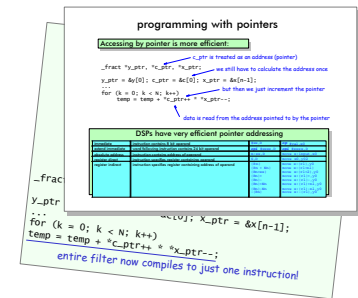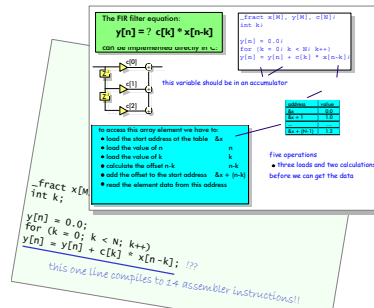# FIR digital filters

DSP foundation series

Benefits

Understand how and why to use FIR digital filters, and how to program them on DSP hardware efficiently, through the clear and practical insights offered by this seminar.

FIR digital filters are often misunderstood and even more often inefficiently implemented. In this very practical seminar we show you how FIR filters are designed and used, and how to program them efficiently in C and in typical DSP assembly language.

From poor design...

...to good design

Contents

This seminar describes and explains how FIR digital filters are used, and also gives very clear and practical guidance on how to implement them efficiently on DSP hardware. We take the view that the aim is an efficient implementation, and show how this aim affects design choices throughout: this focus on implementation is a key feature of our presentation.

FIR filter basics

We review the basics of FIR digital filtering, especially with regard to practical effects.

- Linear FIR Filters
- Finite Impulse Response (FIR) filter
- Filtering to smooth a signal

Analysis of FIR filters

We explain how the FIR filter operation can be analyzed, and show how the impulse and frequency responses are calculated.

- Fourier transforms
- Spectral analysis
- Fourier analysis of FIR filtering
- Filtering in frequency
- FIR frequency response

FIR filter design

The problem of FIR filter design is an inverse one - to design the coefficients, given a desired end result (the filter response). We show how a very simple procedure can be used to design FIR filters.

- Naive FIR filter design

Practical limitations

Analysis of the imitations and compromises faced in practical design situations.

- Effect of limited filter length
- Frequency resolution
- Broadening of frequency shape
- Fourier analysis of limited length effects
- Frequency response leakage

Windowing

Windowing is an important design method for FIR filters. We explain how and why it works, and indicate when it has advantages over other methods.

- What windowing does
- Filter sharpening by windowing
- The Window method of FIR design
- How windows shape the filter
- Problems of window designs
- Typical window design functions

FIR design by optimization

We introduce the idea of mathematical optimization methods of filter design, taking the Parks-McLellan design as an example.

- Window design as a non-optimal method
- Iterative FIR design by optimization
- The Parks-McLellan equiripple design

DSP processors

We explain how DSP processors are designed as filter engines, and consider how best to use their special features.

- DSP processor operations
- A typical DSP core
- Multiply accumulate
- Data move instructions

Filter programming

A step-by-step development of an FIR filter program, from naive and inefficient C to an optimal implementation in typical DSP assembly language.

- Naive FIR filter in C
- Efficiency gain of using pointers
- Using multiple memories
- Placing data in assembler
- Efficient C filter example
- Assembler multiply/accumulate
- Programming parallel operations
- Optimal DSP filter program

Time and arrangements

The 'DSP foundation' 3-day seminar series gives a thorough grounding in DSP including fundamentals, FIR filters and IIR filters. It is presented 'on-site' by arrangement - the material can be adapted if you have specific needs (at extra cost). We recommend it be followed as a series, but individual 1-day seminars can be taken by arrangement if desired.

- on-site by arrangement
- contact: Chris Bore
- email: chris@bores.com

FIR digital filters seminar

- 1-day seminar presentation
- £330 (€550, $660) per person
- arrangements as above

DSP 'foundation' series

- 3-day seminar series
- £ 990 (€1,650 : $ 1,980) per person
- arrangements as above

To book or find out more

Call us by 'phone or send email to book or to ask questions.

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- mobile: +44 (0)7793 732293
- email: chris@bores.com

DSP foundation seminars

The 'DSP foundation' is a 3-day series of seminars designed to give a thorough understanding of DSP including FIR and IIR filtering. The series can be followed as a 3-day session or as separate 1-day sessions, by arrangement.

- Introduction to DSP
- FIR digital filters
- IIR digital filters