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Automatic Generation of Inverse Dynamics for Industrial Robots with Flexible Joints Using a Computer Algebra

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The use of industrial robots in modern manufacturing technologies receives more attention from researchers and engineers in recent years. However, the robotic machining systems have generally lower rigidity than the traditional CNC machines due to the presence of compliant transmission elements that cause poor performance. To overcome this drawback and reduce vibration of the robot's end-effectors, model-based controllers which incorporate dynamic system equations of the robot should be used. Generally, the inverse dynamics problem of flexible-joint robots is much more complicated than that of rigid-joint robots because it requires computing second-time derivatives of actuated forces/moments. In this work, we present a new algorithm based on the recursive Newton-Euler algorithm and Maple to automatically generate inverse dynamics for any industrial flexible-joint robot in symbolic form which can be used for real-time control and numerical simulations. The only input to our algorithm is a numeric/symbolic matrix basically containing the Denavit-Hartenberg as well as physical parameters of robots. The efficiency of the proposed algorithm is compared to existing approaches.

Keywords
Flexible-joint robots, Inverse dynamics, Model-based control, Symbolic computation.

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