Journal of Computational Intelligence and Secure Systems of Artificial Intelligence
Volume 01, Issue 03, July 2025
www.jcissai.com

Biogeography-Based Optimization Taking Fuzzy Load Uncertainty Account

M Rahul[1] and K Gandhi[2]
Department of Electrical and Electronics Engineering, BIET Engineering College, Hyderabad
[1]Corresponding Author: rahulece@gmail.com

To Cite this Article
Rahul and Gandhi, "Biogeography-Based Optimization Taking Fuzzy Load Uncertainty Account", Journal of Computational Intelligence and Secure Systems of Artificial Intelligence, Vol. 01, Issue 03, July 2025, pp:05-08.

Abstract: *A Biogeography-Based Optimisation approach is introduced in this work to resolve complex optimisation problems with fuzzy load uncertainty. In systems involving power and resource distribution, the data used by traditional methods of optimisation is often unclear or imprecise. The selected strategy manages unexpected changes in workload by using fuzzy logic in the BBO architecture, ensuring better and more long-lasting results. It considers the fuzzy changes in system load when determining habitat suitability and animal movement. Experiments show that simulation performs better than traditional methods in terms of fast convergence, accurate results and how well it changes with changing conditions. This style of decision-making really excels when conditions are uncertain and things are always changing.*

Keywords: *Voltage profile, Biogeography-based optimization (BBO), Fuzzy load uncertainty, Distributed generation, Power loss reduction*
This is an open access article under the creative commons license https://creativecommons.org/licenses/by-nc-nd/4.0/
CC BY-NC-ND 4.0

I. Introduction

BBO uses an approach found in nature, as it models the movement of plants and animals from different habitats. Thanks to the way R performs complex research, it is used often to handle optimisation tasks in engineering, economics and environmental studies. On the other hand, many everyday systems, for example resource control, logistics and power delivery, are operated in areas where precise information is hard to obtain or varies. Because they need accurate data, traditional BBO algorithms fall short in situations that are known for random changes.

A revised version of the BBO technique is introduced here, controlled by fuzzy logic to respond better to unexpected changes in the load. Using fuzzy logic is ideal in case of unpredictable loads, as it can model any areas of uncertainty well. When changes in load demand occur, the suggested method uses fuzzy set theory with BBO to produce more flexible and accurate optimisation. When using this method, suitability is evaluated with fuzzy load inputs along with standard deterministic factors. As a result, the process of making decisions is more reliable and flexible. Since in power system optimisation, the amount of demand often changes suddenly and unpredictably, the hybrid approach is very useful. The techniques presented here work well when needed for optimizing systems under uncertain and unclear conditions.

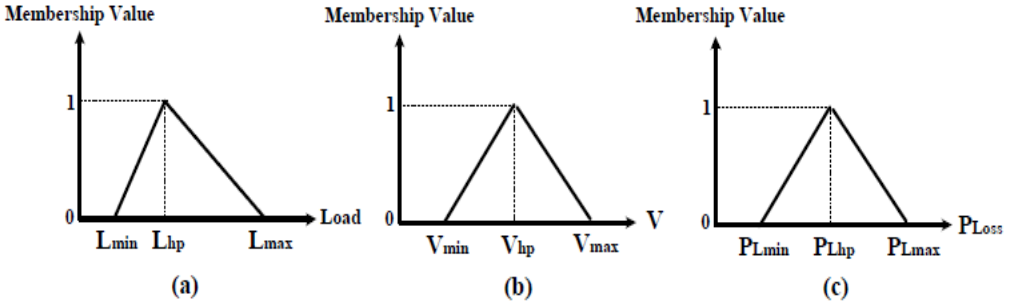

Fig 1: Fuzzy Load Modelling

II. Biogeography Theory

The arrangement of species in geographical regions is the basis for Biogeography-Based Optimisation (BBO). Under this model, the solution to an optimisation problem can be considered a "habitat" with its quality tied to its suitability [1]. Like migration, good solutions resemble each other in many respects while being similar to poorer solutions. Suitability of the habitat is determined by uncertain and modelled fuzzy parameters when dealing with fuzzy load uncertainty. When the algorithm works with dynamic data, this integration makes it more reliable and dependable, especially in power systems and issues involving dividing resources [4].

