International Journal of Engineering & Technology, 7 (3.5) (2018) 105-108

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paperr

Analysis of Combination of Kohonen Algorithm and Resilient Backpropagation in Weighting Process

Medina Roselia Lasmauli Tambunan[1], Poltak Sihombing[1], Pahala Sirait[2]

[1]*Universitas Sumatera Utara, Medan, Indonesia*
[2]*Sekolah Tinggi Manajemen Informatika dan Komputer Mikroskil, Medan, Indonesia*
**Corresponding author E-mail: meditambunan82@gmail.com*

Abstract

The Kohonen algorithm is the most superior clustering algorithm in artificial neural networks compared to other clustering algorithms, and the Resilient Backpropagation (RProp) algorithm is the best algorithm in the supervised algorithm. From the results of this study, the author tries to do a research combining kohonen algorithm with RProp algorithm, where the clustering results in the kohonen algorithm will be used as the initial input process in RProp algorithm which can speed up the data processing in RProp. In this study a combination of kohonen algorithm and Resilient Backpropagation algorithm is produced, which is abbreviated as Kohorprop (Kohonen Risilient Backpropagation). From the test results, the percentage of the Kohorpor versus RProp algorithm speed with testing for 100, 500, 1,000, 5,000, 10,000 data in 10 attempts, respectively: 54.70%, 52.92%, 50.40%, 68.52%, and 78.70%. So that shows that the Kohorprop algorithm is faster than the RProp algorithm

Keywords: *Kohonen, Risilent Backpropagation, Kohorprop*

1. Introduction

Artificial neural networks are computational systems whose architecture and operations are inspired by the knowledge of biological nerve cells in the brain which can be described as mathematical and computational models for non-linear approximation functions, cluster data classifications and non-parametric regression or a simulation of a collection of network models biological nerve[1], [2]. This system will carry out derivative learning to achieve a convergence. Artificial neural system is a tool that is used in general and applied to predict, classify and cluster[3], [4].

Self-Organizing Maps (SOM) artificial neural network or also called the Kohonen network[5]–[7] has been widely used for pattern recognition in the form of disease patterns, images, sounds, and others. SOM networks are often used for feature extraction in the initial process of pattern recognition. It is able to reduce the dimensions of the input pattern to a smaller amount so that computer processing becomes more efficient. In other words, the kohonen algorithm is better than the backpropagation method[7]–[9].

Multilayer Neural networks[10] usually apply the sigmoid function as a transfer function in hidden layers[11]. Using these functions in addition to using a gradient can cause problems of small weight and can change even though it is very far from the optimal value. The BP training algorithm and resiliency propagation are very similar except in heavy weighting routines. The goal of Rprop, introduced by Riedmiller and Braum, is to reduce these side effects by determining the direction of heavy renewal using a partial derivative sign. If the performance function derivative has the same sign as the last two sequential iterations, the update value will be increased and vice versa[12], [13]. If the derivation is zero, the update value will remain constant. In another experiment about estimates of tourist demand implementing tough propagation shows acceptable results that illustrate the performance of this method in estimating and estimating. An accurate weight reading method from the Rprop method turns it into a fast convergent training method than other conventional BP methods, more than that this method is less sensitive to parameter settings[14], [15].

2. Methodology

The neural network is one of the artificial representations of the human brain that always tries to simulate the learning process in the brain of that human. The term artificial here is used because this neural network is implemented using a computer program that is able to complete using a computer program that can complete the calculation process during the learning process. The human brain contains millions of nerve cells that work to process information. Each cell works like a simple processor[16].

There are several types of neural networks, however, almost all have the same components[17]–[21]. Like the human brain, neural networks also consist of several neurons, and there are connections between these neurons. These neurons will transform information that is shouted through its outgoing connections to other neurons. In neural networks, this relationship is known as weight. This information is stored at a certain value in that weight.

In the Artificial Neural Network (ANN) architecture[17], [22], a neuron will be collected in layers or commonly called layers. In the ANN layer from the input layer until the output will go through a hidden layer which is usually called a hidden layer.

The most important factor in determining the behavior of a neuron is the activation function and its weight pattern. Generally, the neurons that are located in the same layer will have the same state so that on each layer the same neurons have the same activation function[23], [24].

