Laxminarayan Sahoo
Associate Professor
Department of Computer and Information Science
Raiganj University, Raiganj – 733134, West Bengal, India
E-mail: lxsahoo@gmail.com, lxsahoo@raiganjuniversity.ac.in
Contact (Mobile & WhatsApp): +91 9932337688

Academic Qualifications:
M.Sc., MTech., Ph.D.; NET (CSIR) Qualified; GATE Qualified (AIR-41, IISc Bangalore)
Ph.D. Thesis Title: *Studies on Reliability Optimization Problems by Genetic Algorithm*
Ph.D. Supervisors:
(i) Prof. A. K. Bhunia, Department of Mathematics, The University of Burdwan, WB, India
(ii) Late Prof. Dilip Roy, Centre for Management Studies, The University of Burdwan, WB, India
MTech Thesis Title: *Studies on Integrated Machine Learning, Deep Learning, and Transformer-Based Techniques for Heart Disease Prediction*
MTech Supervisor: Dr. Ankit A. Bhurane, Department of Electronics and Communication Engineering, Visvesvaraya National Institute of Technology (VNIT), Nagpur, India
Fellowship: MHRD Fellowship, Department of Computer Science and Engineering, IIT (ISM) Dhanbad, India (MTech Program)
Awards and Recognition: Recipient of the Prof. M. N. Gopalan Award for Best Ph.D. Thesis in Operations Research (2012)
Specialization: Advanced Optimization and Operations Research, Artificial Intelligence and Machine Learning.
Research Interests: Research interests include Reliability Optimization, Evolutionary Computations, Interval Mathematics and Optimization Techniques, Fuzzy Decision Making and Multi-Criteria Decision Making under Uncertain Environments, Operations Research, Game Theory, Inventory Control, Search Engine Optimization, Graph Theory, Data Analytics, Wireless Sensor Networks, Distributed Network Systems, Image Processing, Signal Processing, and Artificial Intelligence and Machine Learning (AI/ML).
Research Project:

- Completed: 1, Sponsored by: University Grants Commission (UGC), Government of India

Supervision of Doctoral Scholars:
Successfully supervised and guided the following Ph.D. scholars:

1. Avishek Banerjee, Ph.D. in Engineering, Jadavpur University (2019). *Thesis: Studies of Some Evolutionary Algorithms and Applications in Reliability Optimization.*
2. Subhradeep Maitra, Ph.D. in Science, Raiganj University (2023). *Thesis: Studies on Some Search Engine Optimization Techniques and Its Applications During COVID-19 Pandemic.*
3. Supriyan Sen, Ph.D. in Science, Raiganj University (2024). *Thesis: Modeling and Optimization of Some Network Design Problems Under Uncertainty.*
4. Rakhi Das, Ph.D. in Science, Raiganj University (2024). *Thesis: A Study on Optimal Path Selection of Some Special Graphs.*

5. Sanchita Guchhait, Ph.D. in Science, Raiganj University (Thesis Submitted, 2025). *Thesis: A Study on Homophily Detection in Social Networks Using Dynamic Centrality.*

Currently Supervising:

6. Sumanta Lal Ghosh, Ph.D. in Science, Raiganj University (Pursuing). *Thesis: Investigations on Multi-Criteria Decision-Making Employing Machine Learning and Its Applications in Uncertain Scenarios.*
7. Nivedita Kuity, Ph.D. in Science, Raiganj University (Pursuing). *Thesis: Analysis of Advanced Quantum Graph Structures: Models, Algorithms, Applications.*

Editorial Board Membership:

- Academic Editor: *Mathematical Problems in Engineering*, Wiley
- Associate Editor: *Journal of Graphic Era University (JGEU)*, River Publishers
- Editorial Board Member: *Scientific Reports*, Springer Nature

Fellow Membership:

- Fellow Member, ISROSET (ISROSET-FM-1159)

Publications:

88. Chakraborty, J., Mukherjee, S., & Sahoo, L. (2026). Pythagorean fuzzy set measures and the effects of scoring functions in multi-criteria decision-making, *International Journal of System Assurance Engineering and Management, Springer (Accepted)*

87. Sahoo, L., & Das, R. (2025). Optimal Path Selection for a Weighted Semidirected Network and its Application. *Intelligent Systems Research and Applications Journal*, *1*, 13-26.