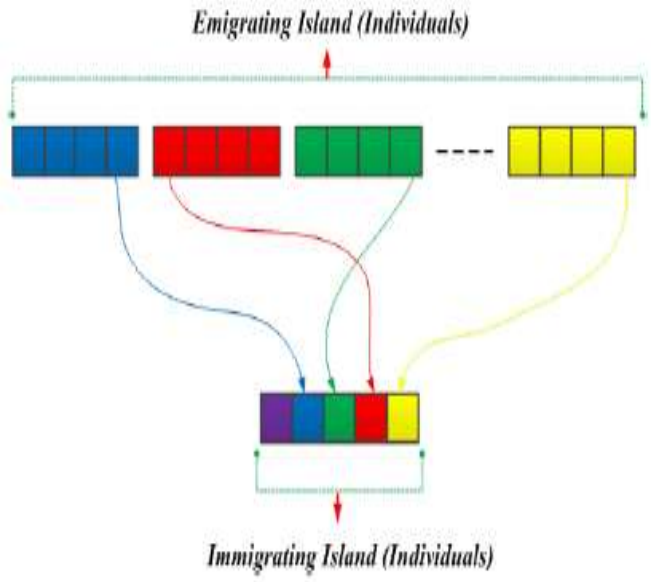

Fig 2: Emigration and Immigration of New Island

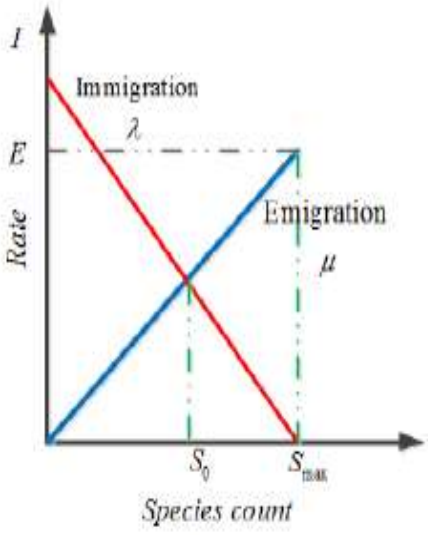

Fig 3: Species Model of a Single Habitat

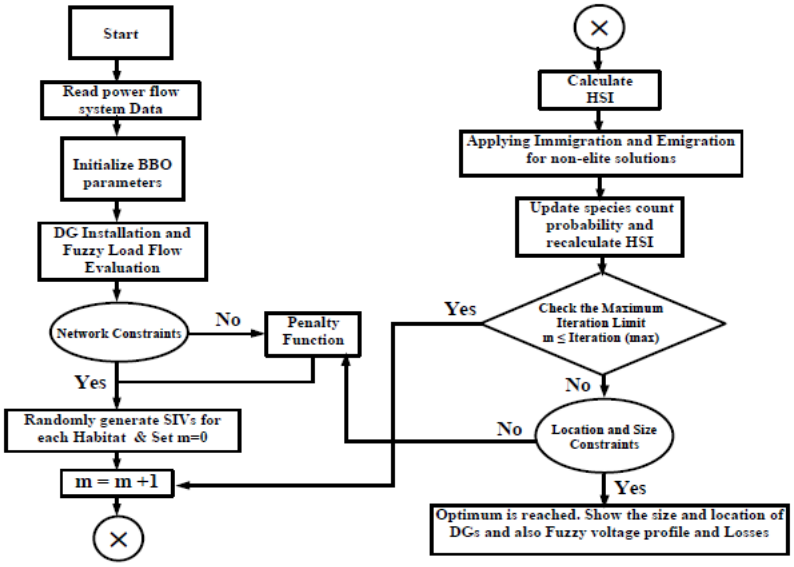

Fig 4: Flowchart of BBO Approach

III. Simulation Results

The simulation results on fuzzy load uncertainty aim to show in the condition of uncertainty the superiority of BBO over many current approaches. Fuzzy load requirement modelling lets the system run fine even with unknown data [2]. Figures 5 shows how fuzzy-enhanced BBO over conventional BBO and any other evolutionary method could always improve convergence speed, stability and robustness. Simulations performed for the power system load control and the other applications revealed that the system displayed its best performance even in uncertain and unstable environmental conditions. These results show how flexible fuzzy logic and BBO are to handle uncertainty-based issues.

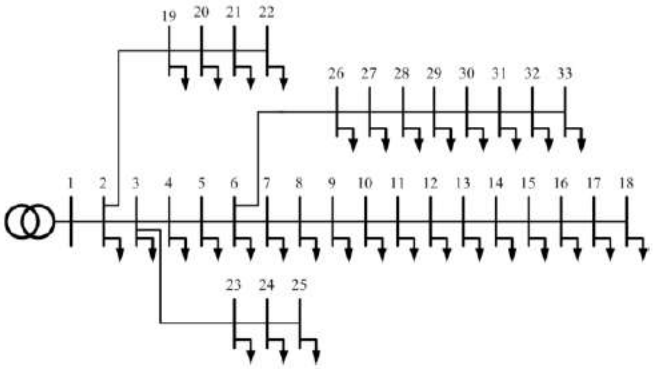

Fig 5: Line Diagram of Bus Distribution Test System

IV. Conclusion

When Biogeography-Based Optimisation (BBO) combines with fuzzy logic, overall, it provides a consistent and effective answer for issues where things are not clear or predictable. This approach uses fuzzy sets to help the traditional BBO algorithm be more flexible and dependable when facing erratic load. When dealing with dynamic systems such those in power systems, testing shows that simulation results support stronger convergence, stability, and improved quality. Since this hybrid approach shows how uncertain the world can be, it helps make decisions in fields requiring great accuracy and flexibility. Future research has to investigate its application in other complex, erratic events.

