

Public Abstract

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Title:Applications of Parallel Computing in Robotics Problems

This thesis presents two case studies of parallel computation to be used in robotics problems. More specifically, two problems of motion planning – the Inverse Kinematics of robotic manipulators and Path Planning for mobile robots – are investigated and the contributions of parallel algorithms are highlighted. For the Inverse Kinematics problem, a novel and fast solution is proposed for general serial manipulators. This new approach relies on the computation of multiple (parallel) numerical estimations of the inverse Jacobian while it selects the current best path to the desire configuration of the end-effector. Unlike other iterative methods, our method converges very quickly, achieving sub-millimeter accuracy in 20.48ms in average. For the Path Planning problem, a solution to the problem of smooth path planning for mobile robots in dynamic and unknown environments is presented. The algorithm is implemented using C/C++ and the CUDA programming environment, and combines stochastic estimation (Kalman filter), Harmonic Potential Fields, Rubber Band model and a novel concept of Time Warped Grid. The proposed method was tested using several simulation scenarios for the Pioneer P3-DX robot, which demonstrated the robustness of the algorithm by finding the optimum path in terms of smoothness, distance, and collision-free either in static or dynamic environments, even with a very large number of obstacles.