ISSN: 2278-4632
Vol-11 Issue-01 March 2021

A MOBILE ROBOT'S NAVIGATION PATH ANALYSIS USING A HYBRID NEURO-INVASIVE WEED OPTIMIZATION TECHNIQUE

P. Paulpandian[1], Sudhansu sekhar barik[2]

[1]Professor, Department of Mechanical Engineering, Raajdhani Engineering College, Bhubaneswar, Odisha

[2]Assistant Professor, Department of Mechanical Engineering, Raajdhani Engineering College, Bhubaneswar, Odisha

ABSTRACT

In the current work, a hybrid Neuro-IWO navigation strategy for mobile robots in congested environments has been examined. ODF (obstacle distance from front), ODL (obstacle distance from left), ODR (obstacle distance from right), TA (target angle), and ODR (obstacle distance from right) are the inputs to the neural network section. The output is interim steering angle. The ODF (obstacle distance from front), ODL (obstacle distance from left), ODR (obstacle distance from right) and intermediate steering angle are the inputs to the invasive weed optimization segment. The final steering angle is the output of the invasive weed optimization approach. Several publications have been evaluated and analysed in the current research using various artificial intelligence approaches. Several modelling and experimental results are presented in this study using the hybrid Neuro-IWO technique.

Key words: *Obstacle, mobile robot, simulation result, experimental result, neuro-vasive weed optimization approach.*

1.INTRODUCTION

Kim [1] has talked about fuzzy technique and algorithm for path planning of mobile robot in a congested environment. They provided a number of results to demonstrate the potency of their paper. Fuzzy dynamic systems, the fusion of probabilistic algorithms, and the GA technique for determining the best path for robotic agents in an obstacle-prone area were studied in papers [2–10]. For mobile robot navigation, papers [11–20] examined fuzzy-neuro, neuro-fuzzy, ant colony optimization approach, and IWO. These publications discuss the navigation of both a single mobile robot and many mobile robots. The kinematic model of a wheeled mobile robot is discussed in paper [15]. An ant colony optimization technique, artificial neural network techniques, MLP & RBF NN techniques, and the firefly algorithm are all covered in papers [21-32]. The papers [33–42] discussed MANFIS, GA, and Takagi–

ISSN: 2278-4632
Vol-11 Issue-01 March 2021

Sugeno algorithms.

2. ANALYSIS OF AI TECHNIQUES

In papers [55–67], the navigation of a wheeled mobile robot in a partially known and unknown environment is discussed using the finite element approach, genetic algorithms, immunized navigational controllers, and the ANFIS method. The authors look for the best approach to take while trying to solve the robot-related path planning problem. In publications [68-84], the self-adaptive fuzzy methodology, RBFNN, artificial neural network, and frog leaping algorithm were studied. The papers [85-100] discuss a variety of papers on mobile robot navigation. In a few of these studies, it was also considered how artificial intelligence could be used to solve other engineering issues. The efficient neural network path planning of mobile robots, the PSO-based path planning of mobile robots, the stable and precise motion control of numerous mobile robots, and the CS-ANFIS approach.

3. METHODOLOGY NEURO-IWO TECHNIQUE

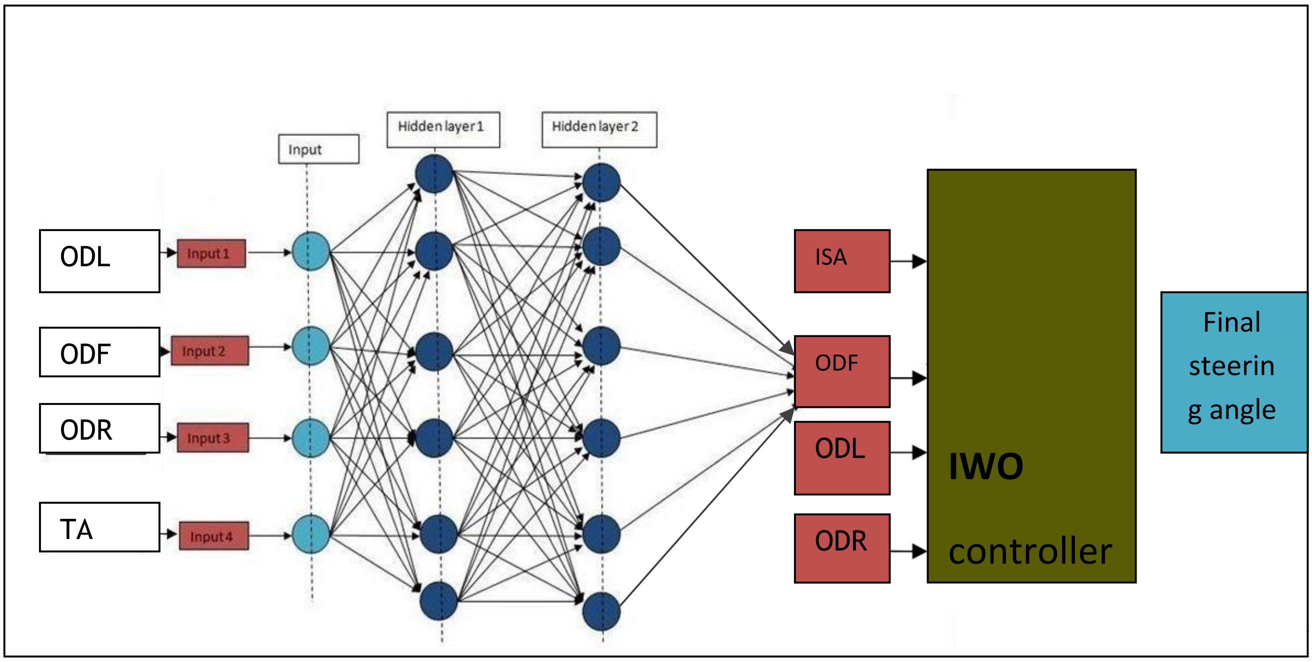

Fig.1. Hybrid Neuro-IWO technique architecture for mobile robot navigation

The inputs such as obstacle distance from left, obstacle distance from right, obstacle distance from front, target angle are given to the neural network. The output from the neural network is interim steering angle (ISA). The flow chart for hybrid Neuro-IWO is given below.

4. FLOW DIAGRAM OF HYBRID NEURO-IWO METHOD

ISSN: 2278-4632
Vol-11 Issue-01 March 2021

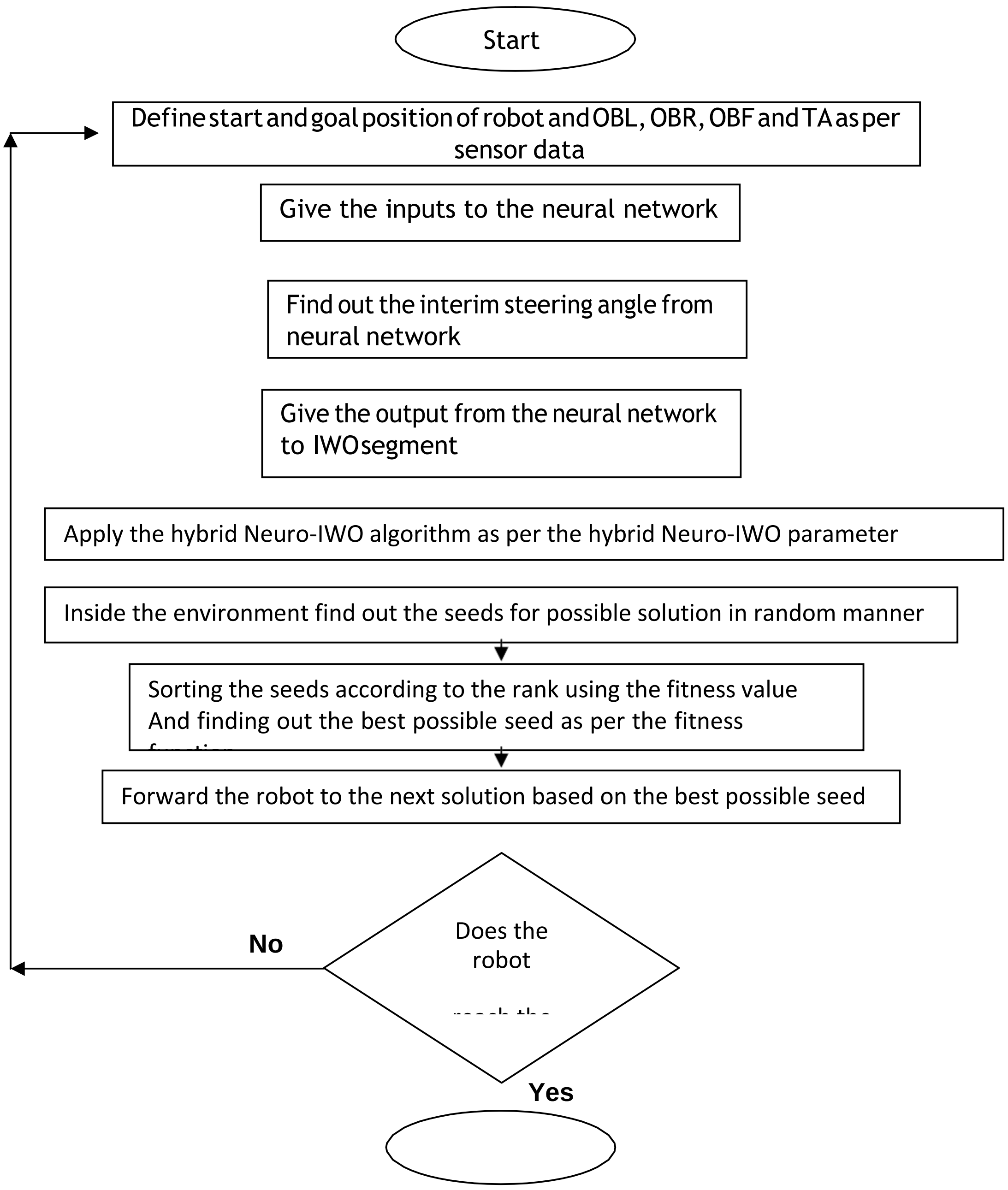

Fig.2. Flow chart for hybrid Neuro-IWO technique for mobile robot navigation

ISSN: 2278-4632
Vol-11 Issue-01 March 2021

5. SIMULATION RESULT

Fig.3 (a) shows the initial position in simulation mode. Fig.3 (b) to fig.3 (e) shows the intermediate position of the robot in simulation mode. Fig.3 (f) shows the final position of robot while reaching the target and also shows the path in the simulation mode.

