The update function for the neurons is defined as:

|  |  |
| --- | --- |
|  | (1) |

where is the matrix of neuron with index at time , with being the current iteration, is the matrix of the input sample, is the BMU, and is the learning rate, which follows an exponential reduction:

|  |  |
| --- | --- |
|  | (2) |

where is the initial learning rate, is a user defined constant which controls the exponential decrease of the learning rate, and isthe neighborhood function, which dictates the cooperation between neurons. It decreases exponentially and includes a reducing Gaussian distance function:

|  |  |
| --- | --- |
| , | (3) |

where is the standard deviation of the initial Euclidean distances of the randomly initiated neurons, is a user defined constant which controls the exponential decrease of the neighborhood function and lastly, isthe Euclidean distance between a neighbor neuron and the BMU, which is calculated using the Frobenius norm of the neuron matrices difference:

|  |  |
| --- | --- |
|  | (4) |