Cross Frequency Coupling (CFC) during Sleep in Patients with Focal Epilepsy
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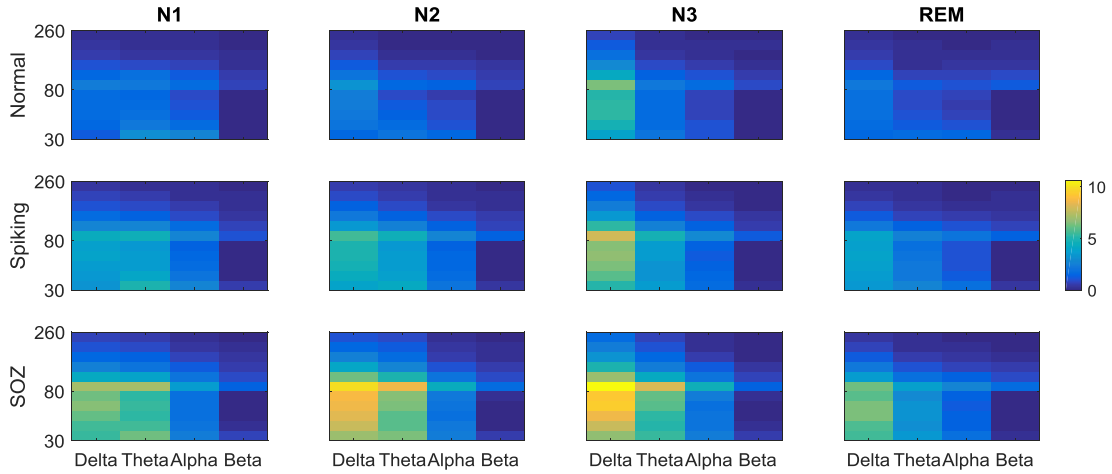
Rationale: It has been shown that the amplitude of EEG higher frequency oscillations is often modulated by the phase of lower frequency activities. During sleep, this modulation facilitates the communication among specific brain regions. In this study we investigate the variation of CFC during different sleep stages, and also in epileptic, and normal regions.
Methods: We studied interictal data of 25 patients with focal epilepsy. During the first sleep cycle, the first 4 minutes of each stage (stage N1, N2, N3 and REM) was selected. The signal was band-pass filtered into low (delta, theta, alpha, and beta) and high (gamma and ripple) frequency bands. The Modulation Index was calculated for each epoch, and each pair of low and high frequencies. Higher values of this index represent stronger coupling between two frequency bands. Sharp transients were discarded allowing the comparison of sections free of epileptic discharges.
Results: The average modulation index in all bands except beta was higher in N3 and N2 compared to REM ($p<0.05$). The average coupling in delta, theta and alpha band in all stages was significantly higher in the seizure onset zone (SOZ) compared to normal channels ($p<0.05$). The coupling of delta and theta in all stages was higher in SOZ compared to spiking channels outside SOZ.
Discussion: Considerable differences were seen between the SOZ and normal channels. Stronger coupling in the epileptic regions, and during deep sleep may be explained by increased neuronal synchrony. CFC may lead to an index for localizing epileptic brain regions.



The average of modulation index for all channels in different sleep stages, and in different regions