ABSTRACT

Determination of manipulator link lengths is one of the important criteria in robotic design. Previous researches on link lengths optimization did not take much into account on the energy consumed by a manipulator’s actuators. The purpose of this study is to find the minimum energy utilization for a 3 DOF revolute articulated manipulator to perform certain point-to-point task by varying the link lengths. The lengths of the second and third link of the developed manipulator can be varied accordingly. The investigation of energy for different link length combinations was carried out theoretically and experimentally. In the simulation, the work-energy method was constituted in order to determine the average mechanical energy of the manipulator. In the experiments, the actual energy of the system was calculated by multiplying the reading torque with the angular displacement of each link. Both energy for different link length combinations from the simulation and experiment were compared with the energy consumed by the fixed manipulator link length. These comparison yielded percentage savings. Then, the percentage savings from the simulation were compared with the percentage savings obtained from the experiments. The simulation shows that, different trajectory of motions results in different link length combinations that could give optimum average energy utilization. Results of the simulations and experiments show that, improved of mechanical energy utilization could be achieved by having variable link length of manipulator rather than having fixed length of manipulator’s arms. The result of optimized link length from the experiment shows that the saving of energy utilization could be achieved up to 16.73 % corresponding to the 19.66 % saving obtained from the simulation. All in all, the use of the variable link length manipulator is utterly important as far as energy saving is concerned.