

Cross correlation

It is the integral of one two time series functions which are offset by some time delay τ

$$R(\tau) = \int_{-\infty}^{+\infty} x(t)y(t + \tau)\delta t$$

If you normalize $R(\tau)$ by the 'energy in the functions' then the maximum value is always 1 (i.e. divide by max value)

If the two functions $x()$ and $y()$ are identical then it becomes an autocorrelation. Some basic characteristics of autocorrelation include

- white noise only correlates at delay = 0 (no correlation at other lags)
- periodic signals taper up to (and away from) a maximum at delay = 0, i.e. as more (and then less) of the signal progressively overlaps with itself.

Now, if in the case of cross-correlation (i.e. non-identical functions) then

- white noise shows zero correlation at all delays
- periodic signals show the same behaviour (but you also get the offset)

In real life there will be noise in the data set, which you might want to smooth out (e.g. boxcar average) after applying the cross correlation