Feature extraction

BCI's use electrophysiological signal features to represent brain events. These include rhythms reflecting oscillation in particular neural circuits, potentials evoked from particular brain regions by any stimuli. The special characteristics and capacities of each signal feature will determine the extent and nature of its usefulness.

The goal is to measure the the signal features accurately.

- When the features are mu rhythms (rhythms between 8-12 Hz [beta], from primary sensory cortical areas of awake people, They are associated with those cortical areas most directly connected to the brain's normal motor output channels.) noises includes visual alpha rhythms.
- When feature are firign rates of specific neurons, noise includes activity of other neurons

Feature extraction affects signal-to-noise ratio, some techniques include spatial and temporal filtering.
Spatial filters derive signal features by the combination of data from to or more locations (focus on spatial distribution)
Temporal filters where the signal can be measured by the integrated output of a band-pass filter or by the amplitude in specific spectran bads.

Spectral filtering is used to remove noisesignals, such as slow drifts and line noise
Spatial filteringlinearly combines signals from multiple electrodes to focus onactivity at a particular location in the brain

Signals can also be enhanced by averaging

Anexample of spatial filtering is independent component analysis(ICA) , which identifies statistically independent sourcesof activity. Alternative spatial filtering approaches are channelre-referencing such as the common average reference or theLaplace filter , source imaging methods that make explicituse of a forward model or spatial filters that makeuse of class information, such as the common spatial patternsmethod that is popular in BCI research

References

(Gastaut, 1952; Kozelka and Pedley, 1990; Fisch, 1999)

(McFarland et al., 1997b)