Basic 2-channel EEG Training Protocols

Approaches, Methods, and Functional Block Diagrams

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Rationale for 2-channel training

- Address L & R Brain, A & P Brain, or Whole Brain
- Train 2+ locations at one time
- Increase/reduce intersite coupling
- Increase/reduce intersite communication
- Achieve brain balance
- Achieve brain asymmetry

Approaches

- Single-channel Bipolar Training
- Sum-channel Training
- Separate Protocol Training
- Coherence Training
- Phase Training
- Asymmetry Training

2-channel vs. bipolar training

- Bipolar takes difference between two sites to produce 1 channel of EEG
- E.g. F7 – O1 measures across left hemisphere
- Any difference in EEG produces measurable signal
- Cannot (generally) train direction, only difference

Single-Channel Bipolar Training

- Always training difference in instantaneous signal amplitudes
- When signals are alike, output is low
- When signals are different, output is high
- Downtraining -> signals more similar
- Can encourage synchrony, similarity
  – Typically occipital alpha, O1 vs. O2
- Can also cause both to decrease
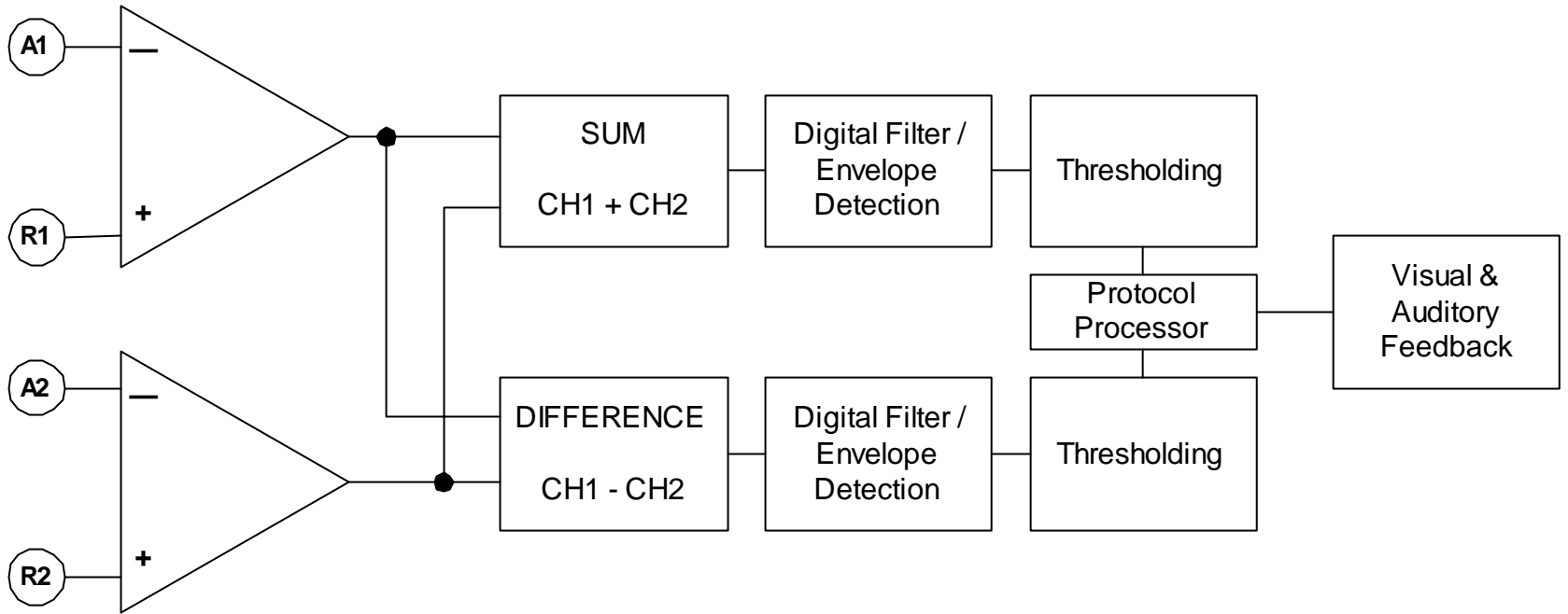
Two-Channel Sum and Difference Training

