# Journal of Embedded & Digital System Design

2025, VOL. 01, NO. 1, 1–10

<http://dx.doi.org/xx.xxxxx/jedsd/XXXXXX>

Paper Title: Digital System Design: Journal of Embedded & Digital System Design

**Author Name 1**1, **Author Name 2**2, and **Author Name 3**1

1Department Name, Organization, City, Country

2Department Name, Organization, City, Country

# Abstract

Finite Impulse Response (FIR) filters are very crucial blocks in signal processing applications. Compared to Infinite Impulse Response (IIR) filters, FIR filters are always stable and provide linear phase response. Numerous structures have been reported in the liter- ature for implementing FIR filters efficiently. Field Programmable Gate Array (FPGA) devices are pop- ular platforms for rapid prototyping of these filters. This work presents a low-pass FIR filter designed us- ing various parallel FIR filter structures, and the per- formances of these structures are compared using Root Mean Squared Error (RMSE).

**Keywords**: Field Programmable Gate Array (FPGA), Finite Impulse Response (FIR), Direct Form, Linear Phase, Cascaded structure, Polyphase struc- ture.

# Introduction

This template provides the necessary formatting for submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1]. This template provides the necessary formatting for submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1]. This template provides the necessary formatting for

This template provides the necessary formatting for submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1].

# Sample Graph Plot

Below is a sample graph Figure 1 plot created using ‘pgfplots‘.

Sample Sine Wave Plot

1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

0

Amplitude

*−*1

0 2 4 6 8 10

Time

Figure 1: Sample graph of a sine wave.

# Sample Figure

Below is an example of a figure, commonly included in journal articles.

*x*

*c*0

*Z−*1

*y*

submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig-

*c*12

*c*11

*Z−*1

*c*10

*Z−*1

ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1].

Figure 2: Sample figure caption illustrating a basic im- age.

Manuscript received XX February XXXX; accepted XX March XXXX. Date of publication XX March XXXX; date of current version XX May XXXX. (Corresponding author: Author Name.)

Email ID: (e-mail: [author1@email.com;](mailto:author1@email.com) [author2@email.com;](mailto:author2@email.com) [author3@email.com).](mailto:author3@email.com)

# Sample Table

Tables are commonly used to present data in a struc- tured format.

|  |  |  |
| --- | --- | --- |
| Parameter | Value 1 | Value 2 |
| Example 1 | 50 | 30 |
| Example 2 | 60 | 35 |

Table 1: Sample table presenting example values.

# Sample Algorithm

Algorithms are often presented in pseudocode format. Here’s an example (see Algorithm 1).

**Algorithm 1** Sample Algorithm for FIR Filter Design

1: Initialize filter parameters

2: **for** each filter coefficient **do** 3: Calculate coefficient value 4: **end for**

5: Return the filter coefficients

# Sample Equation

Equations are usually displayed using the equation (1) environment.

# Design of FIR Filters

The section discusses the FIR filter design techniques. Various design methods are presented, including win- dow methods, frequency sampling techniques, and optimization-based approaches.

# Design of FIR Filters

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

# Performance Evaluation

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

# Conclusion

This study highlights the advantages of parallel struc- tures for FIR filter implementation. Future work in- cludes exploring advanced techniques for further opti-

1

*H*(*z*) = 1 *−* 0*.*5*z−*1

# Design of FIR Filters

(1)

mization.

# Introduction

This template provides the necessary formatting for

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.
    2. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

# Design of FIR Filters

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.
    2. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1].

# Design of FIR Filters

The section discusses the FIR filter design techniques. Various design methods are presented, including win- dow methods, frequency sampling techniques, and optimization-based approaches.

# Design of FIR Filters

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

# Performance Evaluation

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

# Conclusion

This study highlights the advantages of parallel struc- tures for FIR filter implementation. Future work in- cludes exploring advanced techniques for further opti- mization.

# Introduction

This template provides the necessary formatting for submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1].

# Design of FIR Filters

The section discusses the FIR filter design techniques. Various design methods are presented, including win- dow methods, frequency sampling techniques, and optimization-based approaches.

# Design of FIR Filters

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

# Performance Evaluation

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

# Conclusion

This study highlights the advantages of parallel struc- tures for FIR filter implementation. Future work in- cludes exploring advanced techniques for further opti- mization.

# Introduction

This template provides the necessary formatting for submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1].

# Design of FIR Filters

The section discusses the FIR filter design techniques. Various design methods are presented, including win- dow methods, frequency sampling techniques, and optimization-based approaches.

# Design of FIR Filters

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

# Performance Evaluation

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

# Conclusion

This study highlights the advantages of parallel struc- tures for FIR filter implementation. Future work in- cludes exploring advanced techniques for further opti- mization.

# Introduction

This template provides the necessary formatting for submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1].

# Design of FIR Filters

The section discusses the FIR filter design techniques. Various design methods are presented, including win- dow methods, frequency sampling techniques, and optimization-based approaches.

# Design of FIR Filters

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

# Performance Evaluation

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

# Conclusion

This study highlights the advantages of parallel struc- tures for FIR filter implementation. Future work in- cludes exploring advanced techniques for further opti- mization.

# Introduction

This template provides the necessary formatting for submitting articles, surveys, or tutorials to the ”Jour- nal of Embedded & Digital System Design.” The hi- erarchy of sections includes Sections, Subsections, and Subsubsections, with no further divisions allowed. Fig- ures must be referred to as Figure 1, and tables as Ta- ble 1. Captions for tables and figures should follow the style illustrated in this template. References must conform to the IEEE citation style as shown below [1].

# Design of FIR Filters

The section discusses the FIR filter design techniques. Various design methods are presented, including win- dow methods, frequency sampling techniques, and optimization-based approaches.[2].

# Design of FIR Filters

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

* + 1. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.
    2. *Design of FIR Filters* The performance of the designed FIR filters is evaluated using RMSE. Ex- perimental results show that the proposed structures achieve high performance compared to conventional methods.

# Performance Evaluation

The performance of the designed FIR filters is eval- uated using RMSE. Experimental results show that the proposed structures achieve high performance com- pared to conventional methods.

# Conclusion

This study highlights the advantages of parallel struc- tures for FIR filter implementation. Future work in- cludes exploring advanced techniques for further opti- mization.

# References

1. P. R. Babu, *Digital Signa Processing*. SCITECH, 2009.
2. XILINX, “7 series dsp48e1 slice,” vol. UG479 (v1.10), march 2018. [Online]. Available: h[ttps://www.xilinx.com/support/documentation/](http://www.xilinx.com/support/documentation/) user guides/ug479 7Series DSP48E1.pdf