Artificial neural network-based kinematics Jacobian solution for serial manipulator passing through singular configurations

ABSTRACT

Singularities and uncertainties in arm configurations are the main problems in kinematics robot control resulting from applying robot model, a solution based on using Artificial Neural Network (ANN) is proposed here. The main idea of this approach is the use of an ANN to learn the robot system characteristics rather than having to specify an explicit robot system model. Despite the fact that this is very difficult in practice, training data were recorded experimentally from sensors fixed on each joint for a six Degrees of Freedom (DOF) industrial robot. The network was designed to have one hidden layer, where the input were the Cartesian positions along the X, Y and Z coordinates, the orientation according to the RPY representation and the linear velocity of the end-effector while the output were the angular position and velocities for each joint, In a free-of-obstacles workspace, off-line smooth geometric paths in the joint space of the manipulator are obtained. The resulting network was tested for a new set of data that has never been introduced to the network before these data were recorded in the singular configurations, in order to show the generality and efficiency of the proposed approach, and then testing results were verified experimentally.

Keyword: Neural networks; Inverse kinematics; Jacobian matrix; Singularities; Back propagation; Robot control