did, which could partially be because it was able to understand the research more than I did after reading through it a few times. I also feel like the review is quite accurate, the only thing I noticed that wasn’t is the strong use of technical sources. Sure, the sources themselves might be good; however, there are no in-text citations, so it is impossible to tell if the information is credible or not. With the strengths as well, I would have added something about the conciseness of this paper, there’s not much repetition and the overall wording avoids jargon as it currently is. It could be slimmed down some, but for where the paper is at it is at an alright standpoint. Furthermore, the AI tool did a good job reviewing the weaknesses of this article. There are some things that I didn’t mention that it did, but at the same time there are class specific things that I pulled out and wanted to mention. Thus, the AI tool did a good job overall at summarizing the article but gave more explanation than I got out of it and a decent overall review of the strengths and weaknesses.

**--------------------------------------------------------------------------------------------------------------------**

**Revision of AI Review with My Review**

**Summary**

The paper explores the role of artificial intelligence (AI) in modern audio equalization, a process used to adjust frequency bands within an audio signal. Traditionally performed manually using hardware or software equalizers (EQs), AI-based methods are now being integrated to optimize sound processing with greater precision and automation. The paper explains the fundamentals of equalization, covering key concepts such as sampling, Fourier transformation, and digital filtering. It then discusses how AI, particularly convolutional neural networks (CNNs), can be used to train digital filters to automate and enhance equalization, making professional-quality sound engineering more accessible to non-experts.

The later portion of the paper begins to describe how CNNs are used for equalization by learning patterns in frequency data and optimizing filter responses accordingly. The author explains the underlying principles of signal processing, including sampling theory, fast Fourier transform (FFT), and the differences between finite impulse response (FIR) and infinite impulse response (IIR) filters. Additionally, the paper outlines the advantages of AI-based equalization, such as its ability to dynamically adjust sound for different environments and devices. The research ends off abruptly during its beginning explanation of CNN’s and their usage within the audio equilization.

**Strengths**

* **Comprehensive Technical Breakdown** – The paper provides a thorough explanation of equalization fundamentals before diving into AI applications. The sections on Fourier transformations, digital filters, and CNN architectures demonstrate a solid understanding of both traditional and modern approaches to audio processing.
* **Clear and Logical Structure** – The progression from basic concepts to a very brief AI implementation is well-organized. The paper first introduces the need for equalization, then explains signal processing techniques, and finally begins exploring AI’s role, making it sequentially understandable for the reader.
* **Relevance and Practical Applications** – The discussion on AI-driven equalization is timely and relevant, especially as AI-assisted audio tools become increasingly prevalent in music production and sound engineering.
* **Definition Explanations** – Whenever terms are stated, they are also defined in a easily understandable manner, allowing for the reader to keep up with the technical terms within the article itself.
* **Enough Words, No More** – the paper clearly aligns without class motto. There isn’t any noticeable repetition or large amounts of unnecessary jargon throughout that distract the reader from the paper.

**Opportunities for Improvement**

* **Expand the Discussion on AI Model Training and Performance (Lacking Depth of Algorithms and current research)** – While the paper explains how CNNs are used for equalization, it does not provide details on how these models are trained. Information about dataset selection, loss functions, evaluation metrics, and potential model benchmarks (e.g., comparing CNN-based equalization to traditional methods) would make the AI discussion more robust.
* **Clarify the Practical Implementation of AI Equalization** – The paper effectively describes how AI-based equalization works in theory, but it lacks concrete examples of real-world applications. Including case studies or examples of AI-driven equalization in commercial audio software would provide a more practical perspective.
* **Address Computational Constraints and Model Optimization** – CNNs, while effective for pattern recognition, can be computationally intensive. A discussion on how to optimize AI models for real-time equalization (e.g., reducing latency, using lightweight models, or leveraging hardware acceleration) would strengthen the feasibility aspect of AI-based solutions.
* **Improve Conclusion by Suggesting Future Research Directions** – The paper concludes by emphasizing AI’s potential in equalization but does not suggest specific areas for further research. Exploring hybrid approaches (e.g., AI combined with traditional DSP techniques), advancements in explainable AI for audio processing, or real-time AI-driven equalization could provide valuable insights for future work.
* **Format the Paper in the Proper Manner** – The current state of the paper has no structure. It goes through ideas in a straightforward and sequential manner, but it is hard to follow since there are no section headers, title of the paper, or author on the document itself. It also should be implemented using Overleaf and LaTeX format instead of a plain document to adhere with the class guidelines for this paper.
* **Use Citations Throughout** – Alongside the previous idea, the paper currently uses no citations to verify/back any of the points the author makes. Clear citations are key throughout and vital to being an academic document.
* **Find/Implement Figures** – The author uses some equations throughout, but there are no visual figures to help the reader understand and grasp the key concepts behind using CNNs for audio equalization.
* **Think About Limiting Scope** – When the author gets around to formalizing the discussion on AI and its current usages in the field, they should think about limiting their scope to look at one (or a few) things that the AI models have been found to help with. This could be based on the Fourier Transforms, pieces of the equalization techniques or something else the AI can work with in terms of I/O.

