FIR digital filters

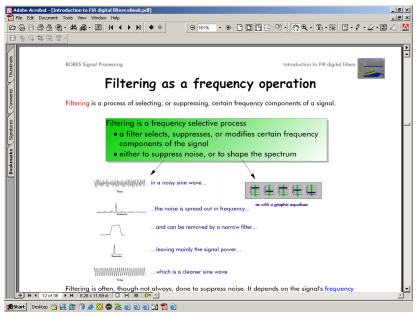
DSP eBook series

Benefits

FIR filters are one of the most common applications of DSP. Through this friendly and concise eBook you will learn to:

- understand what a digital filter does
- use FIR window functions
- design FIR filters by the Window method
- understand equiripple FIR filter design
- write efficient FIR program s for DSPs

The eBook format lets you learn in your own time, at your own pace.



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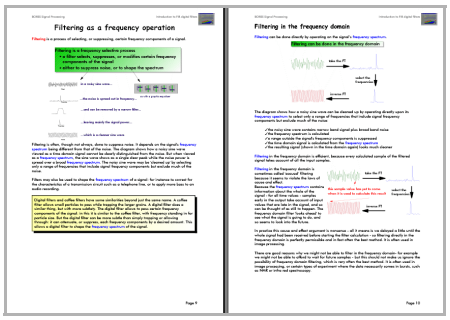

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What is an eBook?

This eBook is an electronic book in Adobe Acrobat™ file format. Clear explanations supported by color diagrams make it easy and helpful to read. You can view it on-screen or print sections to read away from the computer.

Contents

This DSP eBook covers the essentials of FIR filter design including efficient methods for programming general purpose DSP chips. We emphasise practical considerations, making this particularly useful for engineers who have to work with DSP rather than study it as an academic specialisation. Our graphical approach helps to develop intuitive understanding without getting bogged down in unnecessary math proofs.

Digital filters

We introduce the concepts behind digital filtering and explain clearly what we mean by a 'filter'; consider the impulse response, why it is Finite in a Finite Impulse Response filter, and what this means in practice; and explain convolution and how it relates to filtering.

- Linear digital filters
- the FIR simplification
- filter impulse response
- Convolution
- Convolution as a smoothing operation

Frequency analysis

What we mean by 'frequency' and why it is helpful. What the Fourier Transform does, how it works, and how convolution can be done in the frequency domain.

- The Fourier Transform
- Fast convolution

Filtering as a frequency operation

We explain what filtering really means, why filters are defined by their frequency behaviour, and how digital filters are specified.

- Filtering in the frequency domain
- Frequency response
- Digital filter specifications

FIR filters

We consider FIR filters and their design including the problems of having to use a limited number of coefficients in a realistic application where computing power is limited.

- effect of limited coefficients
- Frequency resolution
- compromised performance

Windowing

The method of windowing seeks to solve some practical problems. We consider what windows do, how they work, and how their choice determines the filter design.

- What windowing does
- The Windows method of FIR filter design
- Some window functions

Equiripple filters

We look into methods of filter design by mathematical optimization, using the Parks-McClellan 'equiripple' as a case.

- Parks-McClellan designs

DSP requirements

Filters are no use until they are implemented. We relate filtering to the requirements for a DSP, and show how factors such as interfacing to real signals crucially affect design choices.

- Interfacing to the real world

An example of programming

We develop an FIR program and show how it must be adapted to run optimally on a typical DSP processor.

- A typical DSP core
- Data move instructions
- Address calculation and modes
- Using free address updates
- Programming with pointers
- Using multiple memories
- Using parallel multiply/accumulate (MAC)
- An optimal DSP FIR program

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