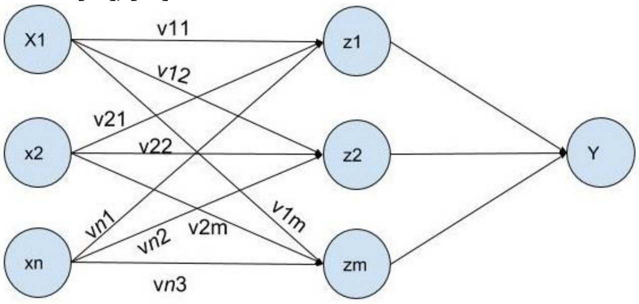

Figure 1. Multilayer Network

Backpropagation artificial neural network was first introduced by Rumelhart, Hinton and William in 1986. Then Rumelhart and Mc Clelland developed it in 1988. Backpropagation algorithms for neural networks are generally applied to multilayer perceptrons. Perceptron has at least the input part, the output part and several layers that are between the input and output. This layer in the middle, which is also known as hidden layers, can be one, two, three and so on. The last layer output from the output layer is directly used as the output of the neural network. Training in Backpropagation method involves 3 stages, namely feed forward training pattern, error calculation and weight adjustment. After training, the network application only uses the first stage of computing, namely feedfoward for testing. Although the training phase is slow, the network can produce output very quickly. The Backpropagation method has been varied and developed to increase the speed of the training process. Although one network layer is very limited in learning, networks with multiple layers can learn more. More than one hidden layer may be useful for some applications, but one hidden layer is enough.

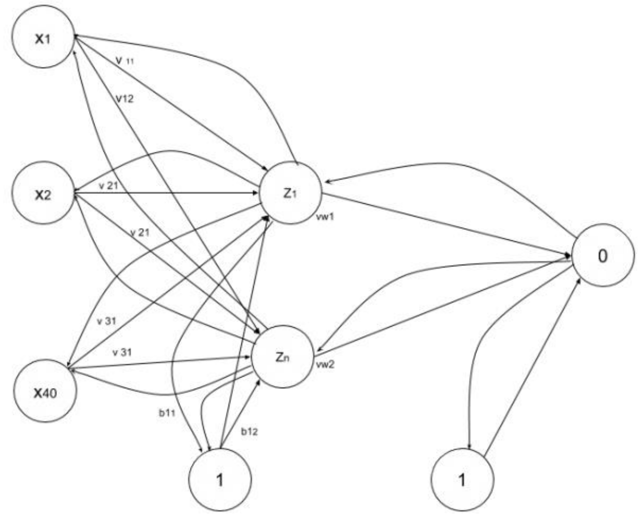

Figure 2. Architecture Neural Network

Kohonen Map or it can be called Self Organizing Map was first introduced by Prof. Teuvo Kohonen from Finland in 1982. Kohonen map is one of the artificial neural network algorithms that is quite unique because it builds a topology preserving map from high-dimensional space into neurons as representations of existing data points.

Kohonen map is one of unsupervised learning neural network methods. This network does not get a target, so the ANN regulates its own interconnection weight. Self-Organizing Learning is learning to classify without being trained. In an unsupervised learning process, ANN will classify examples of available input patterns into different groups. When data is given to the neural network, the data will regulate the structure itself to reflect the given pattern. In most of these models, the limitation refers to the determination of strength between neurons.

In a kohonen network, a layer containing neurons will arrange itself based on the input of certain values in a group known as cluster. During the self-preparation process, clusters that have the best weight vector with the input pattern (having the closest distance) will be selected as the winner. The winning neurons and their neighboring neurons will correct their weights.

The Rprop algorithm is the result of the development of a backpropagation algorithm. The change in weight in backpropagation is affected by the learning rate (learning rate) and depends on the slope of the error curve. The smaller the learning rate (learning rate), the longer the learning process. Whereas the greater the learning rate, the weight value will be far from the minimum weight. To overcome this, a new algorithm called Rprop was developed. This algorithm uses a sign (positive or negative) from the gradient to indicate the direction of weight adjustment. While the size of the weight change is determined by the value of the adjustment.

