Mini Review

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Advancement in navigational path planning of robots using various artificial and computing techniques

Abstract

In this paper, a review analysis has been carried out on navigational methodologies of robots with the help of various artificial intelligence techniques such as Fuzzy Logic, Neural Network, Genetic Algorithm, Particle Swarm Optimisation (PSO) and other Artificial Intelligence techniques. During the survey analysis a systematic review has been done and shown how various artificial intelligence techniques can be successfully used for control and navigation of various types of robots subjected to various environmental conditions.

Keywords: fuzzy, neural, genetic, PSO, artificial intelligence

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Introduction

For decades several papers have been written on control and navigation of robots using artificial intelligent techniques such as fuzzy logic, neural network, genetic technique and other artificial intelligence techniques. Monitel & Adriansyah et al.[1,2] have discussed about use of fuzzy logic techniques for control and navigation of mobile robot. Jin & Zuo et al.[3,4] have analysed neural network techniques for control of mobile robot. Sheng and Li[5] have used genetic algorithm for trajectory control of robot. Mohamed et al.[6] have used potential field method for optimisation of path followed by an unmanned vehicle from source position to target position. Abdalla et al.[7] have used particle swarm optimisation technique to find a safer path for mobile robot during navigation. Various researchers have used several techniques for finding out collision free path for robots.

Analysis of various ai techniques used for navigation

Yunong et al.[8] have discussed about Ubiquitous Robots using Ambient Intelligence. They have achieved the balancing of a robot using fuzzy controller. Rainer et al.[9] have used fuzzy logic for decision making of an autonomous guide-robot. They have shown that the robot can interact with human and fuzzy logic is used to take the suitable decision. Nasrinahar and Chuah[10] have discussed about safe navigation of robot using fuzzy intelligent technique. They have used four behaviour controllers, which are taken care by the fuzzy logic during navigation. To solve these problems, an improved Q-learning algorithm based on a bioinspired neural network (BNN) is proposed for robot path planning in this paper. Ni et al.[11] have used bio inspired neural network (BNN) with Q learning technique for path planning of robot in an unknown environment. Long and Nan[12] used Fuzzy Wavelet Neural Networks method for control and tracking of non Holonomic mobile manipulator robot. Alouache & Choi and Park[13,14] have used Lyapunov criteria and Genetic Algorithms (GA) to optimize the gains of the controller trajectory tracking for mobile robot. Kato et al.[15] in their paper have discussed about the GAIT pattern of robot while moving. Shukla[16] has discussed about exploration of area using robots with the help of Genetic Algorithm. Liu et al.[17] have discussed about virtual potential filed method using reinforced learning method for path control of robot. Papers[18–31] have

discussed about the artificial intelligence method such as fuzzy logic, neural network and genetic algorithm for control of mobile robots and for application in other engineering fields. Ashourian et al.[32] in their paper have discussed about control of motor like mobile robot using neural network and potential field method. Karaboga and kaya[33] have discussed about ANFIS model for addressing optimisation problem. Control of a inverted pendulum using ANFIS has been discussed by Kharola and Patil.[34] Huang et al.[35] have analysed exoskeleton upper body control of a robot using ANFIS methodology. Papers[36–45] discussed about cuckoo search method and other soft computing methods for path planning of robots in complex environments. Aziz Z& Hassanien[46] have discussed about feature selection using cuckoo search algorithm. Manikota et al.[47] have discussed about cuckoo search method for error minimisation and localisation of robot. Sheth et al.[48] have used soft computing technique using computer vision for AGV control. Vermesan et al.[49] have discussed about use of Internet in robotic control. Li and Chou[50] have discussed about PSO for near optimal path planning of mobile robot in a complex environment. Papers[51–54] focus on artificial immune system and other computing techniques for path analysis of mobile robot. Zamri et al.[55] have discussed about gene expression data using swarm intelligence technique. Ravinandan et al.[56] have discussed about path generation using cognitive map and swarm intelligence technique. Hong et al.[57] have discussed about rule based fuzzy navigator with the help of scaling parameters for mobile robot. Mohanta et al.[58] used genetic technique for navigation of mobile robot. Papers[59–66] have discussed about differential evolutionary algorithm integrated with other techniques to address various engineering problems. In the papers[67–71] neuro fuzzy technique for various engineering applications have been discussed. Singh et al.,[72–76] have used neural network and fuzzy logic for robots navigation in various environmental conditions. Pandey et al.[77,78] have discussed about fuzzy logic and ANFIS method for control of robots subjected to various terrains. The paper[79] has discussed about path planning using adaptive neuro-fuzzy inference system for mobile robot. Wavelet neural network for navigation of mobile robot has been discussed by Panigrahi et al.[80–82] have focused on adaptive neuro fuzzy technique for control of mobile robot. Pham et al.[83] have used neural network technique for path planning of mobile robots. Sorin et al.[84] have discussed about safety challenges of robots during functional time of robots.

Conclusion

In the current research review, analysis has been done on various Artificial Intelligence techniques for robotic navigation, control and path generation in complex environments. It is observed that the using methods such as Fuzzy, Neural, PSO, Cuckoo Search, Ant Colony, Artificial Immune System and other AI techniques, robots can successfully negotiate with obstacles while achieving the objectives in complex terrain conditions.

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Conflict of interest

The author declares there is no conflict of interest.

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