# Initialization:

The probability series of the reference is used as input to the Fourier transform (FT). This ensures the conservation of the spearman correlation at all lags. There are options to use the FT of the reference series, FT of the standard normals of the reference a series and FT of the log series of the reference. So far the probability series gave better results than the other transforms and that is what is used. The number of steps in the given series are always even. In case the steps are odd, the last one is dropped.

# Phases to Randomize:

The number of phases to randomize is always (N/2 - 1), where N is the number of time steps. Total number of phases are N/2 + 1.

# Initial temperature:

Initial temperature is given. With 60 to 70% acceptance rate. Computed using an initial temperature computation scheme that finds the optimum initial temperature by ramping up from a very small temperature till it finds one that has an acceptance rate higher than required. The temperature most close to the mean acceptance rate, i.e. 65%, is chosen as the initial temperature.

# Simulation initialization:

For simulation, all phases except for the first and last, are randomized. Randomization takes place by adding random phases to the original phase spectra. Same phases are added to all the phase spectra in case the simulation is multi-site. The random phases, are in the range –pi to +pi. The Fourier spectrum (FS) is updated by assigning the product of the cosine of the random phases and the reference magnitude spectra to the real part of the Fourier coefficients while the product of the sine and reference magnitude spectra are assigned to the imaginary part. First and last coefficients of the phase randomized series are taken directly from the reference FS i.e. they stay unrandomized.

Each time a phase is updated, the counter (that counts the number of times a given phase is updated) is incremented by one.

The Phase randomized series (PR) is given to the inverse Fourier transform (iFT), that produces a new data series at each site. These data have a different distribution than the reference series, so they are further converted to the probability series by dividing the ranks of PR series by N + 1. The probability series are further transformed to look like reference series by reshuffling the reference probability series. This is done to control for the fact that the reference might have repeating ranks while the simulated does not.

# Simulated Annealing:

Initially, random indices for the phase spectra are selected. These serve as the old iteration till a new one is accepted.

All the objective functions (spearman and pearson correlation, copula asymmetries, entropies) at various lags and nth orders are updated.

A snapshot of current variables is saved, this is used later in case a phase change is rejected so as not to recompute everything (same as NiedSim and CP selection algorithms).

A new index in the phase spectrum is randomly selected, randomized, and the objective function is computed again for the new series. All this is same as the initial description of the phase randomization except that only one (in some cases multiple) phases are randomized. The randomization takes place by adding the same phase change to all spectra at that given index.

If the new objective function value is smaller than the previous, it is accepted immediately other wise, a random number (Pr) between 0 and 1 is drawn, Boltzmann probability (Pb) = exp((old\_obj – new\_obj) / current temp) is computed. If the (Pr) is less than Pb, the change is still accepted other wise rejected.

In case of acceptation, the snapshot is updated other wise, it is loaded.

And the next iteration begins.

# Stopping criteria:

There are six stopping criteria. At least one of them should be valid for the simulation to terminate. These are: absolute maximum iterations, maximum iterations without updating the snapshot, running objective function tolerance, temperature almost zero, and acceptance rate dropping to zero. There is one more that is some what tied to the acceptance rate i.e. the factor by which to reduce the newly generated phase. This factor is 1 in the beginning and slowly tapers off to zero as the acceptance rate drops. It can also depend on other factors.