Robotics

Robot Control

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Kinematic Model Accuracy – Error Types (as in measuring systems):

[ Accuracy] - the difference between actual position and position calculated from kinematic model.

[ Repeatability] - the difference between actual positions when repeatedly sent to the same position. It includes hysteresis of joints, thermal elongation of links etc. Does not include bad model design or wrongly estimated parameters. Note that under different load or approaching trajectory the centroid of repeated experiments can significantly differ.

[ Resolution] - the size of the smallest step in position which can be set (given by the sensor resolution.)
Some standards specifying accuracy of robots are:

- **ANSI/RIA R15.05-1-1990 (R1999)** American National Standard for Industrial Robots and Robot Systems - Point-to-Point and Static Performance Characteristics - Eval Approved September 13, 1989, reaffirmed August 5, 1999. 36 pages. This standard is intended to facilitate understanding between manufacturers and users of industrial robots. The standard defines the most important performance criteria and a method for evaluating these criteria. Included in the test method are performance classes, standard test paths and standard test loads. The purpose is to provide meaningful technical information that robot users can apply in the selection of the proper robot for their specific application.

- **ANSI/RIA R15.05-2-1992 (R1999)** American National Standard for Industrial Robots and Robot Systems - Path-Related and Dynamic Performance Characteristics - Eval Approved September 14, 1994, Reaffirmed August 5, 1999. 45 pages. This standard is intended to facilitate understanding between manufacturers and users of industrial robots. The standard defines the fundamental dynamic path-related performance characteristics and provides a method to quantify dynamic performance. Included in the test method are performance classes, standard test paths and standard test loads. The purpose is to provide meaningful technical information that robot users can apply in the selection of the proper robot for their specific application.

- **ANSI/RIA R15.05-3-1992 (R1999)** American National Standard for Industrial Robots and Robot Systems - Guidelines for Reliability Acceptance Testing Approved October 16, 1992, Reaffirmed August 5, 1999. 6 pages. This standard provides the minimum testing requirements that will qualify a newly manufactured of a newly rebuilt industrial robot to be placed into use without additional performance testing. The purpose of the standard is to provide assurance, through testing, that infant mortality failures in industrial robots have been detected and corrected by the manufacturer at their facility prior to shipment to a user. These tests may be reproduced by the user if desired.

Robot Control – Non-geometrical model parameters:

- compliance and stiffness,
- gear backlash,
- encoder resolution,
- temperature related expansion,
- linkage wobble.
Robot Control – Geometrical model parameters:

- structure,
- angles between links,
- links dimensions,
- zero positions of links.

When e.g. end effector position is given as a function of model parameters, we can by sensitivity analysis (derivations) find the influence of parameter change on the end effector position and find (or optimize) the accuracy of manipulator.