**Analysis of Breadth of Topic Exploration**

**The paper "AI-Driven Audio Equalization" provides a strong foundation in traditional equalization techniques and AI-driven approaches, particularly focusing on convolutional neural networks (CNNs). It effectively explains Fourier transforms, digital filters (FIR vs. IIR), and AI’s role in optimizing EQ settings.**

**However, some areas could be expanded for a more comprehensive discussion:**

* **Limited Model Comparisons: While the paper discusses CNNs, it lacks a comparison with other AI models like RNNs or Transformers, and it does not evaluate AI-driven equalization vs. manual methods in terms of accuracy or efficiency.**
* **Lack of Real-World Applications: The paper does not explore industry use cases (e.g., AI in Adobe Audition or Spotify) or how these methods perform outside of theoretical settings.**
* **No Discussion on Ethical & Computational Challenges: There is no mention of bias in training data, impact on human sound engineers, or hardware limitations that could affect real-time AI equalization.**

----------------------------------------------------------------------------------------------------------

My Thoughts

I think the AI does very well describing the strengths and weaknesses of the breadth for this paper. These were my initial thoughts on what the article was missing and could use for its future iterations. With the current state of this AI summary, I would maybe discuss two more things. Firstly maybe cover how the experience is for people using these systems and if it really does help the ordinary user, or more just professionals. Secondly, I would also maybe add in thoughts of how the combination of both the user and AI can work together to produce audio equalization.

----------------------------------------------------------------------------------------------------------

Revised Analysis

**Analysis of Breadth of Topic Exploration**

**The paper "AI-Driven Audio Equalization" provides a strong foundation in traditional equalization techniques and AI-driven approaches, particularly focusing on convolutional neural networks (CNNs). It effectively explains Fourier transforms, digital filters (FIR vs. IIR), and AI’s role in optimizing EQ settings.**

**However, some areas could be expanded for a more comprehensive discussion:**

* **Limited Model Comparisons: While the paper discusses CNNs, it lacks a comparison with other AI models like RNNs or Transformers, and it does not evaluate AI-driven equalization vs. manual methods in terms of accuracy or efficiency.**
* **Lack of Real-World Applications: The paper does not explore industry use cases (e.g., AI in Adobe Audition or Spotify) or how these methods perform outside of theoretical settings.**
* **No Discussion on Ethical & Computational Challenges: There is no mention of bias in training data, impact on human sound engineers, or hardware limitations that could affect real-time AI equalization.**
* **Limited Discussion on User Experience and Practical Usability: While the paper explains AI-driven equalization at a technical level, it does not address how user-friendly these systems are for musicians, producers, or casual users.**
* **No Exploration of Hybrid Approaches: The paper focuses on CNN-based equalization but does not discuss hybrid methods that combine manual control with AI assistance.**

AI **Analysis of Depth of Topic Exploration**

The paper **"AI-Driven Audio Equalization"** demonstrates **strong technical knowledge** of both **traditional audio equalization** and **AI-based techniques**. It provides **detailed explanations** of **Fourier transforms, digital filtering, and convolutional neural networks (CNNs)**, effectively linking **machine learning principles to sound processing**. The breakdown of **sampling, frequency analysis, and digital filter structures** shows a deep understanding of **signal processing fundamentals**.

However, there are areas where the depth could be **enhanced**:

* **Lack of Comparative Performance Analysis:** While CNNs are discussed, the paper does not evaluate **how well CNN-based EQ compares to traditional EQ methods** or other AI models like **RNNs or GANs** in terms of accuracy, efficiency, or user experience.
* **No Real-World Performance Insights:** The discussion remains **theoretical**, with **no testing results, case studies, or industry benchmarks** that demonstrate AI-driven equalization in action.

----------------------------------------------------------------------------------------------------------

My Thoughts

Once again, I think the AI overview has done quite well with this section, there’s only one thing that I would add to the depth part. Since this article is dealing with neural networks, I think it could be important to detail more of the training process and discuss the methods of optimization used for these models as well.

----------------------------------------------------------------------------------------------------------

Revised **Analysis of Depth of Topic Exploration**

The paper **"AI-Driven Audio Equalization"** demonstrates **strong technical knowledge** of both **traditional audio equalization** and **AI-based techniques**. It provides **detailed explanations** of **Fourier transforms, digital filtering, and convolutional neural networks (CNNs)**, effectively linking **machine learning principles to sound processing**. The breakdown of **sampling, frequency analysis, and digital filter structures** shows a deep understanding of **signal processing fundamentals**.

However, there are areas where the depth could be **enhanced**:

* **Lack of Comparative Performance Analysis:** While CNNs are discussed, the paper does not evaluate **how well CNN-based EQ compares to traditional EQ methods** or other AI models like **RNNs or GANs** in terms of accuracy, efficiency, or user experience.
* **No Real-World Performance Insights:** The discussion remains **theoretical**, with **no testing results, case studies, or industry benchmarks** that demonstrate AI-driven equalization in action.
* **Limited Discussion on AI Model Optimization:** The paper does not explore **how CNNs are trained, optimized, or benchmarked** for equalization tasks. Details on **hyperparameter tuning, loss functions, or dataset selection** would strengthen the depth.