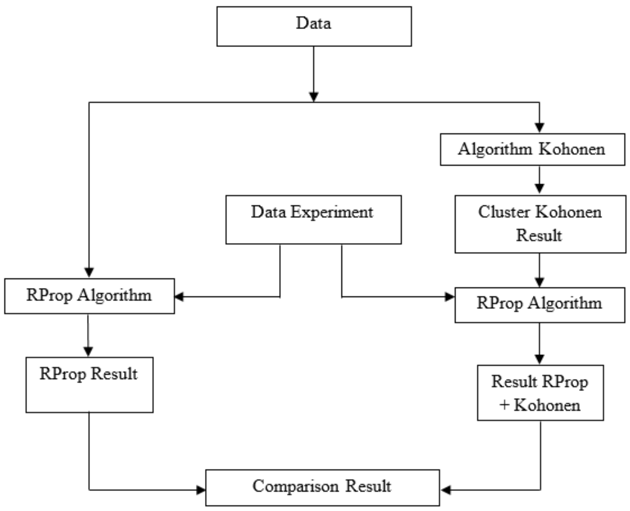

Figure 3. Diagram Process

3. Results and Discussion

Testing is done using the following parameter values:

Table 1. Parameter Value

No	Parameter	Weigth
1	Performance Goals	60%
2	Orientation	10%
3	Integrity	10%
4	Commitment	10%
5	Discipline	5%
6	Teamwork	5%

These parameters are in Table 1. The parameter mean is determined based on the value weight of each parameter, shown in Table 2.

Table 2. Assessment Range

Range Value	Value
1 ≤ Range ≤ 50	Less
51 ≤ Range ≤ 60	Moderate
61 ≤ Range ≤ 75	Enough
76 ≤ Range ≤ 90	Good
91 ≤ Range ≤ 100	Very Good

To determine the respective weights of the overall class values in the range 1-100 Table 1 and Table 2 are as follows:

1. Real Value = 1
   Performance Goals =1 x 60% = 0.60
   Orientation =1 x 10% = 0.10
   Integrity =1 x 10% = 0.10
   Commitment =1 x 10% = 0.10
   Discipline =1 x 5% = 0.05
   Teamwork =1 x 5% = 0.05
2. Real Value = 2
   Performance Goals =2 x 60% = 1.20
   Orientation =2 x 10% = 0.20

	Integrity	=2 x 10% = 0.20
	Commitment	=2 x 10% = 0.20
	Discipline	=2 x 5% = 0.10
	Teamwork	=2 x 5% = 0.10
3.	Real Value = 3	
	Performance Goals	=3 x 60% = 0.60
	Orientation	=3 x 10% = 0.10
	Integrity	=3 x 10% = 0.10
	Commitment	=3 x 10% = 0.10
	Discipline	=3 x 5% = 0.05
	Teamwork	=3 x 5% = 0.05

So it is done up to a value of 4 ... 100. And the results of the weight of the entire data can be shown in Table 3 below:

Table 3. Class Values, Parameters and Weight

Real Value						Weighting Value						Average Value
Performance Goals	Orien-tation	Integ-rity	Com-mitment	Disci-pline	Team-work	Performance Goals	Orien-tation	Integ-rity	Com-mitment	Disci-pline	Team-work	
						60%	10%	10%	10%	5%	5%	
1	1	1	1	1	1	0.60	0.10	0.10	0.10	0.05	0.05	1
2	2	2	2	2	2	1.20	0.20	0.20	0.20	0.10	0.10	2
3	3	3	3	3	3	1.80	0.30	0.30	0.30	0.15	0.15	3
4	4	4	4	4	4	2.40	0.40	0.40	0.40	0.20	0.20	4
5	5	5	5	5	5	3.00	0.50	0.50	0.50	0.25	0.25	5
6	6	6	6	6	6	3.60	0.60	0.60	0.60	0.30	0.30	6
7	7	7	7	7	7	4.20	0.70	0.70	0.70	0.35	0.35	7
8	8	8	8	8	8	4.80	0.80	0.80	0.80	0.40	0.40	8
9	9	9	9	9	9	5.40	0.90	0.90	0.90	0.45	0.45	9
10	10	10	10	10	10	6.00	1.00	1.00	1.00	0.50	0.50	10
11	11	11	11	11	11	6.60	1.10	1.10	1.10	0.55	0.55	11
12	12	12	12	12	12	7.20	1.20	1.20	1.20	0.60	0.60	12
13	13	13	13	13	13	7.80	1.30	1.30	1.30	0.65	0.65	13
14	14	14	14	14	14	8.40	1.40	1.40	1.40	0.70	0.70	14
15	15	15	15	15	15	9.00	1.50	1.50	1.50	0.75	0.75	15
16	16	16	16	16	16	9.60	1.60	1.60	1.60	0.80	0.80	16
17	17	17	17	17	17	10.20	1.70	1.70	1.70	0.85	0.85	17
18	18	18	18	18	18	10.80	1.80	1.80	1.80	0.90	0.90	18
19	19	19	19	19	19	11.40	1.90	1.90	1.90	0.95	0.95	19
20	20	20	20	20	20	12.00	2.00	2.00	2.00	1.00	1.00	20
21	21	21	21	21	21	12.60	2.10	2.10	2.10	1.05	1.05	21
22	22	22	22	22	22	13.20	2.20	2.20	2.20	1.10	1.10	22
23	23	23	23	23	23	13.80	2.30	2.30	2.30	1.15	1.15	23
24	24	24	24	24	24	14.40	2.40	2.40	2.40	1.20	1.20	24
25	25	25	25	25	25	15.00	2.50	2.50	2.50	1.25	1.25	25
26	26	26	26	26	26	15.60	2.60	2.60	2.60	1.30	1.30	26
27	27	27	27	27	27	16.20	2.70	2.70	2.70	1.35	1.35	27
28	28	28	28	28	28	16.80	2.80	2.80	2.80	1.40	1.40	28
29	29	29	29	29	29	17.40	2.90	2.90	2.90	1.45	1.45	29
30	30	30	30	30	30	18.00	3.00	3.00	3.00	1.50	1.50	30
31	31	31	31	31	31	18.60	3.10	3.10	3.10	1.55	1.55	31
32	32	32	32	32	32	19.20	3.20	3.20	3.20	1.60	1.60	32
33	33	33	33	33	33	19.80	3.30	3.30	3.30	1.65	1.65	33
34	34	34	34	34	34	20.40	3.40	3.40	3.40	1.70	1.70	34
35	35	35	35	35	35	21.00	3.50	3.50	3.50	1.75	1.75	35
36	36	36	36	36	36	21.60	3.60	3.60	3.60	1.80	1.80	36
37	37	37	37	37	37	22.20	3.70	3.70	3.70	1.85	1.85	37
38	38	38	38	38	38	22.80	3.80	3.80	3.80	1.90	1.90	38
39	39	39	39	39	39	23.40	3.90	3.90	3.90	1.95	1.95	39
40	40	40	40	40	40	24.00	4.00	4.00	4.00	2.00	2.00	40
41	41	41	41	41	41	24.60	4.10	4.10	4.10	2.05	2.05	41
42	42	42	42	42	42	25.20	4.20	4.20	4.20	2.10	2.10	42
43	43	43	43	43	43	25.80	4.30	4.30	4.30	2.15	2.15	43
44	44	44	44	44	44	26.40	4.40	4.40	4.40	2.20	2.20	44
45	45	45	45	45	45	27.00	4.50	4.50	4.50	2.25	2.25	45
46	46	46	46	46	46	27.60	4.60	4.60	4.60	2.30	2.30	46
47	47	47	47	47	47	28.20	4.70	4.70	4.70	2.35	2.35	47
48	48	48	48	48	48	28.80	4.80	4.80	4.80	2.40	2.40	48
49	49	49	49	49	49	29.40	4.90	4.90	4.90	2.45	2.45	49
50	50	50	50	50	50	30.00	5.00	5.00	5.00	2.50	2.50	50
51	51	51	51	51	51	30.60	5.10	5.10	5.10	2.55	2.55	51
52	52	52	52	52	52	31.20	5.20	5.20	5.20	2.60	2.60	52
53	53	53	53	53	53	31.80	5.30	5.30	5.30	2.65	2.65	53
54	54	54	54	54	54	32.40	5.40	5.40	5.40	2.70	2.70	54
55	55	55	55	55	55	33.00	5.50	5.50	5.50	2.75	2.75	55
56	56	56	56	56	56	33.60	5.60	5.60	5.60	2.80	2.80	56
57	57	57	57	57	57	34.20	5.70	5.70	5.70	2.85	2.85	57
58	58	58	58	58	58	34.80	5.80	5.80	5.80	2.90	2.90	58
59	59	59	59	59	59	35.40	5.90	5.90	5.90	2.95	2.95	59
60	60	60	60	60	60	36.00	6.00	6.00	6.00	3.00	3.00	60
61	61	61	61	61	61	36.60	6.10	6.10	6.10	3.05	3.05	61
62	62	62	62	62	62	37.20	6.20	6.20	6.20	3.10	3.10	62