Sum-Channel Training

- Chan1 = sum, Chan2 = difference
- Can train sum or difference of channels, or both
- Sum trains synchrony, similarity
- Difference looks for differences
- Can uptrain sum, downtrain difference
- Ratio of sum to difference important indicator
- Phase-sensitive, and amplitude sensitive
- All amplitude-based training outputs work, e.g. bargraphs, games, etc.
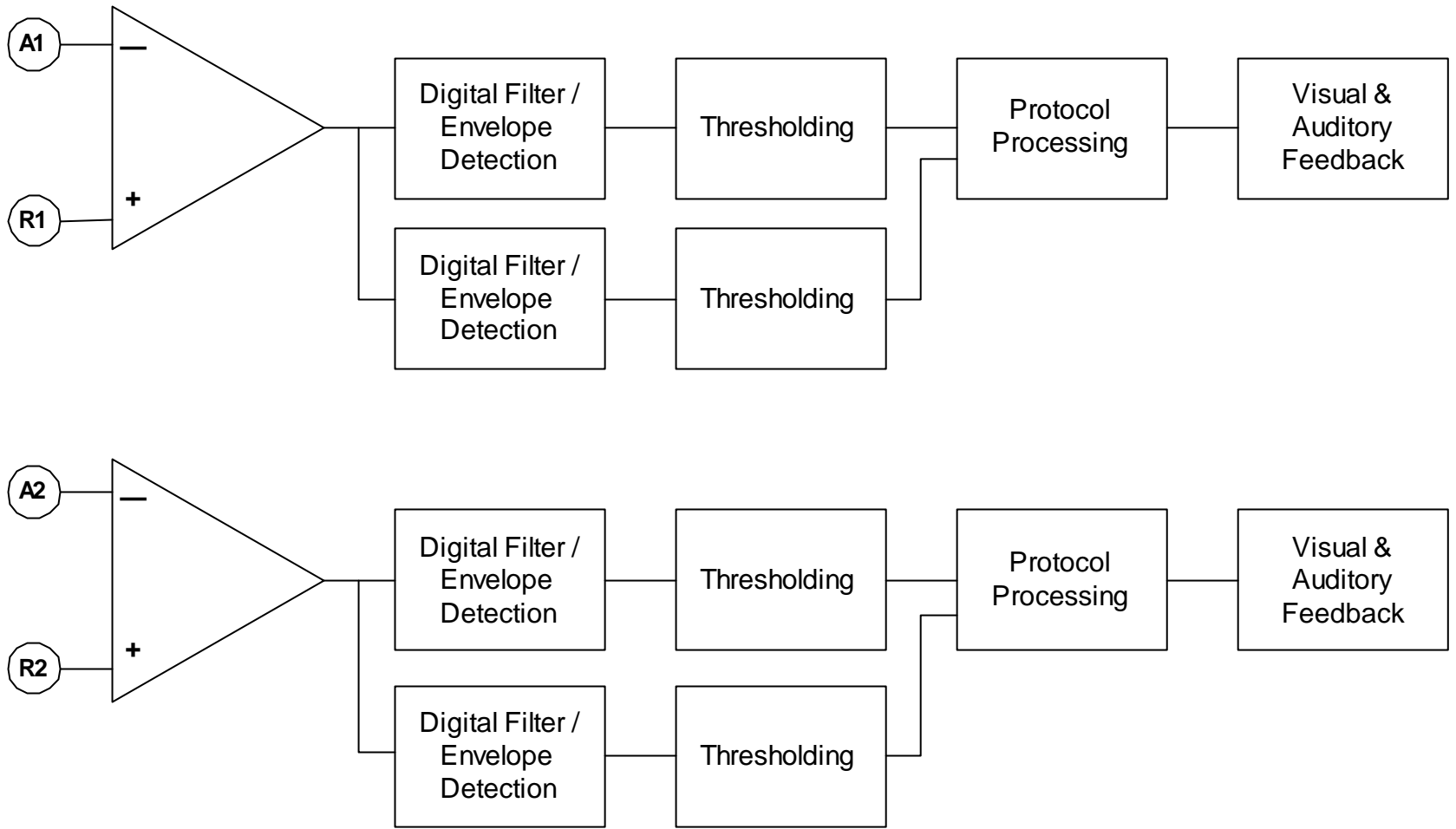
Two-channel Training - Separate Protocol Method

Separate Protocols

- Each channel has own training criteria
- Reward presented when either channel meets criteria – MIDI notes
- OR – Reward presented with both channels meet criteria – Reward Sounds
- Can use complex protocols, up to 16 go's and stops
- Brain "sorts it out"
- All amplitude-based screens, games work

