Summary for
European Control Conference ECC'99
Karlsruhe, Germany, August/September 1999

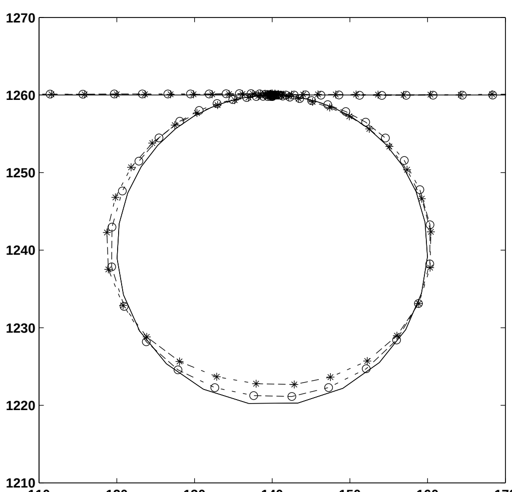
ADAPTIVE MINIMIZATION OF THE MAXIMAL PATH DEVIATIONS OF INDUSTRIAL ROBOTS

Friedrich Lange, Gerhard Hirzinger

Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR)
Oberpfaffenhofen, D-82234 Weßling, Germany
Fax : +49-8153-28-1134 e-mail: Friedrich.Lange@dlr.de

A learning system is presented which applies feedforward control to improve the accuracy of standard position controlled robots. The simultaneous use of several timesteps of the desired path allows better performance than the standard robot control system which in each timestep processes only the current desired position. Learning of the parameters and, if needed, neural nets for decoupling minimizes the mean positional errors. The resulting controller is qualified for the whole workspace. In addition, special trajectories can be optimized individually.

So far the method has already been published. It is normally executed on joint level since in this case there are less couplings than in the cartesian space. On the other side the main goal is to reduce the maximal deviation from a given cartesian path. This requires extended algorithms which are derived in the second part of the paper. They combine learning of the individual joint controllers. By this, the universal controller is adapted to minimize the *maximal path error* instead of the *mean joint error*. In experiments using a KUKA KR6/1 industrial robot the adapted controller shows significantly better performance when repeating the training path or a similar trajectory.



The figure compares the different control approaches at a circle with a diameter of 40 mm executed at maximal speed meaning an execution time of 0.6 s. Each marker corresponds to one sampling step. For better visualization the path errors are displayed extended. The universal controller which is marked by $*$ shows a significantly lower path error than the standard robot controller (not displayed). A refined controller which is adapted to minimize the *maximal cartesian path error* ($\circ$) instead of the *mean joint error* is still closer to the desired path (solid line) which is almost reached by trajectory dependent control (not displayed).

More information is available at http://www.robotic.dlr.de/Friedrich.Lange/.