63	63	63	63	63	63	37.80	6.30	6.30	6.30	3.15	3.15	63
64	64	64	64	64	64	38.40	6.40	6.40	6.40	3.20	3.20	64
65	65	65	65	65	65	39.00	6.50	6.50	6.50	3.25	3.25	65
66	66	66	66	66	66	39.60	6.60	6.60	6.60	3.30	3.30	66
67	67	67	67	67	67	40.20	6.70	6.70	6.70	3.35	3.35	67
68	68	68	68	68	68	40.80	6.80	6.80	6.80	3.40	3.40	68
69	69	69	69	69	69	41.40	6.90	6.90	6.90	3.45	3.45	69
70	70	70	70	70	70	42.00	7.00	7.00	7.00	3.50	3.50	70
71	71	71	71	71	71	42.60	7.10	7.10	7.10	3.55	3.55	71
72	72	72	72	72	72	43.20	7.20	7.20	7.20	3.60	3.60	72
73	73	73	73	73	73	43.80	7.30	7.30	7.30	3.65	3.65	73
74	74	74	74	74	74	44.40	7.40	7.40	7.40	3.70	3.70	74
75	75	75	75	75	75	45.00	7.50	7.50	7.50	3.75	3.75	75
76	76	76	76	76	76	45.60	7.60	7.60	7.60	3.80	3.80	76
77	77	77	77	77	77	46.20	7.70	7.70	7.70	3.85	3.85	77
78	78	78	78	78	78	46.80	7.80	7.80	7.80	3.90	3.90	78
79	79	79	79	79	79	47.40	7.90	7.90	7.90	3.95	3.95	79
80	80	80	80	80	80	48.00	8.00	8.00	8.00	4.00	4.00	80
81	81	81	81	81	81	48.60	8.10	8.10	8.10	4.05	4.05	81
82	82	82	82	82	82	49.20	8.20	8.20	8.20	4.10	4.10	82
83	83	83	83	83	83	49.80	8.30	8.30	8.30	4.15	4.15	83
84	84	84	84	84	84	50.40	8.40	8.40	8.40	4.20	4.20	84
85	85	85	85	85	85	51.00	8.50	8.50	8.50	4.25	4.25	85
86	86	86	86	86	86	51.60	8.60	8.60	8.60	4.30	4.30	86
87	87	87	87	87	87	52.20	8.70	8.70	8.70	4.35	4.35	87
88	88	88	88	88	88	52.80	8.80	8.80	8.80	4.40	4.40	88
89	89	89	89	89	89	53.40	8.90	8.90	8.90	4.45	4.45	89
90	90	90	90	90	90	54.00	9.00	9.00	9.00	4.50	4.50	90
91	91	91	91	91	91	54.60	9.10	9.10	9.10	4.55	4.55	91
92	92	92	92	92	92	55.20	9.20	9.20	9.20	4.60	4.60	92
93	93	93	93	93	93	55.80	9.30	9.30	9.30	4.65	4.65	93
94	94	94	94	94	94	56.40	9.40	9.40	9.40	4.70	4.70	94
95	95	95	95	95	95	57.00	9.50	9.50	9.50	4.75	4.75	95
96	96	96	96	96	96	57.60	9.60	9.60	9.60	4.80	4.80	96
97	97	97	97	97	97	58.20	9.70	9.70	9.70	4.85	4.85	97
98	98	98	98	98	98	58.80	9.80	9.80	9.80	4.90	4.90	98
99	99	99	99	99	99	59.40	9.90	9.90	9.90	4.95	4.95	99
100	100	100	100	100	100	60.00	10.00	10.00	10.00	5.00	5.00	100

Based on the RProp function there is information on the LESS column, then the RProp criteria is given a value of ‘1 'starting from the average of 1 to 50 and ‘0' for others. This is interpreted as value classification. For the "MODERATE" column, it is 51 to 60 given a value of "1" and "0" for others. ENOUGH Column is 61 to 75 given a value of ‘1’ and ‘0’ for others. 76 to 90 intervals in the GOOD column are given a value of '1' and '0' for others. And 91 to 100 are given a value of '1' and '0'.

