Design strategies for high-speed lightweight robots

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Abstract
Industrial robots today can lift objects no heavier than about five percent of their own weight. Imagine a robotic weight lifter competing against the current Olympic human record of 750 lb. By today's standards, that robot would have to weigh about 15,000 lb, as opposed to its human competitor, who would weigh 165 lb (and who is "rated" at 450 percent of body weight). While this analogy is inexact, the point stands that improvements in the performance of robotic manipulators require engineers to consider the weight of the structural and drive components. The advantages of lighter weight include faster motion times for large motions, smaller actuators, lower energy consumption, reduced mounting requirements, and less weight to be transported. But there are also penalties such as lower (structural) strength and lower stiffness. The stiffness constraint arising from the dynamic and static behavior of the arm is the more critical for most uses of robotic arms. Therefore, we have concentrated on controlling the motion of robotic devices that have lightweight structures.

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