Chapter 7: Basics of Fourier Analysis and Filtering
Part 1

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Basics of Filtering in the Frequency Domain

- Most common approach to filtering focuses on suppressing specific frequency bands

- Treats ERPs as if they actually consist of the sum of a set of sine waves → may lead to interpretive errors
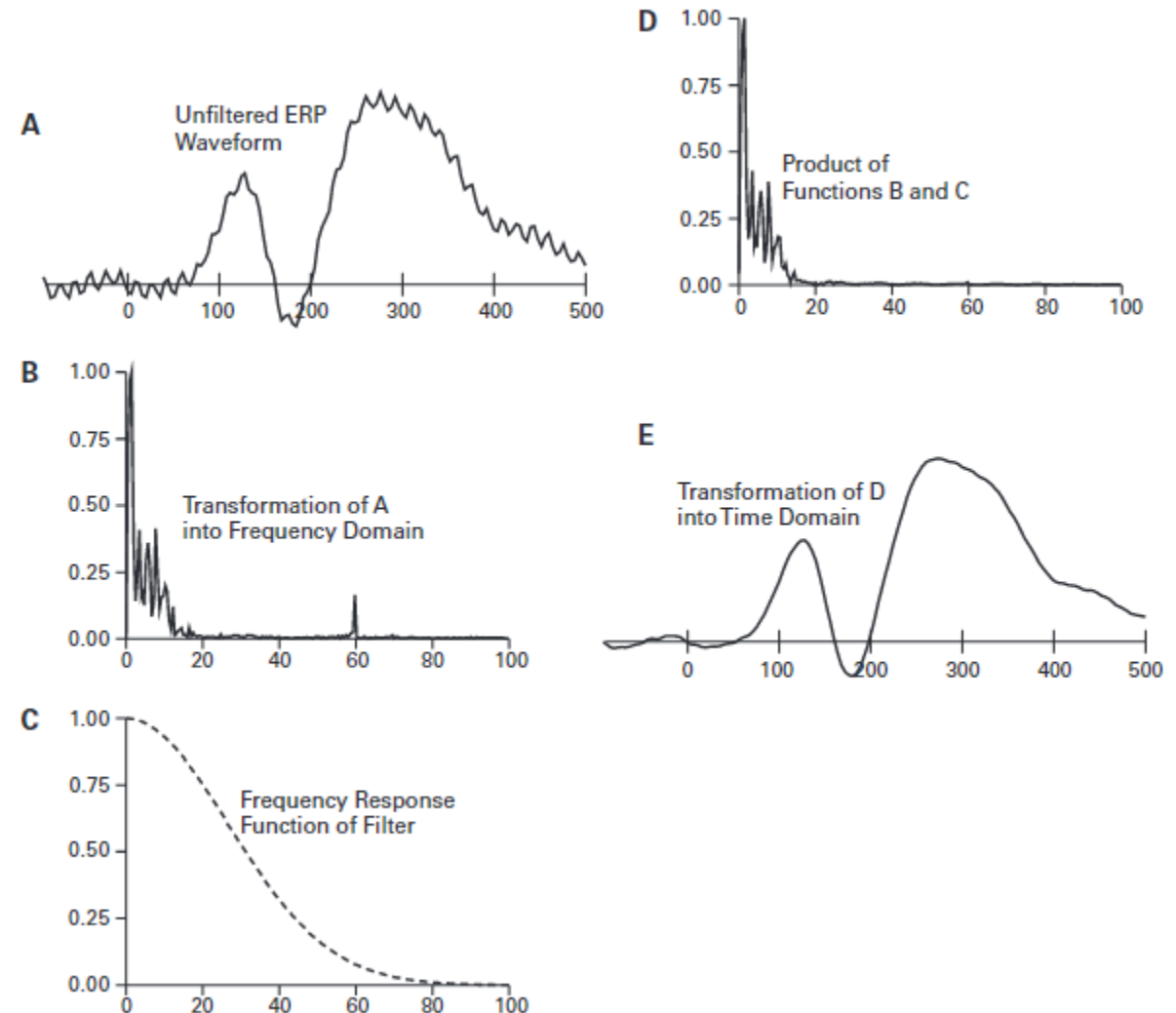
Why Are Filters Necessary?

- Why use filters?
  1) Nyquist theorem
     - Aliasing
     - Anti-aliasing filters
     - Nyquist frequency
  2) Noise reduction
  3) Attenuate very low frequencies
  4) Help you visually inspect your average ERP waveforms

Why Are Filters Necessary?

- Common classes of filters
    1) Low-pass filters
    2) High-pass filters
    3) Band-pass filters
    4) Notch filters

- Frequency response function
  - How each frequency is influenced by the filter
- Gain
  - Multiplication factor
  - In the typical filters, the gain is between 0 and 1 for each frequency

A — Unfiltered ERP Waveform

B — Transformation of A into Frequency Domain

C — Frequency Response Function of Filter

D — Product of Functions B and C

E — Transformation of D into Time Domain

Filtering Twice

- Using hardware low-pass filter during data acquisition to avoid aliasing, then apply a low-pass filter offline in software
- Multiply the frequency response functions of the two filters together
- Filtering a second time with the same filter will change your data