Separate Protocols Example I

- Built-in protocol "peak2"
- C3 / A1 / GND / A2 / C4
- Left: beta up, theta & hibeta down
- Right: SMR up, theta & hibeta down
- Performs "alert" on right, "focus" on left
- Also "slows down right brain"
- General mental fitness, improved affect
- Single reward sound sufficient for feedback

Separate Protocols Example II

- Built-in protocol "deep2"
- Trains up alpha on both left and right
- Trains up theta on both left and right
- Can use stops on delta, hibeta
- Can hear when either channel meets criteria with MIDI sounds – STEREO sound
- Can hear when all criteria met with Reward Sounds – more useful for alpha only
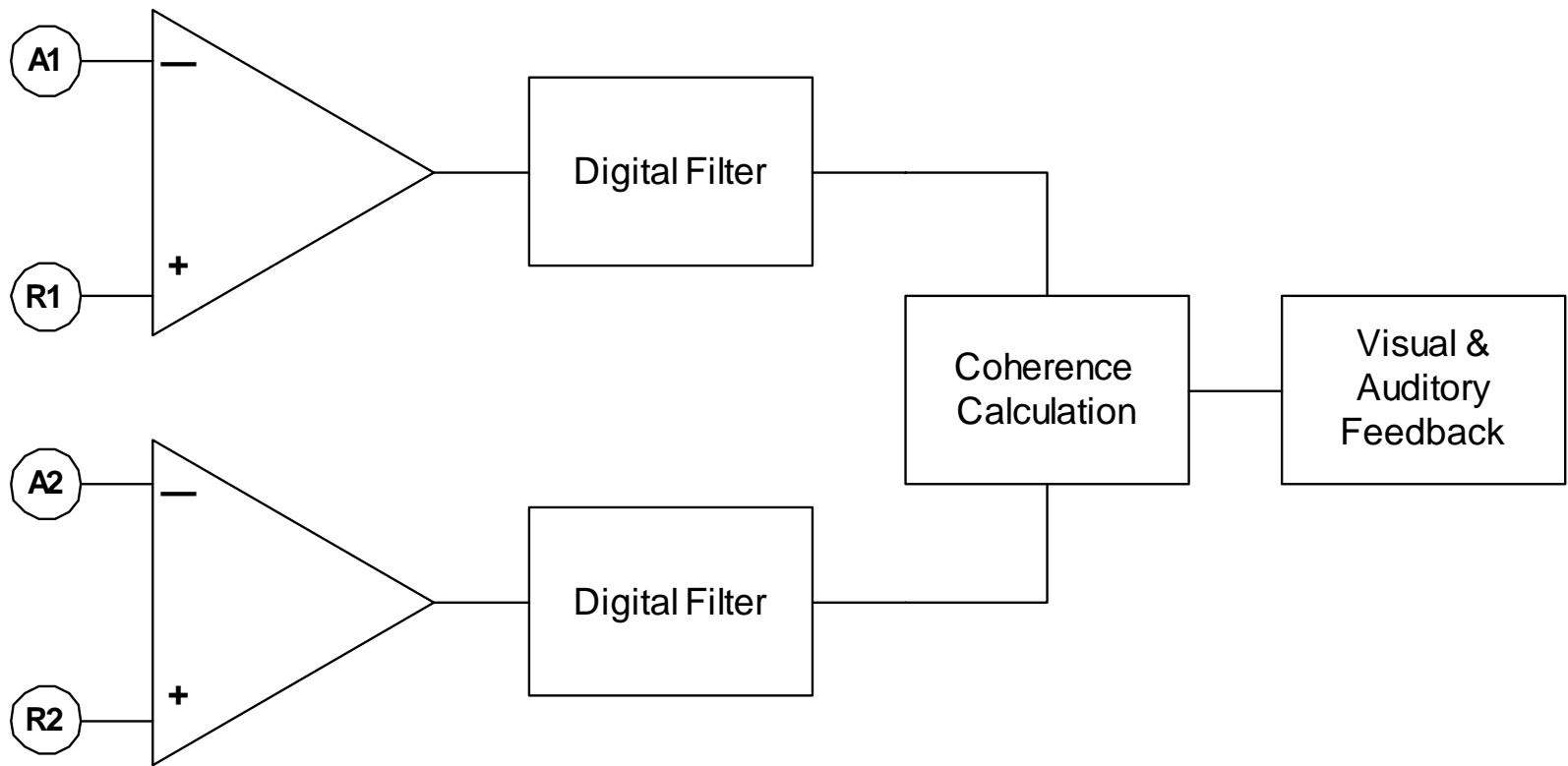
Coherence Training