86. Sahoo, L., Bhurane, A. A. (2025). Explainable fair hybrid learning for heart disease prediction. In Proceedings of the 4th International Conference on Paradigm Shifts in Communication, Embedded Systems, Machine Learning, and Signal Processing (PCEMS 2025). Springer. (Accepted for Publication).

85. Sahoo, L., Bhurane, A. A. (2025). Explainable Hybrid Machine Learning and Deep Learning Ensemble with Fairness Auditing for Accurate Heart Disease Prediction, Franklin Open, Elsevier. (Revised version submitted).

84. Chakraborty, J., Mukherjee, S., & Sahoo, L. (2024). An alternative approach for enhanced decision-making using fermatean fuzzy sets. *Spectrum of engineering and management sciences*, *2*(1), 135-150.

83. Sahoo, L., & Guchhait, S. (2024). Exploring homophily in research collaboration: A dynamic centrality analysis approach. *Journal of Graphic Era University, 12*(2), 243–262.

82. Sahoo, L., & Das, R. (2024). Shortest path of a random graph and its application. *Journal of Graphic Era University, 12*(1), 53–76.

81. Sen, S., Sahoo, L., & Ghosh, S. L. (2024). Lifetime extension of wireless sensor networks by perceptive selection of cluster head using K-means and Einstein weighted averaging aggregation operator under uncertainty. *Journal of Industrial Intelligence, 2*(1), 54–62.

80. Sahoo, L., Guchhait, S., Allahviranloo, T., Kumar, J. R. R., Tarambale, M. R., & Catak, M. (2024). Conflict distance-based variable precision Pythagorean fuzzy rough set in Pythagorean fuzzy decision systems with applications in decision making. *Journal of Mathematics and Computer Science-JMCS.*

79. Sahoo, L., Sen, S., Tiwary, K. S., Moslem, S., & Senapati, T. (2024). Improvement of wireless sensor network lifetime via intelligent clustering under uncertainty. *IEEE Access.*

78. Sen, S., Sahoo, L., Tiwary, K., & Senapati, T. (2023). Entropy weighted TOPSIS based cluster head selection in wireless sensor networks under uncertainty. *Telecom, 4*(4), 678–692.

77. Sahoo, L., Das, R., & Samanta, S. (2023). Bi-weighted graph-based optimal path selection for a network. *International Journal of Scientific Research in Mathematical and Statistical Sciences, 10*(4), 1–8.

76. Sen, S., Sahoo, L., Tiwary, K., Simic, V., & Senapati, T. (2023). Wireless sensor network lifetime extension via K-medoids and MCDM techniques in uncertain environment. *Applied Sciences, 13*(5), 3196.

75. Chakraborty, J., Mukherjee, S., & Sahoo, L. (2023). Intuitionistic fuzzy multi-index multi-criteria decision-making for smart phone selection using similarity measures in a fuzzy environment. *Journal of Industrial Intelligence, 1*(1), 1–7.

74. Maitra, S., Sahoo, L., Sen, S., & Tiwary, K. (2023). Comparison of websites employing search engine optimization and live data. *Journal of Computer Science Research, 5*(2), 16–27.

73. Das, P., Nath, I., Banerjee, A., & Sahoo, L. (2022). Co-bot: An intelligent technique for designing a chatbot for initial COVID-19 test. *Journal of Computer Science Research, 4*(4), 26–35.

72. Das, R., Sahoo, L., Samanta, S., Simic, V., & Senapati, T. (2022). Identifying the shortest path of a semidirected graph and its application. *Mathematics, 10*(24), 4807.

71. Sahoo, L., Bhunia, A. K., Pal, P., & Bala, S. (2023). Tournament constriction coefficient-based particle swarm optimization (TPSO-Co) for engineering design optimization problems. *International Journal of System Assurance Engineering and Management, 14*, 87–98.