**AI Analysis of Prose Efficiency and Clarity**

The paper **"AI-Driven Audio Equalization"** is **technically detailed** and provides **clear explanations** of key concepts like **Fourier transforms, digital filters, and CNNs**. It generally avoids excessive jargon, making complex topics **understandable** while maintaining **technical accuracy**.

However, there are some areas where the writing could be **more concise and precise**:

* **Some Sections Are Overly Detailed:** While depth is valuable, parts of the paper (e.g., explanations of Fourier transforms and CNN layers) **contain excessive technical descriptions** that could be streamlined without losing meaning.
* **Repetitive Phrasing:** Certain ideas—such as **why AI is useful for equalization**—are **restated multiple times**, which could be condensed for better readability.
* **Occasional Informal or Wordy Phrasing:** Some sentences could be **more direct and precise**, reducing unnecessary qualifiers or redundant explanations.

----------------------------------------------------------------------------------------------------------

My Thoughts

The AI revision of this part of the paper is also very well done, there’s only one thing that I would consider changing. The part about sections being overly detailed – I feel like the explanations are needed, just maybe in a different format. For instance, maybe some of the key definitions at times could be streamlined into bullet points instead of term/definition in the middle of a paragraph.

----------------------------------------------------------------------------------------------------------

**Revised Analysis of Prose Efficiency and Clarity**

The paper **"AI-Driven Audio Equalization"** is **technically detailed** and provides **clear explanations** of key concepts like **Fourier transforms, digital filters, and CNNs**. It generally avoids excessive jargon, making complex topics **understandable** while maintaining **technical accuracy**.

However, there are some areas where the writing could be **more concise and precise**:

* **Some Sections Are Overly Detailed:** While depth is valuable, parts of the paper (e.g., explanations of Fourier transforms and CNN layers) **contain excessive technical descriptions** that could be streamlined without losing meaning. Adding these things into a bulleted list while keeping not overly explaining the topics could be useful here.
* **Repetitive Phrasing:** Certain ideas—such as **why AI is useful for equalization**—are **restated multiple times**, which could be condensed for better readability.
* **Occasional Informal or Wordy Phrasing:** Some sentences could be **more direct and precise**, reducing unnecessary qualifiers or redundant explanations.

**AI Analysis of Story Integrity**

The paper **"AI-Driven Audio Equalization"** has a **logical structure**, progressing from **traditional equalization concepts** to **AI-based approaches** and **their applications**. The **beginning** effectively introduces **why equalization matters**, the **middle** provides a **technical breakdown of key processes**, and the **end** wraps up with how **AI-driven techniques enhance traditional equalization**.

However, there are areas for improvement:

* **Conclusion Lacks a Strong Synthesis:** While the paper covers a lot of ground, the conclusion does not fully **synthesize the key takeaways** or discuss **future directions** for AI in equalization.
* **Transitions Could Be Smoother:** Some sections feel like **isolated discussions**, rather than a continuous narrative. Stronger transitions between **traditional equalization, digital filtering, and AI models** would improve **flow**.
* **No Clear Discussion of Broader Impacts:** The paper does not address the **real-world significance** of AI-driven EQ—how it might **change music production, accessibility, or industry practices**.

----------------------------------------------------------------------------------------------------------

My Thoughts

The AI tool did a good job highlighting that the beginning and (current) middle goes into good depth and follows a straightforward, easy to follow scheme. The only thing that I would change here is the part about the conclusion. I would argue that this paper is currently not in a done state and more additions need to be added for this to become a full paper.

----------------------------------------------------------------------------------------------------------

**Revised Analysis of Story Integrity**

The paper **"AI-Driven Audio Equalization"** has a **logical structure**, progressing from **traditional equalization concepts** to **AI-based approaches** and **their applications**. The **beginning** effectively introduces **why equalization matters**, the **middle** provides a **technical breakdown of key processes**, and the **end** wraps up with how **AI-driven techniques enhance traditional equalization**.

However, there are areas for improvement:

* **Lack of Conclusion: There is no conclusion for the research paper at the moment. Once the AI portion of this research is tackled a conclusion will be necessary to synthesize the key points here.**
* Findings With AI in the Real-World: The story lacks what should be the main topic of this research – AI with audio equalization. More research or explanation needs to be done to further the plot of this research and lead to the previously mentioned conclusion.
* **Transitions Could Be Smoother:** Some sections feel like **isolated discussions**, rather than a continuous narrative. Stronger transitions between **traditional equalization, digital filtering, and AI models** would improve **flow**.
* **No Clear Discussion of Broader Impacts:** The paper does not address the **real-world significance** of AI-driven EQ—how it might **change music production, accessibility, or industry practices**.