(one component shown, 8 are possible)

Coherence Training

- Built-in protocol "peak"

- Use computed coherence as training variable

- Trains similarity between sites

- Used to "bind" or "connect" sites

- Increase amount of shared information / communication between sites

- Can also downtrain coherence -> "break up" dependencies between brain locations

Phase Training

- Typically Downtrain Phase
- Reduces delay between sites
- Increased speed of information transfer
- Can also synchronize to a third location, e.g. thalamic pacemaker
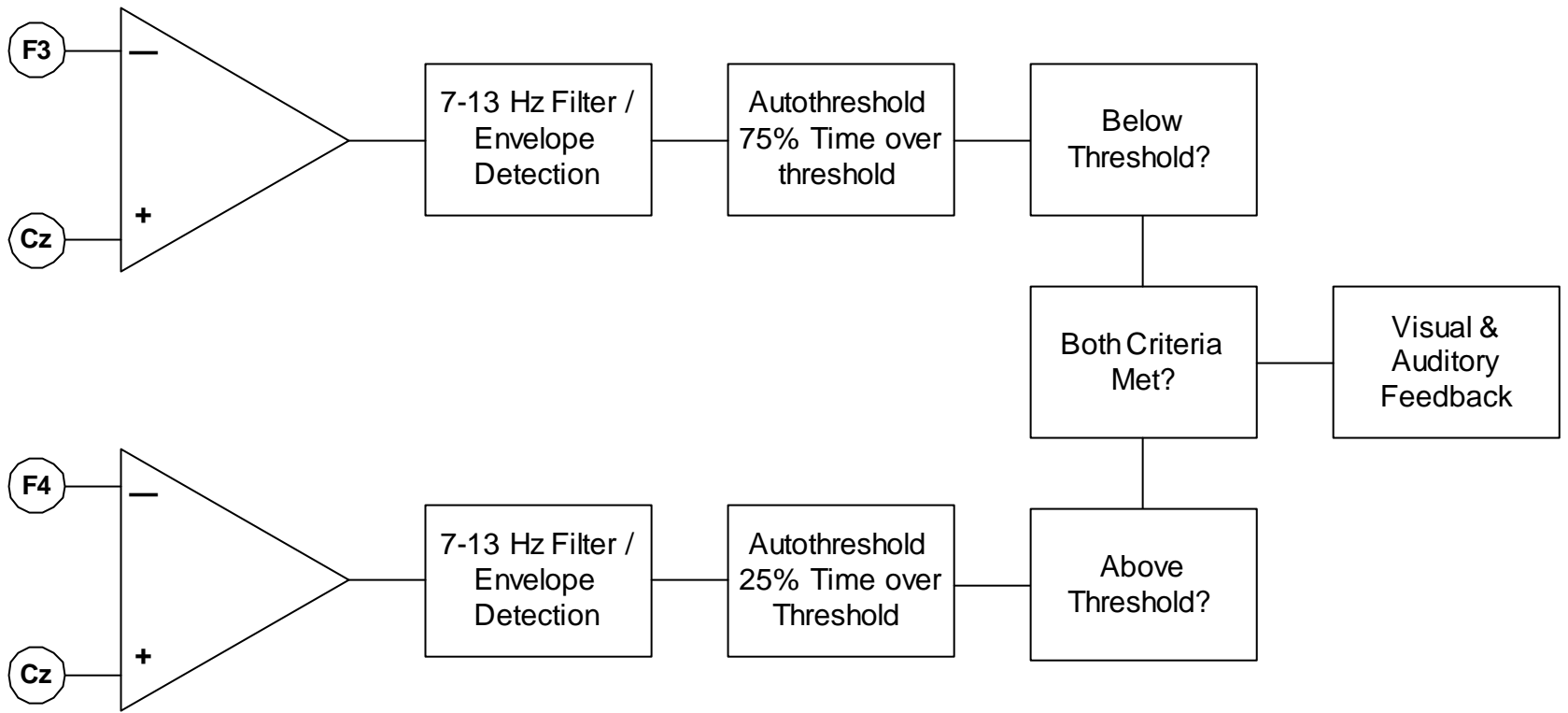
Asymmetry Training - Amplitude Based Method

Asymmetry Training

- Used to train asymmetrically
- Make e.g. right side larger, left side smaller
- Associated with mood, affect
- Typically done frontally, e.g. F3 & F4 with Cz reference
- Cannot be done with 1 channel