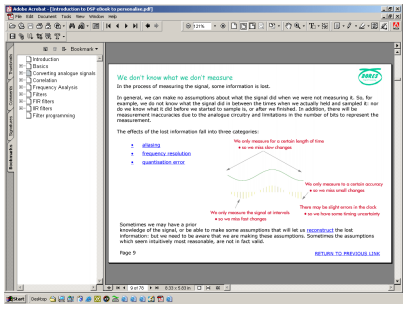
Introduction to DSP

DSP eBook series

Benefits

People are often confused by over-reliance on math proof and derivations in DSP. This eBook explains in a practical, graphical way. You will understand:

- sampled data systems
- antialiasing and signal reconstruction
- convolution and correlation
- spectral analysis and Fourier Transforms
- Purpose and use of Window Functions
- Digital filtering



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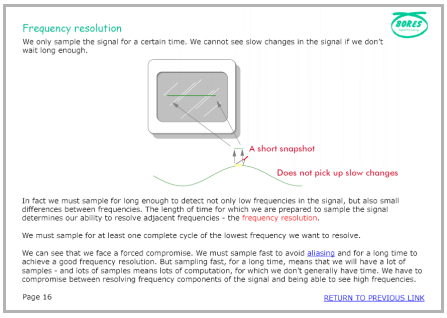

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What is an eBook?

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 eBook covers the essentials of Digital Signal Processing, including filters and frequency analysis using the Fourier Transform. We emphasise practical considerations, making this particularly useful for engineers who have to work with DSP rather than study it as an academic specialisation. A graphical approach to explanation helps to develop intuitive understanding of the operations involved and their effects; and helps in getting a feel for what is reasonable. Some mathematical equations are presented, but there is no derivation or proof and advanced maths is not required to follow and understand the text. The notes are intended for engineers wishing for an introduction to, or refresher course in, the principles of DSP and the practical ways it can be used, including its limitations.

Basics of DSP

- Definition and advantages of DSP
- DSP markets

Converting analog signals

We discuss the important practical considerations of what information is lost during measurement of a signal, and the effects of this in terms of aliasing and frequency resolution together with ways to limit these problematic effects.

- Loss of information due to measurement
- Aliasing
- Nyquist's sampling theorem
- Anti-aliasing
- Signal reconstruction
- Frequency resolution
- Quantization

Correlation and convolution

We explain the two most important time-domain processes and discuss their practical applications.

- Correlation
- Correlation as a measure of similarity
- Auto-correlation to distinguish signals
- Auto-correlation to extract a signal
- Cross correlation to detect a known signal
- Cross-correlation to identify a signal
- Convolution
- Convolution to smooth a signal
- Similarity of correlation and convolution

Frequency analysis

We explain how frequency analysis works and consider the effect of limited signal length as well as ways to work around this.

- The Fourier Transform
- Fast convolution
- Short Time Fourier Transforms
- The effect of short or truncated signals
- Artefacts due to truncation of signals
- Windowing to limit effects of truncation
- Wavelet and other transforms

Digital filters

We introduce digital filters and outline the main design methods and practical limitations.

- What digital filters really do
- Digital filter specifications
- Filtering as a frequency operation
- Impulse and frequency response
- The inverse problem of filter design
- FIR filters
- Simple FIR design methods
- The Window method of FIR design
- Equiripple (Parks-McLellan) FIR design
- IIR filters
- IIR filter design methods
- Filter programming

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