Review of: "Pulse Amplitude Measurement Using Low Sampling ADC and Interpolation Technique"

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Potential competing interests: No potential competing interests to declare.

Rejection of Paper on Pulse Amplitude Measurement Using Low Sampling ADC and Interpolation Techniques

To the editor

1. Limited Scope: The evaluation scope of the study is narrow, focusing solely on a predetermined set of interpolation methods. This narrow focus limits the depth of analysis and overlooks alternative approaches documented in the literature, potentially missing out on valuable insights.

2. Simplified Experimental Setup: The experimental setup appears to oversimplify real-world scenarios by neglecting factors such as noise, nonlinearity, and diverse signal characteristics. A more comprehensive experimental design would provide a more accurate representation of practical applications.

3. Lack of Discussion: The absence of a discussion section prevents the authors from interpreting the results, discussing their implications, and comparing them with existing literature. A discussion section is crucial for providing deeper insights and guiding future research directions.

4. Missing Limitations Section: The paper lacks a limitations section, which is essential for acknowledging any constraints or biases in the study. Addressing limitations is crucial for transparency and ensuring the validity and generalizability of the results.

To the authors

The study investigates interpolation techniques tailored for pulse amplitude measurement, specifically focusing on their implementation using low-sampling ADC and FPGA technology. It rigorously evaluates seven interpolation methods, assessing their effectiveness through metrics such as hardware resource allocation, Mean Square Error (MSE), and Mean Absolute Deviation (MAD). However, despite offering valuable insights, the study has notable limitations that warrant attention. Firstly, its evaluation scope is confined to a predetermined set of interpolation methods, potentially overlooking alternative approaches documented in the literature. This narrow focus may limit the depth of analysis and miss out on potentially advantageous methodologies. Furthermore, while the experimental setup is adequately described, it appears to oversimplify real-world scenarios by neglecting factors such as noise, nonlinearity, and diverse signal characteristics, all of which significantly impact practical applications. Additionally, the study's reliance on Gaussian pulses for signal generation may not fully capture the complexities of real-world analog signals. A more diverse range of signal types could offer

deeper insights into the performance of interpolation methods across various scenarios. Moreover, while the error analysis provides valuable insights, it could benefit from broader coverage with more comprehensive statistical techniques and comparisons against ground truth measurements to enhance accuracy validation. Furthermore, the study lacks in-depth discussion on optimization strategies and scalability concerning FPGA resource utilization, limiting its applicability across different hardware platforms and real-world applications. Addressing these limitations would not only augment the study's relevance but also pave the way for more robust research in the field of signal processing and FPGA-based systems.

General comments

1. The scope of the evaluation should be expanded to include a broader range of interpolation techniques beyond the seven methods currently examined. This would ensure a more comprehensive analysis and potentially uncover additional insights.
2. The experimental setup should be enhanced to better reflect real-world scenarios by incorporating factors such as noise, nonlinearity, and diverse signal characteristics. This would improve the relevance and applicability of the study's findings to practical applications.
3. The reliance on Gaussian pulses for signal generation should be reconsidered. Introducing a more diverse range of signal types would provide a more accurate representation of real-world analog signals and yield more meaningful results.
4. The error analysis could be strengthened by employing more comprehensive statistical techniques and conducting comparisons with ground truth measurements to validate accuracy more effectively.
5. The paper should include a more thorough discussion on optimization strategies and scalability concerning FPGA resource utilization. This would enhance the applicability of the study's findings to different hardware platforms and real-world scenarios.

Specific comments

Abstract

The abstract provides a clear overview of the study's aims and methodology, focusing on pulse amplitude measurement using low sampling ADC and interpolation techniques. The abstract effectively outlines the study's objectives and methodology; additional context, clarification of selection criteria, and highlighting key findings would enhance its comprehensiveness and appeal to readers. However, there are areas for improvement to enhance clarity and completeness:

6. The abstract acknowledges the significance of precise amplitude measurement in various applications. However, it would be beneficial to provide a more explicit explanation of why low sampling ADC and interpolation methods are particularly pertinent or advantageous in this context. This additional context would help readers grasp the significance of the study's focus.

7. Although interpolation methods were chosen based on relative error, mean square error, and mean absolute deviation,

explaining how these criteria were used to select the most suitable method would provide a clearer understanding of the decision-making process. This clarification would elucidate the methodology used to determine the optimal method.

8. The abstract effectively outlines the study's objectives, methodology, and evaluation criteria for pulse amplitude measurement using low sampling ADC and interpolation techniques. However, it lacks a clear presentation of the study's results and findings. Including a summary of the performance of each interpolation method in terms of relative error, mean square error, and mean absolute deviation would significantly enhance the abstract's completeness and effectiveness in conveying the study's contributions.

9. While the abstract briefly mentions the performance evaluation of each method, reinforcing this with a summary of key findings or conclusions from the study would offer readers insights into the paper's contributions. This enhancement would provide a more comprehensive overview of the study's outcomes.

10. The structure of the abstract encompasses an introduction contextualizing the study, an objective statement, a methodology overview, an explanation of selection criteria, a summary of results, and a conclusion highlighting significance.

Addressing these points in a revised version of the paper would improve its quality and make a more significant contribution to the field of signal processing and FPGA-based systems.

