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Non-linear Parameter Identification for Humanoid Robot Components

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Abstract **-** This paper describes a kinematic calibration method applied to a humanoid robot arm having seven degrees of freedom. The methodology is developed and used to determine the parameters of robotic artifacts having a non-linear model. The parameter identification process can be used to identify diverse parameters such as the distance between the joints, moments of inertia, and others. The proposed methodology comprises four main steps: First, the kinematic model of the manipulator is determined using the Denavit-Hartenberg convention. Then, measurement values of the robotic artifact of interest are collected via a Multibody Dynamics simulation software. Subsequently, the desired system parameters are identified using a nonlinear identification algorithm. In this third step, the Gauss-Newton method is employed to linearize the non-linear model of the system, and the least squares method is used to find the best fit for the parameters. As the last step, the obtained identified model (model with identified parameters) is validated by comparing the behaviour of the manufactured system with its simulation behaviour. For this, sine wave signals are used as inputs to the actuators comprising the robot. The results show that the behaviour of both methods perfectly match which verifies that the identified parameters are correctly estimated and highlights the value of model calibration in the control of humanoid robots.

Keywords**:** Humanoids, System Identification, Kinematic Calibration, Robot Manipulators, Parameter Model Identification