4. Conclusion

Determination of the weight value before conducting the clustering process using the Combination of Kohonen Algorithm and Resilient Backpropagation algorithm can produce accurate values based on the predetermined range value.

References

[1] D. Hassabis, D. Kumaran, C. Summerfield, and M. Botvinick, “Neuroscience-Inspired Artificial Intelligence,” *Neuron*. 2017.

[2] Z. Ghahramani, “Probabilistic machine learning and artificial intelligence,” *Nature*. 2015.

[3] A. Intelligence, “Fundamentals of Neural Networks Artificial Intelligence Fundamentals of Neural Networks Artificial Intelligence,” *Fundam. Neural Networks AI Course Lect. 37 – 38, notes, slides*, 2010.

[4] P. Langley and S. Sage, “Induction of Selective Bayesian Classifiers,” *Proc. Tenth Int. Conf. Uncertain. Artif. Intell.*, no. 1990, pp. 399–406, 1994.

[5] T. Kohonen, “The self-organizing map,” *Proc. IEEE*, 1990.

[6] J. Vesanto and E. Alhoniemi, “Clustering of the self-organizing map,” *IEEE Trans. Neural Networks*, 2000.

[7] T. Kohonen, “Essentials of the self-organizing map,” *Neural Networks*, 2013.

[8] J. Vesanto, J. Himberg, E. Alhoniemi, and J. Parhankangas, “Self-organizing map in Matlab : the SOM Toolbox,” *Proc. Matlab DSP Conf.*, 1999.

[9] H. Ritter and T. Kohonen, “Self-organizing semantic maps,” *Biol. Cybern.*, 1989.

[10] M. Kivelä, A. Arenas, M. Barthelemy, J. P. Gleeson, Y. Moreno, and M. A. Porter, “Multilayer networks,” *J. Complex Networks*, 2014.

[11] K. C. Gupta, “Neural Network Structures,” *Neural Networks RF Microw. Des.*, 2000.

[12] M. Riedmiller and H. Braun, “A direct adaptive method for faster backpropagation learning: The RPROP algorithm,” in *IEEE International Conference on Neural Networks - Conference Proceedings*, 1993.

[13] C. Igel and M. Hüsken, “Improving the Rprop learning algorithm,” *Proc. Second Int. Symp. Neural Comput.*, 2000.

[14] C. Igel, M. Toussaint, and W. Weishui, “Rprop using the natural gradient,” *Trends Appl. Constr. …*, 2005.

[15] M. Riedmiller, “Rprop-description and implementation details,” 1994.

[16] L. K. Hansen and P. Salamon, “Neural Network Ensembles,” *IEEE Trans. Pattern Anal. Mach. Intell.*, 1990.

[17] A. K. Jain and J. Mao, “Artificial Neural Network: A Tutorial,” *Communications*, 1996.

[18] O. S. Sitompul and E. B. Nababan, “Optimization Model of K-Means Clustering Using Artificial Neural Networks to Handle Class Imbalance Problem,” *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 288, p. 012075, Jan. 2018.

[19] H. Karimi and F. Yousefi, “Application of artificial neural network-genetic algorithm (ANN-GA) to correlation of density in nanofluids,” *Fluid Phase Equilib.*, vol. 336, pp. 79–83, 2012.

[20] J. Peralta, G. Gutierrez, and A. Sanchis, “Design of Artificial Neural Networks based on Genetic Algorithms to Forecast Time Series,” 2007.

[21] N. K. Kasabov, *Foundations of neural networks, fuzzy systems, and knowledge engineering*. 1996.

[22] J. J. Noon, *Network Artificial Neural & Programming Using Matlab*. Yogyakarta: Andi, 2009.

[23] C. Saranya Jothi, V. Usha, and R. Nithya, “Particle swarm optimization to produce optimal solution,” *Int. J. Eng. Technol.*, vol. 7, no. 1.7 Special Issue 7, pp. 210–216, 2018.

[24] R. Hasan, *Particle Swarm Optimization: Method and Application*. Engineering Systems Division-Massachusetts Institute of Technology, 2004.