Introduction

The introduction provides a comprehensive overview of the necessity for accurate analog-to-digital conversion in various applications, driven by factors such as dynamic range, minimum measurable change, and signal-to-noise ratio. However, it could be improved by:

11. The introduction effectively outlines the need for accurate analog-to-digital conversion across various applications, considering factors like dynamic range and signal-to-noise ratio. This sets the stage for understanding the significance of the study.
12. Including a brief mention of related work in the introduction would provide additional context and highlight the existing knowledge and research in the field. This could help readers understand how the current study contributes to the existing body of literature.
13. Including relevant prior research or methodologies could enrich the introduction, providing a more comprehensive view of the study's context and highlighting its position within the broader research landscape.
14. The introduction lacks specific objectives or aims of the study. Including these would offer clearer direction to the reader, helping them understand the study's purpose and what it seeks to achieve.
15. There is a mention of using FPGA-based interpolation to enhance ADC resolution, but the relationship between ADC resolution and interpolation methods could be clarified further. This would aid readers who may not be familiar with the technical aspects of the topic.
16. Integrating references and a bibliography into the introduction can provide additional credibility and context for the

study.

Interpolation techniques

The section on interpolation techniques provides a detailed exploration of various methods, each with its own mathematical formulation and application. However, there are several points that could be commented on:

17. While the section effectively introduces each interpolation method, the explanations could be further refined for clarity, especially for readers who may not be familiar with the mathematical concepts involved.

18. The section lacks a comparative analysis of the different interpolation techniques, which could help readers understand the relative advantages and disadvantages of each method. Including such an analysis would enrich the discussion and guide readers in selecting the most suitable technique for their specific application.

19. While the mathematical formulations are valuable, practical considerations such as computational complexity, resource requirements, and potential limitations of each interpolation method are not addressed. Incorporating these aspects would provide a more comprehensive perspective for readers evaluating the feasibility of implementing these techniques.

20. Visual aids, such as graphs or diagrams, could be beneficial for illustrating the concepts discussed, particularly for readers who learn better through visual representation. Including visualizations could enhance the clarity and accessibility of the content.

21. The section could be strengthened by explicitly connecting each interpolation technique to the study's objectives and methodology. Clarifying how each method contributes to achieving the overall goal of pulse amplitude measurement using low sampling ADC and interpolation techniques would reinforce the relevance of the discussion.

22. Insert figures in the text (Figure XX) to provide visual support and enhance understanding of the discussed concept.

23. Expanding on the LabVIEW version used in the study could provide valuable context for readers, especially those familiar with LabVIEW or interested in replicating the experiment.

FBGA Implementation

The implementation section provides detailed insights into the FPGA implementation of various interpolation methods, offering valuable information on resource utilization and timing considerations. However, there are a few areas that could be improved for clarity and completeness:

24. While the section mentions the importance of minimizing resource usage, it could benefit from providing specific details on resource utilization for each interpolation method. This would offer readers a clearer understanding of the resource requirements and constraints associated with different algorithms.

25. Although the section briefly discusses timing constraints and the base clock speed, more detailed explanations on how these factors influence the FPGA implementation could enhance understanding. Additionally, providing examples or

specific cases where reduced clock rates were utilized would illustrate the practical implications of timing considerations.

26. While Figures 5, 6, 7, 8, and 9 are referenced, their specific findings or implications are not discussed in the provided text. To enhance clarity and help readers understand the significance of the figures, it would be beneficial to include brief explanations or interpretations of the results depicted in each figure.

27. The section briefly mentions the observed trends in relative error, mean square error (MSE), and mean absolute deviation (MAD) for different interpolation techniques. However, a more in-depth analysis and comparison of these results would provide valuable insights into the performance differences between the interpolation methods.

28. While Figures 8 and 9 display the combinational and sequential cell utilization of the FPGA for different interpolation algorithms, the text does not provide an analysis or interpretation of these findings. Including a discussion on how FPGA utilization varies across different interpolation methods would enhance the understanding of resource requirements and constraints.

Discussion

29. The absence of a discussion section is notable, as it prevents the authors from interpreting the results, discussing their implications, and comparing them with existing literature. Including such a section would enrich the study by providing deeper insights and fostering a better understanding of the findings.

Limitations

30. The lack of a limitations section is a missed opportunity to acknowledge any constraints or biases in the study, which could impact the validity and generalizability of the results. Addressing limitations is crucial for transparency. The study investigates interpolation techniques tailored for pulse amplitude measurement, specifically focusing on their implementation using low-sampling ADC and FPGA technology. It rigorously evaluates seven interpolation methods, assessing their effectiveness through metrics such as hardware resource allocation, Mean Square Error (MSE), and Mean Absolute Deviation (MAD). However, despite offering valuable insights, the study has notable limitations that warrant attention. Firstly, its evaluation scope is confined to a predetermined set of interpolation methods, potentially overlooking alternative approaches documented in the literature. This narrow focus may limit the depth of analysis and miss out on potentially advantageous methodologies. Furthermore, while the experimental setup is adequately described, it appears to oversimplify real-world scenarios by neglecting factors such as noise, nonlinearity, and diverse signal characteristics, all of which significantly impact practical applications. Additionally, the study's reliance on Gaussian pulses for signal generation may not fully capture the complexities of real-world analog signals. A more diverse range of signal types could offer deeper insights into the performance of interpolation methods across various scenarios. Moreover, while the error analysis provides valuable insights, it could benefit from broader coverage with more comprehensive statistical techniques and comparisons against ground truth measurements to enhance accuracy validation. Furthermore, the study lacks in-depth discussion on optimization strategies and scalability concerning FPGA resource utilization, limiting its applicability across different hardware platforms and real-world applications. Addressing these limitations would not only augment the

study's relevance but also pave the way for more robust research in the field of signal processing and FPGA-based systems.

The paper would benefit from a revision to address several key areas.

General comments

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