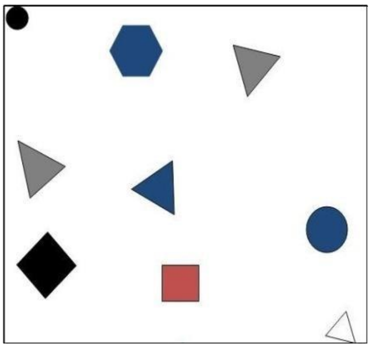

Fig.3 (a)

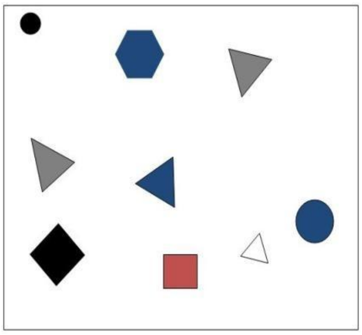

Fig.3 (b)

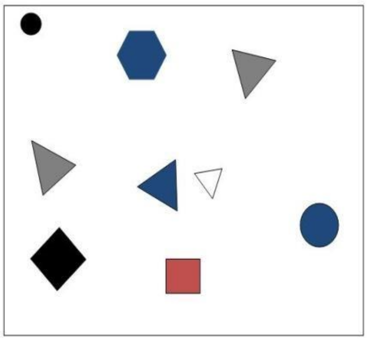

Fig.3(c)

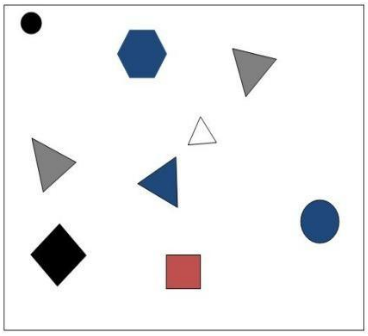

Fig.3(d)

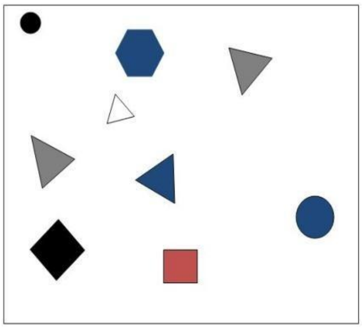

Fig.3(e)

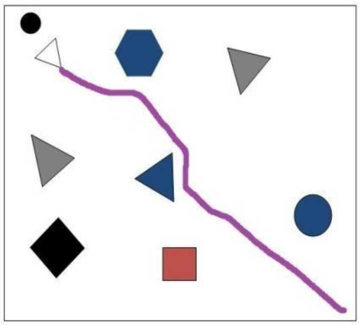

Fig.3(f)

6.EXPERIMENTAL RESULT

Fig.4 (a) shows the start position of the robot in experimental mode. Fig.4 (b) to fig.4 (e) shows the intermediate position of the robot in experimental setup when the robot navigates in a cluttered environment avoiding obstacles. Fig.4 (f) shows the final position while reaching the target also shows the path of robot in experimental setup.

ISSN: 2278-4632
Vol-11 Issue-01 March 2021

Fig.4 (a)

Fig.4 (b)

Fig.4(c)

Fig.4(d)

Fig.4(e)

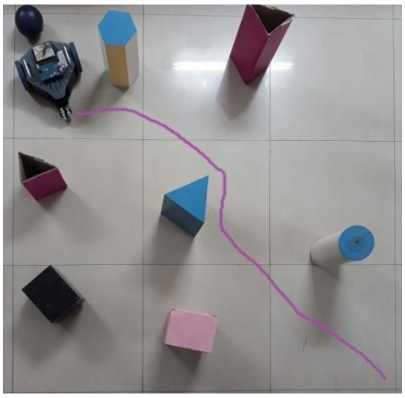

Fig.4(f)

Table 1 shows the time taken by the robot for 10 scenarios from start position to end position and the deviation is found to be below 6%

No. of Exercise	Time Taken in Simulation (TTS) from start to goal in milliseconds	Time Taken in Experiment (TTE) from start to goal in milliseconds	Deviation $\frac{(\lvert TTS - TTE \rvert)}{TTS} \times 100$	Average Deviation
1	4152.42	4312.08	3.84	5.102
2	4112.64	4304.16	4.65	
3	4079.71	4292.10	5.20	
4	4175.28	4424.22	5.96	
5	4184.28	4371.48	4.47	
6	3755.72	3946.51	5.07	
7	3702.42	3896.15	5.23	
8	3807.36	4055.94	6.52	
9	3881.76	4113.72	5.97	
10	4038.35	4204.44	4.11	

Table 2 shows the path length covered by the robot from start position to goal position for simulation and experimental setup and the path deviation is found to be below 6%

No. of Exercise	Path Length in Simulation (PLS) from start to goal in centimetres	Path Length in Experiment (PLE) from start to goal in centimetres	Deviation $\frac{(\lvert PLS - PLE \rvert)}{PLS} \times 100$	Average Deviation
1	230.69	239.56	3.84	5.103
2	228.48	239.12	4.65	
3	226.65	238.45	5.20	
4	231.96	245.79	5.96	
5	232.46	242.86	4.47	
6	208.65	219.25	5.08	
7	205.69	216.45	5.23	
8	211.52	225.33	6.52	
9	215.65	228.54	5.97	
10	224.35	233.58	4.11	

7. CONCLUSION

Using a hybrid Neuro-IWO approach, the three wheeled mobile robots in the current study were guided from the beginning point to the objective position in a crowded environment. Utilizing a hybrid Neuro-IWO technique, analysis has been learned in the suggested technique. The inputs to the hybrid Neuro-IWO techniques are the distance to the obstacle from the front, the distance to the right, the distance to the left, and the angle of the target. The neural network method produces the interim steering angle, whereas the hybrid Neuro-IWO method produces the final steering angle. There are numerous graphical and tabular theoretical and experimental confirmations offered. When comparing experimental and simulation data, it has been noticed that the variation is found to be less than 6%.

REFERENCES

1. Kim, Y. H., & Kim, J. H. (2009, May). Multiobjective quantum-inspired evolutionary algorithm for fuzzy path planning of mobile robot. In Evolutionary Computation, 2009. CEC'09. IEEE Congress on (pp. 1185-1192). IEEE.
2. Juidette, H., & Youlal, H. (2000). Fuzzy dynamic path planning using genetic algorithms. Electronics Letters, 36(4), 374-376.
3. Kala, R., Shukla, A., & Tiwari, R. (2010). Fusion of probabilistic A* algorithm and fuzzy inference system for robotic path planning. Artificial Intelligence Review, 33(4), 307-327.
4. Surmann, H., Huser, J., & Wehking, J. (1996, September). Path planning far a fuzzy controlled autonomous mobile robot. In Fuzzy Systems, 1996., Proceedings of the Fifth IEEE International Conference on

