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Real-time Collision Detection for Position-Controlled Humanoid Robots

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Abstract **-** Humanoid robots (humanoids), at least in theory, can assist humans and work with them in cluttered and confined environments. However, further developments are needed to fully enable them to work in close proximity (even in physical interactions) with humans while not risking the safety of themselves and the objects and people around them. Current methods have not been fully successful in preparing humanoids for 100% safe physical Human Robot Interaction (HRI) due partially to the unresolved challenges of detecting the characteristics of the surrounding environment. Furthermore, current humanoids employ expensive and fragile equipment making them costly, thus limiting humanity of using them. This paper presents a novel real-time and hardware inexpensive collision detection methodology that employs signals from the robots' motor joints and data processing capabilities from the computers running the robot. The approach enables the safe close-proximity HRI for position-controlled humanoids that minimizes any negative effects caused by the detected collision. Using the proposed algorithm, humanoids can speedily identify the joint(s) responsible for the collision and the affected joints from which effective path planning movement control can be determined. Experimental results using a life-size humanoid robot having 29 degrees of freedom are presented that demonstrates the applicability of the proposed approach.

Keywords**:** Humanoids, Safe Human Robot Interaction (HRI), Collision Detection, Signal Analysis, Path Planning