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Modeling, analysis and optimization of uncertainties in robot manipulators

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The accuracy and repeatability of robot manipulators is influenced by several uncertain factors such as manufacturing and assembly tolerances and deviations in the joint actuators and controllers. The effects of these uncertain factors must be carefully analyzed to obtain a clear insight into the manipulator performance. In order to ensure the position and orientation accuracy of a robot end-effector as well as to reduce the manufacturing cost of the robot, it is necessary to quantify the influence of the uncertain factors and optimally allocate the tolerances and clearances. For this, the direct and inverse kinematic analysis of robot end-effectors is to be conducted in the presence of uncertain factors. This work presents three different uncertainty models, namely, the probability-, fuzzy- and interval- based models, for predicting the performance of robot manipulators in the presence of uncertainties. The optimal allocation of joint tolerances with consideration of the positional error of the robot end-effector, the directional error of the robot end-effector and the manufacturing cost is also considered. The results given by the different models are compared for the Stanford manipulator for illustration. The cost-tolerance model is assumed to be of an exponential form during optimization. The effects of the upper bounds on the minimum cost and relative deviations of the directional and positional errors of the end-effector are also studied.

Biography

Singiresu S. Rao has completed his Ph.D. at the age of 27 years from Case Western Reserve University, Cleveland, USA. He is a Professor in the Department of Mechanical and Aerospace Engineering at University of Miami, USA. He has published more than 180 papers in reputed refereed journals, 130 papers in refereed Conference Proceedings, 7 popular books that are being used as text books throughout the world.

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