(Vol. 3, pp. 1660-1665). IEEE.
5. Motamedinejad, M. B., Barzamini, R., Jouzdani, J., & Khosravi, A. (2006, December). A new fuzzy path planning for multiple robots. In Information and Automation, 2006. ICIA 2006. International Conference on (pp. 295-300). IEEE.
6. Pandey, A., Sonkar, R. K., Pandey, K. K., & Parhi, D. R. (2014, January). Path planning navigation of mobile robot with obstacles avoidance using fuzzy logic controller. In Intelligent Systems and Control (ISCO), 2014 IEEE 8th International Conference on (pp. 39-41). IEEE.
7. Saboori, I., Menhaj, M. B., & Karimi, B. (2006, November). Optimal robot path planning based on fuzzy model of obstacles. In IEEE Industrial Electronics, IECON 2006-32nd Annual Conference on (pp. 383-387). IEEE.
8. Jiang, M., Yu, Y., Liu, X., Zhang, F., & Hong, Q. (2012, July). Fuzzy neural network based dynamic path planning. In Machine Learning and Cybernetics (ICMLC), 2012 International Conference on (Vol. 1, pp. 326-330). IEEE.
9. Safiotti, A. (1997, July). Fuzzy logic in autonomous robotics: behavior coordination. In Fuzzy Systems, 1997., Proceedings of the Sixth IEEE International Conference on (Vol. 1, pp. 573-578). IEEE.
10. Shibata, T., & Fukuda, T. (1993, May). Coordinative behavior by genetic algorithm and fuzzy in evolutionary multi-agent system. In Robotics and Automation, 1993. Proceedings., 1993 IEEE International Conference on (pp. 760-765). IEEE.
11. Kundu, S., & Parhi, D. R. (2010, December). Fuzzy based reactive navigational strategy for mobile agent. In Industrial Electronics, Control & Robotics (IECR), 2010 International Conference on (pp. 12-17). IEEE.
12. Pradhan, S. K., Parhi, D. R., & Panda, A. K. (2006). Navigation technique to control several mobile robots. International Journal of Knowledge-based and Intelligent Engineering Systems, 10(5), 387-401.
13. Pradhan, S. K., Parhi, D. R., & Panda, A. K. (2009). Motion control and navigation of multiple mobile robots for obstacle avoidance and target seeking: a rule-based neuro-fuzzy technique. Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering, 223(2), 275-288.
14. Mohanty, P. K., & Parhi, D. R. (2014). A new efficient optimal path planner for mobile robot based on Invasive Weed Optimization algorithm. Frontiers of Mechanical Engineering, 9(4), 317-330.
15. Deepak, B. B. V. L., Parhi, D. R., & Jha, A. K. (2011). Kinematic Model of Wheeled Mobile Robots. Int. J. on Recent Trends in Engineering & Technology, 5(04).
16. Das, H. C., & Parhi, D. R. (2008). Online fuzzy logic crack detection of a cantilever beam. International Journal of Knowledge-based and Intelligent Engineering Systems, 12(2), 157-171.
17. Sutar, M. K., & Parhi, D. R. K. (2010). Smart detection of damage in a cracked cantilever beam using artificial intelligence. Noise & Vibration Worldwide, 41(5), 26-36.
18. Parhi, D. R., Deepak, B. B. V. L., Nayak, D., & Amrit, A. (2012). Forward and Inverse Kinematic Models for an Articulated Robotic Manipulator. International Journal of Artificial Intelligence and Computational Research, 4(2), 103-109.
19. Parhi, D. R., & Behera, A. K. (2000). Vibrational analysis of cracked rotor in viscous medium. Journal of Vibration and Control, 6(3), 331-349.
20. da Silva, A. M. L., Rezende, L. S., da Fonseca Manso, L. A., & de Resende, L. C. (2010). Reliability worth applied to transmission expansion planning based on ant colony system. International Journal of Electrical Power & Energy Systems, 32(10), 1077-1084.
21. Kumar, P. B., Sahu, C., & Parhi, D. R. (2018). A Hybridized Regression-Adaptive Ant Colony Optimization Approach for Navigation of Humanoids in a Cluttered Environment. Applied Soft Computing, Volume 68, July 2018,565-585..
22. Parhi, D. R., & Pothal, J. K. (2011). Intelligent navigation of multiple mobile robotsusing an ant colony optimization techniquein a highly cluttered environment. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 225(1), 225-232.
23. Garcia, M. P., Montiel, O., Castillo, O., Sepúlveda, R., & Melin, P. (2009). Path planning for autonomous mobile robot navigation with ant colony optimization and fuzzy cost function evaluation. Applied Soft Computing, 9(3), 1102-1110.
24. Parhi, D. R., & Kundu, S. (2012). Review on Guidance, Control and Navigation of Autonomous UnderwaterMobile Robot. International Journal of Artificial Intelligence and Computational Research (IJAICR), 4(1).
25. Lee, J. W., Kim, J. J., & Lee, J. J. (2009, July). Improved ant colony optimization algorithm by path crossover for optimal path planning. In Industrial Electronics, 2009. ISIE 2009. IEEE International Symposium on (pp. 1996-2000). IEEE.
26. Mohanty, P. K., & Parhi, D. R. (2014). Navigation of autonomous mobile robot using adaptive neuro-fuzzy controller. In Intelligent Computing, Networking, and Informatics (pp. 521-530). Springer, New Delhi.
27. Panigrahi, P. K., Ghosh, S., & Parhi, D. R. (2014). Intelligent Leaning and Control of Autonomous Mobile Robot using MLP and RBF based Neural Network in Clustered Environment. International Journal of

Scientific and Engineering Research, 5(6), 313-316.
28. Dorigo, M., & Birattari, M. (2011). Ant colony optimization. In Encyclopedia of machine learning (pp. 36- 39). Springer, Boston, MA.
29. Parhi, D. R., & Sahu, S. (2017). Clonal fuzzy intelligent system for fault diagnosis of cracked beam. International Journal of Damage Mechanics, 1056789517708019.
30. Patle, B. K., Parhi, D. R., Jagadeesh, A. & Kashyap, S. K. (2017). On firefly algorithm: optimization and application in mobile robot navigation. World Journal of Engineering, 14(1), 65-76.
31. Welch, S. M., Roe, J. L., & Dong, Z. (2003). A Genetic Neural Network Model of Flowering Time Control in Arabidopsis thaliana Contrib. no. 01-290-J from the Kansas Agric. Exp. Stn.(KAES), Kansas State Univ. This project was supported in part by KAES Project 0507 at Kansas State Univ. A common situation in genomics is to know that a group of genes may form a path but not be able to tell the order in which they fall. For example, one might be uncertain as to whether a portion of the photoperiod pathway runs PHYB→ GI→ CO, as in the Simpson et al Agronomy Journal, 95(1), 71-81.
32. Parhi, D. R., & Mohanta, J. C. (2011). Navigational control of several mobile robotic agents using Petri- potential-fuzzy hybrid controller. Applied Soft Computing, 11(4), 3546-3557.
33. Parhi, D. R., & Singh, M. K. (2010). Navigational path analysis of mobile robots using an adaptive neuro- fuzzy inference system controller in a dynamic environment. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 224(6), 1369-1381.
34. Parhi, D. R., & Choudhury, S. (2011). Intelligent Fault Detection of a Cracked Cantilever Beam Using Fuzzy Logic Technology with Hybrid Membership Functions. International Journal of Artificial Intelligence and Computational Research, 3(1), 9-16.
35. Deepak, B. B. V. L., Parhi, D. R., & Praksh, R. (2016). Kinematic Control of a Mobile Manipulator. In Proceedings of the International Conference on Signal, Networks, Computing, and Systems (pp. 339-346). Springer India.
36. Chen, C. P., & Ahmed, F. (1993, March). Polynomial-neural-network-based mobile robot path planning. In Applications of Artificial Intelligence 1993: Machine Vision and Robotics (Vol. 1964, pp. 320-327). International Society for Optics and Photonics.
37. Parhi, D. R. (2005). Navigation of mobile robots using a fuzzy logic controller. Journal of Intelligent & Robotic Systems, 42(3), 253-273.
38. Sahu, S., Kumar, P. B., & Parhi, D. R. (2017). Design and development of 3-stage determination of damage location using Mamdani-adaptive genetic-Sugeno model. Journal of Theoretical and Applied Mechanics, 55(4), 1325-1339.
39. Parhi, D. R., & Agarwalla, D. K., (2012), "Diagnosis of Damaged Al Cantilever Beam Subjected to Free Vibration by Numerical and Experimental Method", I J A I C R, 4(2), pp. 71-77.
40. Deepak, B. B. V. L., & Parhi, D. R. (2016). Control of an automated mobile manipulator using artificial immune system. Journal of Experimental & Theoretical Artificial Intelligence, 28(1-2), 417-439.
41. Ling, S. H., Leung, F. H. F., Lam, H. K., Lee, Y. S., & Tam, P. K. S. (2003). A novel genetic-algorithm- based neural network for short-term load forecasting. IEEE Transactions on Industrial Electronics, 50(4), 793-799.
42. Mohanty, S., Parhi D.R., & Das, S.S. (2018).Control Strategy of a Real Mobile Robot Using Singleton Takagi Sugeno Fuzzy Inference Methodology within the Frame Work of Artificial Intelligence Techniques,Emerging Trends in Engineering, Science and Manufacturing (ETESM-2018),IGIT Sarang, India.
43. Mohanty, P. K., & Parhi, D. R. (2014). Path planning strategy for mobile robot navigation using MANFIS controller. In Proceedings of the International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA) 2013 (pp. 353-361). Springer, Cham.
44. Pandey, A., Pandey, S., & Parhi, D. R. (2017). Mobile Robot Navigation and Obstacle Avoidance Techniques: A Review. Int Rob Auto J, 2(3), 00022.
45. Lee, S., & Kardaras, G. (1997, July). Elastic string based global path planning using neural networks. In Computational Intelligence in Robotics and Automation, 1997. CIRA'97., Proceedings., 1997 IEEE International Symposium on (pp. 108-114). IEEE.
46. Jena, S. P., & Parhi, D. R. (2014). Dynamic Deflection of a Cantilever Beam Carrying Moving Mass. In Applied Mechanics and Materials (Vol. 592, pp. 1040-1044). Trans Tech Publications.
47. Deepak, B. B. V. L., Parhi, D. R., & Kundu, S. (2012). Innate immune based path planner of an autonomous mobile robot. Procedia Engineering, 38, 2663-2671.
48. Parhi, D. R. (2018). Advancement in navigational path planning of robots using various artificial and computing techniques. Int Rob Auto J, 4(2), 133-136..
49. Das, P. K., Pradhan, S. K., Patro, S. N., & Balabantaray, B. K. (2012). Artificial immune system based path planning of mobile robot. In Soft Computing Techniques in Vision Science(pp. 195-207). Springer, Berlin, Heidelberg.