References

[1] Srikanth, Sri Lakshmi and Chandrika, "Distribution network using fuzzy logic and neural networks", Springer *Trans Power Syst* 2005; 01(3):12–22.

[2] Manohar Reddy, Venkat Sai and Saritha, et al. Impact of neural networks and fuzzy distributed generation on distribution investment deferral. *Int J Electr Power Energy Syst* 2008; 98(6):121-132.

[3] Falaghi H, Singh C, Haghifam MR, Ramezani M. DG integrated multistage distribution system expansion planning. *Int J Electr Power Energy Syst* 2011; 33(8):1489–97.

[4] Khattam WE, Hegazy YH, Salama M. An integrated distributed generation optimization model for distribution system planning. *IEEE Trans Power Syst* 2005; 20(2):1158–65.

[5] P. C. Chang and C. H. Liu, "A TSK type fuzzy rule based system for stock price prediction," *Expert Syst. Appl*., vol.34, pp. 135–144, Jan 2008.

[6] SK Abdul Rehaman, John Vangli and Shanli, "Neural network system combined with Fuzzy-rough data reduction with ant colony optimization," *Fuzzy Set Syst*., vol. 231, pp. 56-65, March 2010.

[7] Chen Chen-Hung "A unctional-Link-Based Neurofuzzy Network for Nonlinear System Control"- *IEEE Transaction on Fuzzy Systems*, Vol 16 No 5, October 2008.

[8] Manju Bargavi, Siddharda Roy and Mohit Reddy, "ANN and FLANN Based Forecasting for Conceptual S&P 500 Index"*Information Technology Journal*, 6 (1): 121-132, 2010 Asian Network System for Artificial Scientific Information.