70. Sahoo, L. (2023). Transportation problem in Fermatean fuzzy environment. *RAIRO - Operations Research, 57*, 145–156.

69. Maitra, S., Sahoo, L., & Tiwary, K. S. (2022). Study, analysis, and comparison between Amazon A10 and A11 search algorithm. *Journal of Computer Science Research, 4*(4), 1–6.

68. Maitra, S., Sahoo, L., & Tiwary, K. S. (2022). Methods and strategies for search engine optimization. *COJ Robotics & Artificial Intelligence, 2*(2), 1–7.

67. Sahoo, L., Sen, S., Tiwary, K. S., Samanta, S., & Senapati, T. (2022). Optimization of data distributed network system under uncertainty. *Discrete Dynamics in Nature and Society, 2022*, 1–12.

66. Sahoo, L., Sen, S., Tiwary, K. S., Samanta, S., & Senapati, T. (2022). Modified Floyd-Warshall's algorithm for maximum connectivity in wireless sensor networks under uncertainty. *Discrete Dynamics in Nature and Society, 2022*, 1–11.

65. Banerjee, A., Garg, D., Das, V., Sahoo, L., Nath, I., Varadarajan, V., & Kotecha, K. (2022). Design of energy efficient WSN using a Nobel SMOWA algorithm. *Computers, Materials & Continua, 72*(2), 3585–3600.

64. Sahoo, L., Bhunia, A. K., & Mahato, S. (2022). Optimization of system reliability in the imprecise environment via genetic algorithm. *International Journal of Swarm Intelligence Research, 13*(1), 1–21.

63. Sahoo, L. (2022). Similarity measures for Fermatean fuzzy sets and its applications in group decision-making. *Decision Science Letters, 11*, 167–180.
62. Sahoo, L. (2021). A new score function based Fermatean fuzzy transportation problem. *Results in Control and Optimization, 4*, 100040.
61. Sahoo, L. (2021). Some score functions on Fermatean fuzzy sets and its application to bride selection based on TOPSIS method. *International Journal of Fuzzy System Applications, 10*(3), 18–29.
60. Sahoo, L., & Bhunia, A. K. (2021). Optimization of plant location problem in interval domain via particle swarm optimization. *International Journal of System Assurance Engineering and Management, 12*(6), 1094–1105.
59. Sahoo, L. (2019). Solving matrix game with linguistic payoffs. *International Journal of System Assurance Engineering and Management, 10*, 484–490.
58. Shaikh, A. A., Bhunia, A. K., Barron, L. E. C., Sahoo, L., & Tiwari, S. (2018). A fuzzy inventory model for deteriorating item with variable demand, permissible delay in payments and partial backlogging with shortage follows inventory (SFI) policy. *International Journal of Fuzzy Systems, 20*, 1606–1623.
57. Sahoo, L., & Mahato, S. K. (2018). Optimal redundancy allocation for bridge network system with fuzzy parameters. *Journal of Applied Quantitative Methods, 13*(1), 1–13.
56. Sahoo, L. (2017). Genetic algorithm-based approach for reliability redundancy allocation problems in fuzzy environment. *International Journal of Mathematical, Engineering and Management Science, 2*(4), 272–283.
55. Bhunia, A. K., Duary, A., & Sahoo, L. (2017). A genetic algorithm-based hybrid approach for reliability-redundancy optimization problem of a series system with multiple-choice. *International Journal of Mathematical, Engineering and Management Science, 2*(3), 185–212.
54. Sahoo, L., & Ghosh, S. K. (2017). Solving assignment problem with linguistic costs. *Journal of New Theory, 17*, 26–37.
53. Sahoo, L. (2017). Solving job sequencing problems with fuzzy processing times. *International Journal of Advance Research and Innovative Ideas in Education, 3*(4), 3326–3329.
52. Sahoo, L. (2017). An application of interval system of linear equations in circuit analysis. *International Journal of Advance Research and Innovative Ideas in Education, 3*(4), 2779–2784.
51. Sahoo, L. (2017). An approach for solving fuzzy matrix games using signed distance method. *Journal of Information and Computing Science, 12*(1), 73–80.
50. Sahoo, L., Mahato, S. K., & Bhunia, A. K. (2016). Genetic algorithm for reliability optimization of redundancy allocation problem in imprecise environment. *Fuzzy Information and Engineering.*
49. Bhunia, A. K., Shaikh, A. A., & Sahoo, L. (2016). A two-warehouse inventory model for deteriorating item under permissible delay in payment via particle swarm optimization. *International Journal of Logistic and System Management, 24*(1), 45–69.
48. Sahoo, L. (2016). An interval parametric technique for solving fuzzy matrix games. *Elixir Applied Mathematics, 93*, 39392–39397.

47. Sahoo, L. (2015). Effect of defuzzification methods in solving fuzzy matrix games. *Journal of New Theory*, *8*, 51–64.
46. Sahoo, L., Mahato, S. K., & Bhunia, A. K. (2015). Multi-level reliability redundancy allocation problem in interval environment via genetic algorithm. *Communications in Dependability and Quality Management, 18*(1), 65–80.
45. Bhunia, A. K., Biswas, A., & Sahoo, L. (2015). Comparison of different approaches for redundancy allocation problem with interval valued reliability via genetic algorithm. *Communications in Dependability and Quality Management, 18*(4), 33–51.
44. Sahoo, L. (2015). Genetic algorithm approach to solve integer nonlinear programming problem in reliability optimization. *Journal of Information and Computing Science, 10*(4), 255–264.
43. Sahoo, L., Banerjee, A., Bhunia, A. K., & Chattopadhyay, S. (2014). An efficient GA-PSO approach for solving mixed-integer nonlinear programming problem in reliability optimization. *Swarm and Evolutionary Computations*, *19*, 43–51.
42. Sahoo, L., Bhunia, A. K., & Roy, D. (2014). Reliability optimization in stochastic domain via genetic algorithm. *International Journal of Quality & Reliability Management, 31*(6), 698–717.
41. Sahoo, L., Mahato, S. K., & Bhunia, A. K. (2014). Optimization of system reliability for series system with fuzzy component reliabilities by genetic algorithm. *Journal of Uncertain Systems, 8*, 136–148.
40. Sahoo, L., Bhunia, A. K., & Roy, D. (2014). Reliability optimization with high- and low-level redundancies in interval environment via genetic algorithm. *International Journal of Systems Assurance Engineering and Management, 5*(4), 513–522.
39. Sen, N., Sahoo, L., & Bhunia, A. K. (2014). An application of integer linear programming problem in tea industry of Barak Valley of Assam, India under crisp and fuzzy environments. *Journal of Information and Computing Science, 9*(2), 132–140.
38. Sahoo, L., Bhunia, A. K., Pal, D., & Mandal, B. (2013). Alternative approach for PDE-constrained optimization via genetic algorithm. *Journal of Information and Computing Science, 8*(1), 2041–2054.
37. Bhunia, A. K., & Sahoo, L. (2013). Optimization of constrained multi-objective reliability problems with interval valued reliability of components via genetic algorithm. *Indian Journal of Industrial & Applied Mathematics*, *3*(1), 25–44.
36. Mahato, S. K., Sahoo, L., & Bhunia, A. K. (2013). Effects of defuzzification methods in redundancy allocation problem with fuzzy valued reliabilities via genetic algorithm. *International Journal of Information and Computer Science, 2*(6), 106–115.
35. Mahato, S. K., Sahoo, L., & Bhunia, A. K. (2012). Reliability-redundancy optimization problem with interval valued reliabilities of components via genetic algorithm. *Journal of Information and Computing Science, 7*(4), 284–295.
34. Sahoo, L., Bhunia, A. K., & Kapur, P. K. (2012). Genetic algorithm based multi-objective reliability optimization in interval environment. *Computers and Industrial Engineering, 62*, 152–160.

33. Sahoo, L., Bhunia, A. K., & Roy, D. (2012). An application of genetic algorithm in solving reliability optimization problem under interval component Weibull parameters. *Mexican Journal of Operations Research, 1*(1), 2–19.