50. Jena, S. P., & Parhi, D. R. (2017). Response analysis of cracked structure subjected to transit mass-a parametric study. Journal of Vibroengineering, 19(5).
51. Parhi, D. R. K., & Dash, A. K. (2010). Faults detection by finite element analysis of a multi cracked beam using vibration signatures. International Journal of Vehicle Noise and Vibration, 6(1), 40-54.
52. Ülker, E., Turanalp, M. E., & Halkaci, H. S. (2009). An artificial immune system approach to CNC tool path generation. Journal of Intelligent Manufacturing, 20(1), 67-77.
53. Parhi, D. R., Behera, A. K., & Behera, R. K. (1995). Dynamic characteristics of cantilever beam with transverse crack. Aeronautical Society of India, Journal, 47(3), 131-144.
54. Jena, P. C., Parhi, D. R., Pohit, G., & Samal, B. P. (2015). Crack Assessment by FEM of AMMC Beam Produced by Modified Stir Casting Method. Materials Today: Proceedings, 2(4-5), 2267-2276.
55. Deepak, B. B. V. L., & Parhi, A. K. J. D. R. Path Planning of an Autonomous Mobile Robot Using Artificial Immune System.
56. Pandey, A., Kumar, S., Pandey, K. K., & Parhi, D. R. (2016). Mobile robot navigation in unknown static environments using ANFIS controller. Perspectives in Science, 8, 421-423.
57. Hu, X., & Xu, Q. (2007, December). Robot path planning based on artificial immune network. In Robotics and Biomimetics, 2007. ROBIO 2007. IEEE International Conference on (pp. 1053-1057). IEEE.
58. Sahu, S., & Parhi, D. R. (2014). Automatic Design of Fuzzy Rules Using GA for Fault Detection in Cracked Structures. In Applied Mechanics and Materials (Vol. 592, pp. 2016-2020). Trans Tech Publications.
59. Bhaduri, A. (2009, December). A mobile robot path planning using genetic artificial immune network algorithm. In Nature & Biologically Inspired Computing, 2009. NaBIC 2009. World Congress on (pp. 1536- 1539). IEEE.
60. Behera, R. K., Parhi, D. R. K., Pradhan, S. K., & Kumar, S. N. Vibration Analysis Of Cantilever Shaft With Transverse Cracks.
61. Chhotray, A., Pradhan, M. K., Pandey, K. K., & Parhi, D. R. (2016). Kinematic Analysis of a Two-Wheeled Self-Balancing Mobile Robot. In Proceedings of the International Conference on Signal, Networks, Computing, and Systems (pp. 87-93). Springer India.
62. Deepak, B. B. V. L., Parhi, D. R., & Kundu, S. (2012). Innate immune based path planner of an autonomous mobile robot. Procedia Engineering, 38, 2663-2671.
63. Ammar, H. H., Ngan, P., Crout, R. J., Mucino, V. H., & Mukdadi, O. M. (2011). Three-dimensional modeling and finite element analysis in treatment planning for orthodontic tooth movement. American Journal of Orthodontics and Dentofacial Orthopedics, 139(1), e59-e71.
64. Parhi, D. R., Deepak, B. B. V. L., Mohana, J., Ruppa, R., & Nayak, M. (2012). Immunised Navigational Controller for Mobile Robot Navigation.
65. Singh, M. K., Parhi, D. R., & Pothal, J. K. (2009, October). ANFIS approach for navigation of mobile robots. In Advances in Recent Technologies in Communication and Computing, 2009. ARTCom'09. International Conference on (pp. 727-731). IEEE.
66. Dash, A. K., & Parhi, D. R. (2012). Development of a Vibration-Based Crack Diagnostic Application Using the MANFIS Technique. International Journal of Acoustics & Vibration, 17(2).
67. Zhang, Y., & Chou, Y. K. (2006). Three-dimensional finite element analysis simulations of the fused deposition modelling process. Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 220(10), 1663-1671.
68. Yadao, A. R., & Parhi, D. R. (2016). The influence of crack in cantilever rotor system with viscous medium. International Journal of Dynamics and Control, 4(4), 363-375.
69. Khan, I. A., & Parhi, D. R. (2015). Fault detection of composite beam by using the modal parameters and RBFNN technique. Journal of Mechanical Science and Technology, 29(4), 1637-1648.
70. Loboa, E. G., Fang, T. D., Parker, D. W., Warren, S. M., Fong, K. D., Longaker, M. T., & Carter, D. R. (2005). Mechanobiology of mandibular distraction osteogenesis: finite element analyses with a rat model. Journal of orthopaedic research, 23(3), 663-670.
71. Das, H. C., & Parhi, D. R. (2010). Identification of crack location and intensity in a cracked beam by fuzzy reasoning. International journal of intelligent systems technologies and applications, 9(1), 75-95.
72. Nanda, J., & Parhi, D. R. (2013). Theoretical analysis of the shaft. Advances in Fuzzy Systems, 2013, 8.
73. Jena, P. C., Parhi, D. R., & Pohit, G. (2016). Dynamic Study of Composite Cracked Beam by Changing the Angle of Bidirectional Fibres. Iranian Journal of Science and Technology, Transactions A: Science, 40(1), 27-37.
74. Jiang, C. P., Huang, Y. M., & Liu, C. H. (2006). Dynamic finite element analysis of photopolymerization in stereolithography. Rapid Prototyping Journal, 12(3), 173-180.
75. Kundu, S., & Parhi, D. R. (2015). Navigational Analysis for Underwater Mobile Robot based on

Multiple ANFIS Approach. Journal of Advances in Mechanical Engineering and Science, 1(1), 46-56.
76. Parhi, D. R., & Behera, A. K. (1997). Dynamic deflection of a cracked beam with moving mass. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 211(1), 77-87.
77. Tuncer, A., & Yildirim, M. (2012). Dynamic path planning of mobile robots with improved genetic algorithm. Computers & Electrical Engineering, 38(6), 1564-1572.
78. Jena, S. P., & Parhi, D. R. (2017). Parametric Study on the Response of Cracked Structure Subjected to Moving Mass. JOURNAL OF VIBRATION ENGINEERING & TECHNOLOGIES, 5(1), 11-19.
79. Sethi, R., Parhi, D. R. K., & Senapati, S. K., (2016) "FAULT DETECTION OF CRACKED BEAMS LIKE STRUCTURE USING ARTIFICIAL NEURAL NETWORK (ANN) APPROACH", International Journal of Research in Engineering and Technology, 5(13), 1-4.
80. Tsai, C. C., Huang, H. C., & Chan, C. K. (2011). Parallel elite genetic algorithm and its application to global path planning for autonomous robot navigation. IEEE Transactions on Industrial Electronics, 58(10), 4813-4821.
81. Mohanty, J. R., Verma, B. B., Ray, P. K., & Parhi, D. K. (2009). Application of artificial neural network for fatigue life prediction under interspersed mode-I spike overload. Journal of Testing and Evaluation, 38(2), 177-187.
82. Mohanty, P. K., & Parhi, D. R. (2013). Controlling the motion of an autonomous mobile robot using various techniques: a review. Journal of Advance Mechanical Engineering, 1(1), 24-39.
83. Parhi, D. R., & Deepak, B. B. V. L. (2011). Kinematic model of three wheeled mobile robot. Journal of Mechanical Engineering Research, 3(9), 307-318.
84. Ito, T. (1999). A genetic algorithm approach to piping route path planning. Journal of Intelligent Manufacturing, 10(1), 103-114.
85. D. R. Parhi and Alok Kumar Jha,(2012) "Review and Analysis of Different Methodologies Used in Mobile Robot Navigation", IJAAIES, 4(1), pp. 1-18.
86. Jena, S. P., & Parhi, D. R. (2016). Response of Damaged Structure to High Speed Mass. Procedia Engineering, 144, 1435-1442.
87. Shubhasri, K., & Parhi, D. R. (2015). Navigation based on adaptive shuffled frog-leaping algorithm for underwater mobile robot. In Intelligent Computing, Communication and Devices (pp. 651-659). Springer, New Delhi.
88. Parhi, D. R., & Agarwalla, D. K., (2012) "DETERMINATION OF MODIFIED NATURAL FREQUENCIES OF FRACTURED FIXED-FIXED BEAM BY NUMERICAL & EXPERIMENTAL METHOD", I J A A I E S, 4(2), 95-101.
89. Tian, L., & Collins, C. (2004). An effective robot trajectory planning method using a genetic algorithm. Mechatronics, 14(5), 455-470.
90. Khan, I. A., Yadao, A., Parhi, D. R., Ghazaly, N. M., El-Sharkawy, M., & Ahmed, I. (2014). Fault Diagnosis of Cracked Cantilever Composite Beam by Vibration Measurement and RBFNN. Journal of Mechanical Design, 1(1), 1-4.
91. Parhi, D. R., & Choudhury, S. (2011). Analysis of smart crack detection methodologies in various structures. Journal of Engineering and Technology Research, 3(5), 139-147.
92. Jena, P. K., Thatoi, D. N., & Parhi, D. R. (2015). Dynamically Self-Adaptive Fuzzy PSO Technique for Smart Diagnosis of Transverse Crack. Applied Artificial Intelligence, 29(3), 211-232.
93. Kundu, S., Parhi, R., & Deepak, B. B. V. L. (2012). Fuzzy-neuro based navigational strategy for mobile robot. International Journal of Scientific & Engineering Research, 3(6), 1-6.
94. Parhi, D. R., Dash, A. K., & Das, H. C. (2011). Formulation of a genetic algorithm based methodology for multiple crack detection in a beam structure. Australian Journal of Structural Engineering, 12(2), 127-139.
95. Tsai, C. C., Chan, C. K., Shih, S. C., & Lin, S. C. (2008, October). Adaptive nonlinear control using RBFNN for an electric unicycle. In Systems, Man and Cybernetics, 2008. SMC 2008. IEEE International Conference on (pp. 2343-2348). IEEE.
96. Dash, A. K., & Parhi, D. R. (2011). Development of an inverse methodology for crack diagnosis using AI technique. International Journal of Computational Materials Science and Surface Engineering, 4(2), 143- 167.
97. Kundu, S., Mishra, M., & Parhi, D. R. (2014, December). Autonomous navigation of underwater mobile robot based on harmony search optimization. In Power Electronics, Drives and Energy Systems (PEDES), 2014 IEEE International Conference on (pp. 1-6). IEEE.
98. Parhi, D. R. (2008). Neuro-Fuzzy Navigation Technique for Control of Mobile Robots. In Motion Planning. InTech.
99. Lee, C. T., & Tsai, C. C. (2010). Improved nonlinear trajectory tracking using RBFNN for a robotic helicopter. International Journal of Robust and Nonlinear Control, 20(10), 1079-1096.
100. Jena, S. P., Parhi, D. R., & Jena, P. C. Dynamic Response of Damaged Cantilever Beam Subjected to

