Appendix

Calculating the Bicoherence

To find the bicoherence, first the bispectrum must be found. The bispectrum ($B$) depends on both the phase and amplitude relationships between two primary frequencies ($f_1$ & $f_2$) and their modulation component frequency ($f_1 + f_2$), as described in equation (1), where $X(f)$ is the Fourier transform of the spontaneous EEG ($x$) and $X^*$ is the complex conjugate of the Fourier transform. This group of frequencies is known as a triplet.

$$B(f_1, f_2) = X(f_1)X(f_2)X^*(f_1 + f_2)$$  \hspace{1cm} (1)

The amplitude relationships are expressed in the real triple product ($RTP$) as described in equation (2), where $P$ is the power of $f$ ($|X(f)|^2$).

$$RTP(f_1, f_2) = P(f_1)P(f_2)P(f_1 + f_2)$$  \hspace{1cm} (2)

The amplitude independent bicoherence ($BIC$) is calculated as the bispectrum normalized with respect to the $RTP$ as described in equation (3). This results in a value between 0 and 100, indicating the percentage of phase correlation between the two frequencies, $f_1$ and $f_2$.

$$BIC(f_1, f_2) = 100 \frac{B(f_1, f_2)}{\sqrt{RTP(f_1, f_2)}}$$  \hspace{1cm} (3)

Due to the stochastic nature of the EEG, when calculating the bicoherence of a segment of EEG, it is important to average successive smaller epochs across that segment. As such, to calculate the bicoherence of a segment of EEG, the EEG needs
to be split into small epochs, which may be overlapped to increase the number of epochs available in a segment. The bicoherence is calculated for all epochs and then averaged, providing the average bicoherence for the original segment of EEG.

For further information regarding calculating bicoherence for depth of anaesthesia monitoring, please refer to either Rampil [1], or Sigl and Chamoun [2].

References:
