

Design, optimization and fabrication of a climbing six articulated-wheeled robot using artificial evolution and 3D printing

Abstract

Over the last decade, various mobile robots have been developed and widely used in myriad sectors. However, the vast majority of mobile robots are manually designed where the designers must have the preliminary knowledge of the interaction between the robots with the environment. Additionally, the high complexity involved in the design of the kinematics and controllers of a mobile robot has always been the biggest challenge for the researchers and practitioners alike. Thus, the task of designing a robot can be considered very demanding and extremely challenging. In this research, an artificial evolution approach utilizing Single-Objective Evolutionary Algorithm (SOEA) and Multi-Objective Evolutionary Algorithm (MOEA) respectively are investigated in the automatic design and optimization of the morphology of a Six Articulated-Wheeled Robot (SAWR) with climbing ability. Results show that SOEA is able to produce optimized SAWR with climbing ability while MOEA is able to produce a set of Pareto optimal solutions which provide users with a choice of solutions for trade-off between the objectives of morphology size and climbing performance. The Pareto optimal set of solutions are the smallest SAWR with least climbing ability to biggest SAWR with the best climbing motion. The research continues by transferring the evolved solutions from simulation to the real world using 3D printing. The body, legs and wheels of the evolved robots are printed by a 3D printer and assembled with sensors, servos and motors for real world testing. Results show that the fabricated real world SAWRs are able to perform the climbing motion with the average accuracy of 85.8% in comparing to the performance in simulation.