Traversing Mass.
101. Dash, A. K., & Parhi, D. R. (2012). A vibration based inverse hybrid intelligent method for structural health monitoring. International Journal of Mechanical and Materials Engineering, 6(2).
102. Parhi, D. R., & Singh, M. K. (2009). Navigational strategies of mobile robots: a review. International Journal of Automation and Control, 3(2-3), 114-134.
103. {11} Parhi, D. R., Pradhan, S. K., Panda, A. K., & Behera, R. K. (2009). The stable and precise motion control for multiple mobile robots. Applied Soft Computing, 9(2), 477-487.
104. Singh, A., Sahoo, C., & Parhi, D. R. (2015, January). Design of a planar cable driven parallel robot using the concept of Capacity Margin Index. In Intelligent Systems and Control (ISCO), 2015 IEEE 9th International Conference on (pp. 1-7). IEEE.
105. Yang, S. X., & Meng, M. (2000). An efficient neural network approach to dynamic robot motion planning. Neural Networks, 13(2), 143-148.
106. Deepak, B. B. V. L., & Parhi, D. (2012). PSO based path planner of an autonomous mobile robot. Open Computer Science, 2(2), 152-168.
107. {130} Jena, P. C., Pohit, G., & Parhi, D. R. (2017). Fault Measurement in Composite Structure by Fuzzy- Neuro Hybrid Technique from the Natural Frequency and Fibre Orientation. JOURNAL OF VIBRATION ENGINEERING & TECHNOLOGIES, 5(2), 123-136.
108. Fierro, R., & Lewis, F. L. (1998). Control of a nonholonomic mobile robot using neural networks. IEEE Transactions on neural networks, 9(4), 589-600.
109. Behera, R. K., Parhi, D. R. K., & Sahu, S. K. (2006). Vibration analysis of a cracked rotor surrounded by viscous liquid. Journal of Vibration and Control, 12(5), 465-494.
110. Singh, M. K., & Parhi, D. R. (2011). Path optimisation of a mobile robot using an artificial neural network controller. International Journal of Systems Science, 42(1), 107-120.
111. Pradhan, S. K., Parhi, D. R., & Panda, A. K. (2006). Neuro-fuzzy technique for navigation of multiple mobile robots. Fuzzy Optimization and Decision Making, 5(3), 255-288.
112. Mohanty, P. K., & Parhi, D. R. (2015). A new hybrid optimization algorithm for multiple mobile robots navigation based on the CS-ANFIS approach. Memetic Computing, 7(4), 255-273.
113. Pandey, A., & Parhi, D. R. (2017). Optimum path planning of mobile robot in unknown static and dynamic environments using Fuzzy-Wind Driven Optimization algorithm. Defence Technology, 13(1), 47-58.
114. Yang, S. X., & Meng, M. (2000). Real-time collision-free path planning of robot manipulators using neural network approaches. Autonomous Robots, 9(1), 27-39.
115. Sethi, R., Senapati, S. K., & Parhi, D. R. K. (2014). Analysis of Crack in Structures Using Finite Element Method. Analysis, 2(2).
116. Pandey, K. K., Pol, M. S., & Parhi, D. R. Using an AI Technique Navigation and Path Planning for Mobile Robot on Webots Platform.
117. Agarwalla, D. K., & Parhi, D. R. (2013). Effect of crack on modal parameters of a cantilever beam subjected to vibration. Procedia Engineering, 51, 665-669.
118. Mohanty, P. K., & Parhi, D. R. (2015). A new hybrid intelligent path planner for mobile robot navigation based on adaptive neuro-fuzzy inference system. Australian Journal of Mechanical Engineering, 13(3), 195- 207.
119. Xin, D., Hua-hua, C., & Wei-kang, G. (2005). Neural network and genetic algorithm based global path planning in a static environment. Journal of Zhejiang University-Science A, 6(6), 549-554.
120. Panigrahi, P. K., Ghosh, S., & Parhi, D. R. (2015). Navigation of autonomous mobile robot using different activation functions of wavelet neural network. Archives of Control Sciences, 25(1), 21-34.
121. Deepak, B. B. V. L., Parhi, D. R., & Amrit, A. (2012). Inverse Kinematic Models for Mobile Manipulators. Caspian Journal of Applied Sciences Research, 1(13), 322,151-158.
122. Das, H. C., & Parhi, D. R. (2009, December). Application of neural network for fault diagnosis of cracked cantilever beam. In Nature & Biologically Inspired Computing, 2009. NaBIC 2009. World Congress on (pp. 1303-1308). IEEE.
123. Behera, R. K., Pandey, A., & Parhi, D. R. (2014). Numerical and experimental verification of a method for prognosis of inclined edge crack in cantilever beam based on synthesis of mode shapes. Procedia Technology, 14, 67-74.
124. Hui, N. B., Mahendar, V., & Pratihar, D. K. (2006). Time-optimal, collision-free navigation of a car-like mobile robot using neuro-fuzzy approaches. Fuzzy Sets and systems, 157(16), 2171-2204.
125. Rath, A. K., Parhi, D. R., Das, H. C., Muni, M. K., & Kumar, P. B. (2018). Analysis and use of fuzzy intelligent technique for navigation of humanoid robot in obstacle prone zone. Defence Technology.
126. Mohanty, J. R., Verma, B. B., Ray, P. K., & Parhi, D. R. K. (2010). Prediction of mode-I overload-induced fatigue crack growth rates using neuro-fuzzy approach. Expert systems with Applications, 37(4), 3075-3087.
127. Bhowmik, S., Subudhi, B., & Parhi, D. R. K. (2007). Coordinated Motion Control of a Mobile

Manipulator.
128. Parhi, D. R., & Kundu, S. (2011). A Hybrid Fuzzy Controller for Navigation of Real Mobile Robot. International Journal of Applied Artificial Intelligence in Engineering System, 3(1).
129. Mohanty, P. K., Pandey, K. K., & Parhi, D. R. (2014). MANFIS Approach for Path Planning and Obstacle Avoidance for Mobile Robot Navigation. In ICT and Critical Infrastructure: Proceedings of the 48th Annual Convention of Computer Society of India-Vol I (pp. 361-370). Springer, Cham.
130. Kumar, P. B., & Parhi, D. R. (2017). Vibrational Characterization of a Human Femur Bone and its Significance in the Designing of Artificial Implants. World Journal of Engineering, 14(3), 222-226.
131. Parhi, D. R., & Khan, I. A. "FAULT DETECTION IN VARIOUS STRUCTURES USING DIFFERENT METHODOLOGIES: A REVIEW," 4(1), 59-61.
132. {193} Agarwalla, D. K., & Parhi, D. R. Diagnosis of Modal Characteristics of Aircraft Wing Model subjected to Irregularities. ijB, 3, 1.
133. Parhi, D. R., Behera, A. K., & Sahoo, P. K. (1997). Dynamic Response of Beams with a Moving Mass. JOURNAL-AERONAUTICAL SOCIETY OF INDIA, 49, 69-75.
134. Mohanta, J. C., Parhi, D. R., Mohanty, S. R., & Keshari, A. (2018). A Control Scheme for Navigation and Obstacle Avoidance of Autonomous Flying Agent. Arabian Journal for Science and Engineering, 43(3), 1395-1407.
135. Kashyap, S. K., Parhi, D. R., & Sinha, A. (2009). ARTIFICIAL NEURAL NETWORK-A TOOL FOR OPTIMISING MINING PARAMETERS Paper No. 377. In Proceedings of the ISRM-Sponsored International Symposium on Rock Mechanics:" Rock Characterisation, Modelling and Engineering Design Methods"(SINOROCK2009).
136. Hamad, A. H., & Ibrahim, F. B. (2010). Path Planning of Mobile Robot Based on Modification of Vector Field Histogram using Neuro-Fuzzy Algorithm. Int. J. Adv. Comp. Techn., 2(3), 129-138.
137. Das, S.S.,Parhi D.R., & Mohanty, S.(2018).Insight of a Six Layered Neural Network along with other AI Techniques for Path Planning Strategy of a Robot, Emerging Trends in Engineering, Science and Manufacturing (ETESM-2018),IGIT Sarang, India.
138. Deepak, B. B. V. L., & Parhi, D. R. (2013, December). Target seeking behaviour of an intelligent mobile robot using advanced particle swarm optimization. In Control, Automation, Robotics and Embedded Systems (CARE), 2013 International Conference on (pp. 1-6). IEEE.
139. Pradhan, S. K., Parhi, D. R., Panda, A. K., & Behera, R. K. (2006). Potential field method to navigate several mobile robots. Applied Intelligence, 25(3), 321-333.
140. Singh, M. K., Parhi, D. R., Bhowmik, S., & Kashyap, S. K. (2008, October). Intelligent controller for mobile robot: Fuzzy logic approach. In The 12th International Conference of International Association for Computer Methods and Advances in Geomechanics (IACMAG) (pp. 1-6).
141. Thatoi, D. N., Nanda, J., Das, H. C., & Parhi, D. R. (2012). Analysis of the dynamic response of a cracked beam structure. In Applied Mechanics and Materials (Vol. 187, pp. 58-62). Trans Tech Publications.
142. Choudhury, S., Sahu, S., & Parhi, D. R. (2011, July). Vibration Analysis of Cracked Beam Using Genetic Controller. In Process Automation, Control and Computing (PACC), 2011 International Conference on (pp. 1-4). IEEE.
143. Kundu, S., & Parhi, D. R. (2016). Navigation of underwater robot based on dynamically adaptive harmony search algorithm. Memetic Computing, 8(2), 125-146.
144. Ng, K. C., & Trivedi, M. M. (1998). A neuro-fuzzy controller for mobile robot navigation and multirobot convoying. IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics), 28(6), 829-840.
145. Ghosh, S., Kumar, P. P., & Parhi, D. R. (2016). Performance comparison of novel WNN approach with RBFNN in navigation of autonomous mobile robotic agent. Serbian Journal of Electrical Engineering, 13(2), 239-263.
146. Patle, B. K., Parhi, D. R. K., Jagadeesh, A., & Kashyap, S. K. (2017). Matrix-Binary Codes based Genetic Algorithm for path planning of mobile robot. Computers & Electrical Engineering, pp. 1-22.
147. Thatoi, D. N., Das, H. C., & Parhi, D. R. (2012). Review of techniques for fault diagnosis in damaged structure and engineering system. Advances in Mechanical Engineering, 4, 327569,1-11.
148. Agarwalla, D. K., Parhi, D. R., & Baliarsingh, A. Investigation of Dynamic Characteristics in Cracked Structures subjected to Vibration.
149. Mbede, J. B., Huang, X., & Wang, M. (2003). Robust neuro-fuzzy sensor-based motion control among dynamic obstacles for robot manipulators. IEEE Transactions on Fuzzy Systems, 11(2), 249-261.
150. Mohanta, J. C., Parhi, D. R., & Patel, S. K. (2011). Path planning strategy for autonomous mobile robot navigation using Petri-GA optimisation. Computers & Electrical Engineering, 37(6), 1058-1070.
151. Behera, R. K., & Parhi, D. R. (2014). Validation of Results Obtained from Different Types of Fuzzy Controllers for Diagnosis of Inclined Edge Crack in Cantilever Beam by Vibration Parameters. Journal of Mechanical Design and Vibration, 2(3), 63-68.

152. Yadao, A. R., Singh, R. P., & Parhi, D. R. (2014). Influence of Parameters of Cracked Rotor System on its Vibration Characteristics in Viscous Medium at Finite Region. In Applied Mechanics and Materials (Vol. 592, pp. 2061-2065). Trans Tech Publications.
153. Mbede, J. B., Huang, X., & Wang, M. (2003). Robust neuro-fuzzy sensor-based motion control among dynamic obstacles for robot manipulators. IEEE Transactions on Fuzzy Systems, 11(2), 249-261.
154. Yadao, A. R., & Parhi, D. R. (2017). Dynamic Analysis of Fixed-Fixed Type Cracked Rotor in Viscous Medium. JOURNAL OF VIBRATION ENGINEERING & TECHNOLOGIES, 5(6), 535-546.
155. Parhi, D. R., Pothal, J. K., & Singh, M. K. (2009, December). Navigation of multiple mobile robots using swarm intelligence. In Nature & Biologically Inspired Computing, 2009. NaBIC 2009. World Congress on (pp. 1145-1149). IEEE.
156. Parhi, D. R., & Kundu, S. (2012). Theoretical Analysis of 6 DOF Motion for Underwater Robot. International Journal of Artificial Intelligence and Computational Research (IJAICR), 4(2).
157. Demirli, K., & Khoshnejad, M. (2009). Autonomous parallel parking of a car-like mobile robot by a neuro- fuzzy sensor-based controller. Fuzzy Sets and Systems, 160(19), 2876-2891.
158. Patle, B. K., Parhi, D., Jagadeesh, A., & Sahu, O. P. (2017). Real Time Navigation Approach for Mobile Robot. JCP, 12(2), 135-142.
159. Parhi, D. R., & Das, H. C. (2008). Smart crack detection of a beam using fuzzy logic controller. Int. J. Comput. Intell.: Theory Pract, 3(1), 9-21.
160. Pandey, A. & Parhi, D. R. (2016). Autonomous mobile robot navigation in cluttered environment using hybrid Takagi-Sugeno fuzzy model and simulated annealing algorithm controller. World Journal of Engineering, 13(5), 431-440.
161. Ge, S. S., & Cui, Y. J. (2000). New potential functions for mobile robot path planning. IEEE Transactions on robotics and automation, 16(5), 615-620.
162. Parhi, D. R. (2005). Navigation of mobile robots using a fuzzy logic controller. Journal of Intelligent & Robotic Systems, 42(3), 253-273.
163. Chouhan, A.S., Parhi, D.R.,& Chhotray, A. (2018). Control and Balancing of Two-Wheeled Mobile Robots using Sugeno Fuzzy Logic in the domain of AI Techniques, Emerging trends in Engineering, Science and Manufacturing,(ETESM - 2018), IGIT, Sarang, India
164. Kundu, S., & Parhi, D. R. (2013). Modified shuffled frog leaping algorithm based 6DOF motion for underwater mobile robot. Procedia Technology, 10, 295-303.
165. Hu, X., & Xie, C. (2007, August). Niche genetic algorithm for robot path planning. In Natural Computation, 2007. ICNC 2007. Third International Conference on (Vol. 2, pp. 774-778). IEEE.
166. Das, H. C., Dash, A. K., Parhi, D. R., & Thatoi, D. N. (2010, June). Experimental validation of numerical and fuzzy analysis of a faulty structure. In System of Systems Engineering (SoSE), 2010 5th International Conference on (pp. 1-6). IEEE.
167. Nanda, J., Das, S., & Parhi, D. R. (2014). Effect of Slenderness ratio on crack parameters of simply supported Shaft. Procedia Materials Science, 6, 1428-1435.
168. Mohanty, P. K., & Parhi, D. R. (2016). Optimal path planning for a mobile robot using cuckoo search algorithm. Journal of Experimental & Theoretical Artificial Intelligence, 28(1-2), 35-52.
169. Barraquand, J., & Latombe, J. C. (1990, May). A Monte-Carlo algorithm for path planning with many degrees of freedom. In Robotics and Automation, 1990. Proceedings., 1990 IEEE International Conference on (pp. 1712-1717). IEEE.
170. Parhi, D. R., & Behera, A. K. (2003). Vibration analysis of cantilever type cracked rotor in viscous fluid. Transactions of the Canadian Society for Mechanical Engineering, 27(3), 147-173.
171. Sahoo, B., Parhi, D.R., & Priyadarshi, B.K. (2018). Analysis of Path Planning of Humanoid Robots Using Neural Network Methods and Study of Possible Use of Other AI Techniques, Emerging trends in Engineering, Science and Manufacturing,(ETESM - 2018), IGIT, Sarang, India
172. Jena, P. C., Parhi, D. R., & Pohit, G. (2012). Faults detection of a single cracked beam by theoretical and experimental analysis using vibration signatures. IOSR Journal of Mechanical and Civil Engineering, 4(3), 01-18.
173. DENG, G. F., ZHANG, X. P., & LIU, Y. P. (2009). Ant colony optimization and particle swarm optimization for robot-path planning in obstacle environment. Control Theory & Applications, 8, 012.
174. Pandey, A.& Parhi, D. R. (2016). New algorithm for behaviour-based mobile robot navigation in cluttered environment using neural network architecture. World Journal of Engineering, 13(2), 129-141.
175. Khan, I. A., & Parhi, D. R. (2015). Damage Identification in Composite Beam by Vibration Measurement and Fuzzy Inference System. Journal of Mechanical Design and Vibration, 3(1), 8-23.
176. Jena, P. K., & Parhi, D. R. (2015). A modified particle swarm optimization technique for crack detection in Cantilever Beams. Arabian Journal for Science and Engineering, 40(11), 3263-3272.
177. Ranjan, K. B., Sahu, S., & Parhi Dayal, R. (2014). A New Reactive Hybrid Membership Function in Fuzzy Approach for Identification of Inclined Edge Crack in Cantilever Beam Using Vibration Signatures. In

Applied Mechanics and Materials (Vol. 592, pp. 1996-2000). Trans Tech Publications.
178. Shiltagh, N. A., & Jalal, L. D. (2013). Optimal path planning for intelligent mobile robot navigation using modified particle swarm optimization. International Journal of Engineering and Advanced Technology, 2(4), 260-267.
179. Jena, P. K., Thatoi, D. N., Nanda, J., & Parhi, D. R. K. (2012). Effect of damage parameters on vibration signatures of a cantilever beam. Procedia Engineering, 38, 3318-3330.
180. Kundu, S., & Parhi, D. R. (2017). Reactive navigation of underwater mobile robot using ANFIS approach in a manifold manner. International Journal of Automation and Computing, 14(3), 307-320.
181. Mohanty, P. K., Parhi, D. R., Jha, A. K., & Pandey, A. (2013, February). Path planning of an autonomous mobile robot using adaptive network based fuzzy controller. In Advance Computing Conference (IACC), 2013 IEEE 3rd International (pp. 651-656). IEEE.
182. Jena, S. P., Parhi, D. R., & Mishra, D. (2015, December). Response of Cracked Cantilever Beam Subjected to Traversing Mass. In ASME 2015 Gas Turbine India Conference (pp. V001T05A011-V001T05A011). American Society of Mechanical Engineers.
183. Curkovic, P., & Jerbic, B. (2007). Honey-bees optimization algorithm applied to path planning problem. International Journal of Simulation Modelling (IJSIMM), 6(3).
184. Parhi, D. R., & Behera, A. K. (1997). Dynamic deflection of a cracked shaft subjected to moving mass. Canadian Society for Mechanical Engineering, Transactions, 21(3), 295-316.
185. Parhi, D. R., & Das, H. C. (2008). Structural damage detection by fuzzy-gaussian technique. International Journal of Mathematics and Mechanics, 4, 39-59.
186. Panigrahi, P. K., Ghosh, S., & Parhi, D. R. (2014). Comparison of GSA, SA and PSO Based Intelligent Controllers for Path Planning of Mobile Robot in Unknown Environment. World Academy of Science, Engineering and Technology, International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering, 8(10), 1626-1635.
187. Zhu, Q., Yan, Y., & Xing, Z. (2006, October). Robot path planning based on artificial potential field approach with simulated annealing. In Intelligent Systems Design and Applications, 2006. ISDA'06. Sixth International Conference on (Vol. 2, pp. 622-627). IEEE.
188. Sahu, S., & Parhi, D. R. (2017). Performance Comparison of Genetic Algorithm and Differential Evolution Algorithm in the Field of Damage Detection in Cracked Structures. JOURNAL OF VIBRATION ENGINEERING & TECHNOLOGIES, 5(1), 61-71.
189. Sahu, S., & Parhi, D. R. (2014, May). Automatic design of fuzzy MF using Genetic Algorithm for fault detection in structural elements. In Engineering and Systems (SCES), 2014 Students Conference on (pp. 1- 5). IEEE.
190. Sethi, R., Senapati, S. K., & Parhi, D. R. (2014). Structural Damage Detection by Fuzzy Logic Technique. In Applied Mechanics and Materials (Vol. 592, pp. 1175-1179). Trans Tech Publications.
191. Ahuactzin, J. M., Talbi, E. G., Bessiere, P., & Mazer, E. (1993). Using genetic algorithms for robot motion planning. In Geometric Reasoning for Perception and Action (pp. 84-93). Springer, Berlin, Heidelberg.
192. Mohanty, J. R., Verma, B. B., Parhi, D. R. K., & Ray, P. K. (2009). Application of artificial neural network for predicting fatigue crack propagation life of aluminum alloys, 1(3), 133-138.
193. Mahapatra, S., Jha, A. K., Patle, B. K., & Parhi, D. R. K. (2012, February). Fuzzy logic control of a WMR. In Computing, Communication and Applications (ICCCA), 2012 International Conference on (pp. 1-5). IEEE.
194. Ghosh, S., Panigrahi, P. K., & Parhi, D. R. (2017). Analysis of FPA and BA meta-heuristic controllers for optimal path planning of mobile robot in cluttered environment. IET Science, Measurement & Technology, 11(7), 817-828.
195. Mohanty, P. K., & Parhi, D. R. (2014, December). A new real time path planning for mobile robot navigation using invasive weed optimization algorithm. In Proceedings of ASME 2014 gas turbine india conference, p V001T07A002.
196. Buniyamin, N., Sariff, N., Wan Ngah, W. A. J., & Mohamad, Z. (2011). Robot global path planning overview and a variation of ant colony system algorithm. International journal of mathematics and computers in simulation, 5(1), 9-16.
197. Parhi, D. R., & Deepak, B. B. V. L. (2011). Sugeno Fuzzy Based Navigational Controller of an Intelligent Mobile Robot. International Journal of Applied Artificial Intelligence in Engineering System, 3(2), 103-108.
198. Parhi, D. R., & Singh, M. K. (2008). Intelligent fuzzy interface technique for the control of an autonomous mobile robot. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 222(11), 2281-2292.
199. Parhi, D. R., & Choudhury, S. (2011). Smart crack detection of a cracked cantilever beam using fuzzy logic technology with hybrid membership functions. Journal of Engineering and Technology Research, 3(8), 270-

278.
200. Park, M. G., Jeon, J. H., & Lee, M. C. (2001). Obstacle avoidance for mobile robots using artificial potential field approach with simulated annealing. In Industrial Electronics, 2001. Proceedings. ISIE 2001. IEEE International Symposium on (Vol. 3, pp. 1530-1535). IEEE.
201. Parhi, D. R., & Mohanty, P. K. (2016). IWO-based adaptive neuro-fuzzy controller for mobile robot navigation in cluttered environments. The International Journal of Advanced Manufacturing Technology, 83(9-12), 1607-1625.
202. Parhi, D. R., & Singh, M. K. (2010). Heuristic-rule-based hybrid neural network for navigation of a mobile robot. Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 224(7), 1103-1118.
203. Parhi, D. R. K., & Das, H. (2010). Diagnosis of fault and condition monitoring of dynamic structures using the multiple adaptive-neuro-fuzzy inference system technique. Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering, 224(3), 259-270.
204. Das, H. C., & Parhi, D. R. (2009). Detection of the crack in cantilever structures using fuzzy gaussian inference technique. AIAA J, 47(1), 105-115.
205. Pandey, A., & Parhi, D. R. (2016). Multiple mobile robots navigation and obstacle avoidance using minimum rule based ANFIS network controller in the cluttered environment. Int J Adv Robot Automation, 1(1), 1-11.
206. Dash, A., & Parhi, D. (2014). Analysis of an Intelligent Hybrid System for Fault Diagnosis in Cracked Structure. Arabian Journal for Science & Engineering (Springer Science & Business Media BV), 39(2).
207. Sahu, S., Kumar, P. B., & Parhi, D. R. (2017). Intelligent hybrid fuzzy logic system for damage detection of beam-like structural elements. Journal of Theoretical and Applied Mechanics, 55(2), 509-521.
208. Pandey, K. K., Pandey, A., Chhotray, A., & Parhi, D. R. (2016). Navigation of Mobile Robot Using Type-2 FLC. In Proceedings of the International Conference on Signal, Networks, Computing, and Systems (pp. 137-145). Springer India.
209. Samadi, M., & Othman, M. F. (2013, December). Global path planning for autonomous mobile robot using genetic algorithm. In Signal-Image Technology & Internet-Based Systems (SITIS), 2013 International Conference on (pp. 726-730). IEEE.
210. Parhi, D. R., & Jena, S. P. (2017). Dynamic and experimental analysis on response of multi-cracked structures carrying transit mass. Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability, 231(1), 25-35.
211. Mohanty, P. K., & Parhi, D. R. (2013, December). A new intelligent approach for mobile robot navigation. In International Conference on Pattern Recognition and Machine Intelligence (pp. 243-249). Springer, Berlin, Heidelberg.
212. Mohanty, J. R., Verma, B. B., Ray, P. K., & Parhi, D. R. K. (2011). Application of adaptive neuro-fuzzy inference system in modeling fatigue life under interspersed mixed-mode (I and II) spike overload. Expert Systems with Applications, 38(10), 12302-12311.
213. Parhi, D. R. (2000). Navigation of multiple mobile robots in an unknown environment (Doctoral dissertation, University of Wales. Cardiff).
214. Contreras-Cruz, M. A., Ayala-Ramirez, V., & Hernandez-Belmonte, U. H. (2015). Mobile robot path planning using artificial bee colony and evolutionary programming. Applied Soft Computing, 30, 319-328.
215. Deepak, B. B. V. L., & Parhi, D. R. (2011). Kinematic analysis of wheeled mobile robot. Automation & Systems Engineering, 5(2),96-111.
216. Parhi, D. R., & Singh, M. K. (2009). Real-time navigational control of mobile robots using an artificial neural network. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 223(7), 1713-1725.
217. Mohanty, P. K., & Parhi, D. R. (2013, December). Cuckoo search algorithm for the mobile robot navigation. In International Conference on Swarm, Evolutionary, and Memetic Computing (pp. 527-536). Springer, Cham.
218. Parhi, D. R., & Kundu, S. (2017). Navigational control of underwater mobile robot using dynamic differential evolution approach. Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment, 231(1), 284-301.
219. Shiltagh, N. A., & Jalal, L. D. (2013). Optimal path planning for intelligent mobile robot navigation using modified particle swarm optimization. International Journal of Engineering and Advanced Technology, 2(4), 260-267.
220. Kundu, S., & Dayal, R. P. (2010, December). A fuzzy approach towards behavioral strategy for navigation of mobile agent. In Emerging Trends in Robotics and Communication Technologies (INTERACT), 2010 International Conference on (pp. 292-297). IEEE.
221. Jena, S. P., Parhi, D. R., & Subbaratnam, B. (2017, December). Parametric Evaluation on the Response of Damaged Simple Supported Structure Under Transit Mass. In ASME 2017 Gas Turbine India Conference (pp.

V002T05A003-V002T05A003). American Society of Mechanical Engineers, vol. 2, pp. 1-8.
222. Mohanty, P. K., & Parhi, D. R. (2014). Navigation of autonomous mobile robot using adaptive network based fuzzy inference system. Journal of Mechanical Science and Technology, 28(7), 2861-2868.
223. Ram, A., Boone, G., Arkin, R., & Pearce, M. (1994). Using genetic algorithms to learn reactive control parameters for autonomous robotic navigation. Adaptive behavior, 2(3), 277-305.
224. Das, H. C., & Parhi, D. R. (2009). Fuzzy-neuro controler for smart fault detection of a beam. International Journal of Acoustics and Vibrations, 14(2), 70-80.
225. Jena, P. C., Parhi, D. R., & Pohit, G. (2014). Theoretical, Numerical (FEM) and Experimental Analysis of composite cracked beams of different boundary conditions using vibration mode shape curvatures. International Journal of Engineering and technology, 6, 509-518.
226. Yadao, A. R., & Parhi, D. R. (2015). Experimental and Numerical Analysis of Cracked Shaft in Viscous Medium at Finite Region. In Advances in Structural Engineering (pp. 1601-1609). Springer, New Delhi.
227. Jena, P. K., Thatoi, D. N., & Parhi, D. R. (2013). Differential evolution: an inverse approach for crack detection. Advances in Acoustics and Vibration, 2013.
228. Ghorbani, A., Shiry, S., & Nodehi, A. (2009, April). Using genetic algorithm for a mobile robot path planning. In Future Computer and Communication, 2009. ICFCC 2009. International Conference on (pp. 164-166). IEEE.