32. Bhunia, A. K., Sahoo, L., & Roy, D. (2010). Reliability stochastic optimization for a series system with interval component reliability via genetic algorithm. *Applied Mathematics and Computation, 216*(3), 929–939.

31. Sahoo, L., Bhunia, A. K., & Roy, D. (2010). A genetic algorithm-based reliability redundancy optimization for interval valued reliabilities of components. *Journal of Applied Quantitative Methods, 5*(2), 270–287.

30. Sadhukhan, D., Sahoo, L., Mondal, B., & Maiti, M. (2010). Food chain model with optimal harvesting in fuzzy environment. *Journal of Applied Mathematics and Computing, 34*, 1–18.

29. Guchhait, S., Sahoo, L., Samanta, S., Dubey, V. K., & Allahviranloo, T. (2024). Homophily-Based Link Prediction Within a Social Network Using Linguistic Z-number. In *Management of Uncertainty Using Linguistic Z-Numbers: Applications for Decision-Making, Granular Computing and Social Networks* (pp. 179-199). Cham: Springer Nature Switzerland.

28. Guchhait, S., Sahoo, L., Kalampakas, A., Samanta, S., & Allahviranloo, T. (2024). Optimal Route in Linguistic Z-Graphs: A Shortest Path Approach. In *Management of Uncertainty Using Linguistic Z-Numbers: Applications for Decision-Making, Granular Computing and Social Networks* (pp. 289-305). Cham: Springer Nature Switzerland.

27. Kuity, N., Sahoo, L., Hazra, S., & Maity Das, K. (2025). Routing Protocols Based on Quantum Bunch Graph. In *Quantum Theory and Fuzzy Systems: Traversing Uncertainty in Group Decision-Making and Social Networks: Quantum and Fuzzy Approaches to Social Network Analysis and Group Decisions* (pp. 287-305). Cham: Springer Nature Switzerland.

26. Guchhait, S., Sahoo, L., & Allahviranloo, T. (2025). Dynamic Centrality Measure for Bunch Nodes in Quantum Graph: Perspective on Brain Network. In *Quantum Theory and Fuzzy Systems: Traversing Uncertainty in Group Decision-Making and Social Networks: Quantum and Fuzzy Approaches to Social Network Analysis and Group Decisions* (pp. 271-285). Cham: Springer Nature Switzerland.

25. Bhattacharjee, N., Sen, N., & Sahoo, L. (2025). Root Hair Algorithm: A Swarm Intelligence Algorithm. In *Decision Making Under Uncertainty Via Optimization, Modelling, and Analysis* (pp. 583-595). Singapore: Springer Nature Singapore.

24. Bhattacharjee, N., Sen, N., Nath, P. K., & Sahoo, L. (2025). Imperfect Production Inventory Under a Multi-Production Cycle for Non-deteriorating Items with Carbon Tax and Green Investment. In *Decision Making Under Uncertainty Via Optimization, Modelling, and Analysis* (pp. 267-283). Singapore: Springer Nature Singapore.

23. Chakraborty, J., Mukherjee, S., & Sahoo, L. (2025). Pythagorean Fuzzy Ordered Weighted Averaging Aggregation Operator Based on Appropriate Score Function and Their Application to Multi-criteria Decision-Making in IT Project Management. In *Decision Making Under Uncertainty Via Optimization, Modelling, and Analysis* (pp. 597-614). Singapore: Springer Nature Singapore.

22. Sahoo, L., Banerjee, A., & Chakraborty, A. (2025). An efficient GA-PSO algorithm for addressing multi-objective reliability optimization problems. *Operational Perspective of Modeling System Reliability: Research Tools for System Dynamics*, *18*, 47.

21. Bhowmik, A., Pal, M., Sahoo, L., & Samanta, S. (2023). A study on developments of fuzzy set and its extensions. In Kulkarni et al. (Eds.), *Optimization techniques for sustainable environment under uncertainty*. Springer.

20. Sahoo, L., Rana, A., & Senapati, T. (2022). Score function based effective ranking of interval valued Fermatean fuzzy sets and its applications. In L. Sahoo et al. (Eds.), *Real life applications of multiple criteria decision-making techniques in fuzzy domain*. Springer.

