Fourier and Wavelet Transformations

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Lecture Outline

- Signals
- Properties of waves
- Fourier transformations
- Discrete and Fast Fourier Transformations
- Wavelet transformations

Signals

- What is a signal?
- Change in a variable over time
- Many things can be treated as signals
  - Sound
  - Light
  - Images
  - DNA
- Signal processing is an important field in computing

Properties of Waves

- Displacement in a medium
- Waves are signals
- Waves can interfere with one another
  - Constructive
  - Destructive
  - Beats
- Complex waves can be created
  - Use a large (possibly infinite) number of component waves

Properties of Waves

- Visualisation of waves
  - Time domain
  - Frequency domain
- Time domain is traditional
  - Amplitude vs time
- Frequency domain is more useful for analysis

Fourier Transformations

- Convert a signal into the frequency domain
- Separates signal in components
- Useful for many things
  - Analysis of the signal
  - Noise suppression
  - Signal modeling
    - Speech recognition

Fourier Transformations

- Discrete Fourier Transforms
  - DFT
- Used for discretised signals
  - Ergo, digital signals
- Fast Fourier Transforms
  - FFT
- Efficient implementation of the DFT
  - Does the same thing quicker

Wavelet Transformations

- What is a wavelet?
- Two main properties
  - Limited duration
  - Average value of zero
- A wavelet fades in and fades out
- Wavelet analysis breaks a signal into its component wavelets

Wavelet Analysis

- Wavelet coefficients can be recombined to form the original signal
- Wavelets have many applications
  - Noise filtering
  - Compression
- Wavelets are used when FFT don't work

Summary

- Fourier transforms break signals into component sinusoids
- Used in many signal processing applications
- DFT applied to DSP
  - FFT is an implementation of DFT
- Wavelet transforms break signal into component wavelets
- Used in signal compression among others