229. Parhi, D. R., & Behera, A. K. (1997). Vibration Characteristics of a Spinning Shaft in Viscous Liquid. JOURNAL-AERONAUTICAL SOCIETY OF INDIA, 49, 174-179.
230. Jena, S. P., Parhi, D. R., & Mishra, D. (2015). Comparative study on cracked beam with different types of cracks carrying moving mass. Structural Engineering and Mechanics, 56(5), 797-811.
231. Mohanty, P. K., & Parhi, D. R. (2012, December). Path Generation and Obstacle Avoidance of an Autonomous Mobile Robot Using Intelligent Hybrid Controller. In SEMCCO (pp. 240-247).
232. Liang, J. H., & Lee, C. H. (2015). Efficient collision-free path-planning of multiple mobile robots system using efficient artificial bee colony algorithm. Advances in Engineering Software, 79, 47-56.
233. Patle, B. K., Parhi, D. R., Jagadeesh, A. & Kashyap, S. K. (2016). Probabilistic fuzzy controller based robotics path decision theory. World Journal of Engineering, 13(2), 181-192.
234. Parhi, D. R., Muni, M. K., & Sahu, C. (2012). Diagnosis of Cracks in Structures Using FEA Analysis,27-42.
235. Deepak, B. B. V. L., Parhi, D. R., & Raju, B. M. V. A. (2014). Advance particle swarm optimization-based navigational controller for mobile robot. Arabian Journal for Science and Engineering, 39(8), 6477-6487.
236. Parhi, D. R., & Behera, A. K. (1998). The Study of Virtual Mass and Damping Effect on a Rotating Shaft in Viscous Medium. JOURNAL-INSTITUTION OF ENGINEERS INDIA PART MC MECHANICAL ENGINEERING DIVISION, 109-113.
237. Pandey, K. K., Mohanty, P. K., & Parhi, D. R. (2014, January). Real time navigation strategies for webots using fuzzy controller. In Intelligent Systems and Control (ISCO), 2014 IEEE 8th International Conference on (pp. 10-16). IEEE.
238. Jing, X. J. (2005). Behavior dynamics based motion planning of mobile robots in uncertain dynamic environments. Robotics and autonomous systems, 53(2), 99-123.
239. Pradhan, S. K., Parhi, D. R., & Panda, A. K. (2009). Fuzzy logic techniques for navigation of several mobile robots. Applied soft computing, 9(1), 290-304.
240. Pradhan, S. K., Parhi, D. R., & Panda, A. K. (2006). Navigation of multiple mobile robots using rule-based neuro-fuzzy technique. International Journal of Computational Intelligence, 3(2), 142-152.
241. Mohanty, P. K., & Parhi, D. R. (2012, August). Navigation of an autonomous mobile robot using intelligent hybrid technique. In Advanced Communication Control and Computing Technologies (ICACCCT), 2012 IEEE International Conference on (pp. 136-140). IEEE.
242. Loo, C. K., Rajeswari, M., Wong, E. K., & Rao, M. V. C. (2004). Mobile robot path planning using hybrid genetic algorithm and traversability vectors method. Intelligent Automation & Soft Computing, 10(1), 51-63.
243. Panigrahi, I., & Parhi, D. R. (2009, December). Dynamic analysis of Cantilever beam with transverse crack. In 14th National Conference on Machines and Mechanisms, India.
244. Parhi, D. R. K., & Kumar, D. A. (2009). Analysis of methodologies applied for diagnosis of fault in vibrating structures. International Journal of Vehicle Noise and Vibration, 5(4), 271-286.
245. Rawat, H., Parhi, D. R., Priyadarshi, B.K., Pandey, K.K.,& Behera, A.K.(2018). Analysis and Investigation of Mamdani Fuzzy for Control and Navigation of Mobile Robot and Exploration of Different AI Techniques Pertaining to Robot Navigation, Emerging trends in Engineering, Science and Manufacturing,(ETESM -2018), IGIT, Sarang, India
246. Lingelbach, F. (2004, April). Path planning using probabilistic cell decomposition. In Robotics and Automation, 2004. Proceedings. ICRA'04. 2004 IEEE International Conference on (Vol. 1, pp. 467-472). IEEE.

247. Pothal, J. K., & Parhi, D. R. (2015). Navigation of multiple mobile robots in a highly clutter terrains using adaptive neuro-fuzzy inference system. Robotics and Autonomous Systems, 72, 48-58.
248. Elappila, M., Chinara, S., & Parhi, D. R. (2018). Survivable Path Routing in WSN for IoT applications. Pervasive and Mobile Computing, 43, 49-63.
249. Mohanty, J. R., Parhi, D. R. K., Ray, P. K., & Verma, B. B. (2009). Prediction of residual fatigue life under interspersed mixed‐mode (I and II) overloads by Artificial Neural Network. Fatigue & Fracture of Engineering Materials & Structures, 32(12), 1020-1031.
250. Barraquand, J., Langlois, B., & Latombe, J. C. (1992). Numerical potential field techniques for robot path planning. IEEE transactions on systems, man, and cybernetics, 22(2), 224-241.
251. Kundu, S., & Parhi, D. R. (2010, September). Behavior-based navigation of multiple robotic agents using hybrid-fuzzy controller. In Computer and Communication Technology (ICCCT), 2010 International Conference on (pp. 706-711). IEEE.
252. Mohanty, P. K., & Parhi, D. R. (2014). A New Intelligent Motion Planning for Mobile Robot Navigation using Multiple Adaptive Neuro-Fuzzy Inference System. Applied Mathematics & Information Sciences, 8(5), 2527-2535.
253. Pandey, A., Sonkar, R. K., Pandey, K. K., & Parhi, D. R. (2014, January). Path planning navigation of mobile robot with obstacles avoidance using fuzzy logic controller. In Intelligent Systems and Control (ISCO), 2014 IEEE 8th International Conference on (pp. 39-41). IEEE.
254. Kumar, P. B., Pandey, K. K., Sahu, C., Chhotray, A., & Parhi, D. R. (2017, November). A hybridized RA- APSO approach for humanoid navigation. In Engineering (NUiCONE), 2017 Nirma University International Conference on (pp. 1-6). IEEE.
255. Deepak, B. B. V. L., & Parhi, D. (2013). Intelligent adaptive immune-based motion planner of a mobile robot in cluttered environment. Intelligent Service Robotics, 6(3), 155-162.
256. Choset, H., & Pignon, P. (1998). Coverage path planning: The boustrophedon cellular decomposition. In Field and service robotics (pp. 203-209). Springer, London.
257. Kumar, A., Kumar, P. B., & Parhi, D. R. (2018). Intelligent Navigation of Humanoids in Cluttered Environments Using Regression Analysis and Genetic Algorithm. Arabian Journal for Science and Engineering, 1-24.
258. Behera, R.K.& Parhi, D.R.(2007). Vibration analysis of a beam carrying a moving mass.ICSV14 , 9-12 July, Cairns , Australia,1-8.
259. Panigrahi, P. K., Ghosh, S., & Parhi, D. R. (2014, January). A novel intelligent mobile robot navigation technique for avoiding obstacles using RBF neural network. In Control, Instrumentation, Energy and Communication (CIEC), 2014 International Conference on (pp. 1-6). IEEE.
260. Behera, R. K., Parhi, D. R. K., & Sahu, S. K. (2006). Dynamic characteristics of a cantilever beam with transverse cracks. International journal of Acoustics and vibration, 11(1), 3-18.
261. Das, H. C., & Parhi, D. R. (2008). Modal analysis of vibrating structures impregnated with crack. International Journal of Applied Mechanics and Engineering, 13(3), 639-652.
262. Choiu, R. C. H., Kaufman, A. E., Liang, Z., Hong, L., & Achniotou, M. (1999). An interactive fly-path planning using potential fields and cell decomposition for virtual endoscopy. IEEE Transactions on Nuclear Science, 46(4), 1045-1049.
263. Agarwalla, D. K., & Parhi, D. R. Analysis of Vibrating Steel Structures Subjected to Various Damage Attributes.
264. Parhi, D. R., & Sonkar, R. K. (2012). Different Methodologiesof a Navigation of Autonomous Mobile Robot for Unknown Environment.
265. Pandey, A., & Parhi, D. R. (2014). MATLAB Simulation for Mobile Robot Navigation with Hurdles in Cluttered Environment Using Minimum Rule Based Fuzzy Logic Controller. Procedia Technology, 14, 28- 34.
266. Eliot, E., BBVL, D., & Parhi, D. R. (2012). Design & kinematic analysis of an articulated robotic manipulator.
267. Lingelbach, F. (2004). Path planning for mobile manipulation using probabilistic cell decomposition. In Intelligent Robots and Systems, 2004.(IROS 2004). Proceedings. 2004 IEEE/RSJ International Conference on (Vol. 3, pp. 2807-2812). IEEE.
268. Parhi, D. R., & Dash, A. K. (2011). Application of neural network and finite element for condition monitoring of structures. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 225(6), 1329-1339.
269. Pham, D. T., & Parhi, D. R. (2003). Navigation of multiple mobile robots using a neural network and a Petri Net model. Robotica, 21(1), 79-93.
270. Khan, I. A., & Parhi, D. R. (2013). Finite element analysis of double cracked beam and its experimental validation. Procedia Engineering, 51, 703-708.
271. Parhi, D. R., & Kundu, S. (2017). Navigational strategy for underwater mobile robot based on adaptive neuro-fuzzy inference system model embedded with shuffled frog leaping algorithm–based hybrid learning approach.

Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment, 231(4), 844-862.

272. Scheurer, C., & Zimmermann, U. E. (2011, May). Path planning method for palletizing tasks using workspace cell decomposition. In Robotics and Automation (ICRA), 2011 IEEE International Conference on (pp. 1-4). IEEE.

273. Kashyap, S. K., Parhi, D. R. K., Sinha, A., Singh, M. K., & Singh, B. K. (2008, October). Optimization of Mine Support Parameters Using Neural Network Approach. In Proceedings of the 12th International Conference on Computer Methods and Advances in Geomechanics (p. 1770).

274. Parhi, D. R., & Yadao, A. R. (2016). Analysis of dynamic behavior of multi-cracked cantilever rotor in viscous medium. Proceedings of the Institution of Mechanical Engineers, Part K: Journal of Multi-body Dynamics, 230(4), 416-425.

275. Singh, M. K., & Parhi, D. R. (2009, January). Intelligent neuro-controller for navigation of mobile robot. In Proceedings of the International conference on advances in computing, communication and control (pp. 123-128). ACM.

276. Zavlangas, P. G., & Tzafestas, S. G. (2000). Industrial robot navigation and obstacle avoidance employing fuzzy logic. Journal of Intelligent and robotic Systems, 27(1-2), 85-97.

277. Mohanty, P. K., Kumar, S., & Parhi, D. R. (2015). A new ecologically inspired algorithm for mobile robot navigation. In Proceedings of the 3rd International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA) 2014 (pp. 755-762). Springer, Cham.

278. Bhattacharjee, P., Rakshit, P., Goswami, I., Konar, A., & Nagar, A. K. (2011, October). Multi-robot path- planning using artificial bee colony optimization algorithm. In Nature and Biologically Inspired Computing (NaBIC), 2011 Third World Congress on (pp. 219-224). IEEE.

279. Liang, J. H., & Lee, C. H. (2015). Efficient collision-free path-planning of multiple mobile robots system using efficient artificial bee colony algorithm. Advances in Engineering Software, 79, 47-56.

280. Curkovic, P., & Jerbic, B. (2007). Honey-bees optimization algorithm applied to path planning problem. International Journal of Simulation Modelling (IJSIMM), 6(3).