19. Maitra, S., Sahoo, L., Lahiri Dey, J., & Tiwary, K. S. (2022). Multi-criteria decision making and its application to online learning platform selection during the COVID-19 pandemic based on TOPSIS method. In L. Sahoo et al. (Eds.), *Real life applications of multiple criteria decision-making techniques in fuzzy domain*. Springer.

18. Sahoo, L. (2021). Reliability redundancy allocation problems under fuzziness using genetic algorithm and dual connection numbers. In Mellal et al. (Eds.), *Nature-inspired computing paradigms in systems* (pp. 11–125). Elsevier.

17. Sahoo, L. (2021). A brief discussion about search engine optimization. In P. K. Paul et al. (Eds.), *Foundation and emergence of computing and communications*.

16. Sahoo, L. (2020). Method for solving intuitionistic fuzzy assignment problem. In Ram et al. (Eds.), *Soft computing* (pp. 155–164). De Gruyter.

15. Sahoo, L. (2019). Solutions of fuzzy system of linear equations. In C. Jana et al. (Eds.), *Emerging applications of fuzzy algebraic structures* (pp. 26–33). IGI Global.

14. Sahoo, L., & Pal, P. (2019). Solving (2 × n) fuzzy matrix games. In U. Biswas et al. (Eds.), *Advances in computer, communication, and control* (Vol. 41, pp. 633–641). Springer.

13. Sahoo, L. (2018). System reliability optimization in a fuzzy environment via hybridized GA–PSO. In A. Anand et al. (Eds.), *System reliability management: Solutions and technologies* (pp. 35–49). CRC Press.

12. Bhunia, A. K., Sahoo, L., & Mahato, S. K. (2015). Chance constrained redundancy allocation problem with imprecise component reliabilities via genetic algorithm: A simulation-based approach. In *Quality, reliability, Infocom technology and industrial technology management* (pp. 55–71). I. K. International Publishing House.

11. Sahoo, L., Banerjee, A., Bhunia, A. K., & Chattopadhyay, S. (2014). Reliability redundancy allocation problem of series system by hybrid GA-PSO approach. In *ETES 2014* (pp. 83–89). McGraw Hill Education.

10. Sahoo, L., & Bala, S. (2014). Genetic algorithm to solve integer programming problem in reliability optimization. In *ETES 2014* (pp. 99–103). McGraw Hill Education.

9. Bhunia, A. K., Sahoo, L., & Roy, D. (2012). Genetic algorithm based mixed-integer nonlinear programming in reliability optimization problems. In *Quality, reliability, and Infocom technology: Trends and future directions* (pp. 25–42). Narosa Publishing House.

8. Bhunia, A. K., & Sahoo, L. (2011). Genetic algorithm-based reliability optimization in interval environment. In N. Nedjah et al. (Eds.), *Innovative computing methods* (pp. 13–36). Springer.

7. Bhunia, A. K., & Sahoo, L. (2011). Reliability optimization in imprecise environment via genetic algorithm. In *AMOC 2011* (pp. 372–379). IIT Roorkee.

6. Sahoo, L., & Bhunia, A. K. (2011). Optimization of high- and low-level redundancies via genetic algorithm with interval valued reliabilities. In *AMOC 2011* (pp. 380–387). IIT Roorkee.

Text Books:

5. Bhunia, A. K., Sahoo, L., & Shaikh, A. A. (2020). *Advanced optimization and operations research*. Springer Nature.

4. Bhunia, A. K., & Sahoo, L. (2011). *Advanced operations research*. Asian Books Private Limited.

Edited Volumes:

3. Jana, R. Sahoo, L. & Sen, N. (Eds.) (2026). *Uncertainty, Optimization and Machine Learning with Applications*, Springer.

2. Sahoo, L., Senapati, T., Pal, M., & Yager, R. R. (Eds.). (2025). *Decision Making Under Uncertainty Via Optimization, Modelling, and Analysis*. Springer.

1. Sahoo, L., Senapati, T., & Yager, R. R. (2022). *Real life applications of multiple criteria decision-making techniques in fuzzy domain* (Vol. 420). Springer.