Feasibility and Design of a Low-Cost Prosthetic Knee Joint Using a Compliant Member for Stance-Phase Control

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This paper is concerned with the feasibility and design of a low-cost prosthetic knee joint that uses a compliant member for stance-phase control. A mechanical locking mechanism was used in conjunction with a compliant control axis to achieve automatic stance-phase locking. The concept was developed with the aid of computer-aided engineering software and was validated through the fabrication and testing of a simplified prototype made of an injection moldable polymer. A prosthetic knee joint was then designed, incorporating the compliant member concept. After modeling, fabrication, and laboratory testing, a pilot study was conducted in a clinical setting. A simple gait analysis showed asymmetric gait patterns that demonstrated the need for improved swing-phase control and damping, while qualitative feedback indicated the desire to reduce the noise produced by the knee. The knee provided the automatic stance-phase control for which it was designed and shows significant potential to evolve into a highly functioning, low-cost knee.

The Present Role of Actuator Technology in Surgical Robotic Devices

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Surgical robots have greatly facilitated numerous challenging medical procedures such as totally endoscopic coronary artery bypass grafting. Despite the initial success of some classical robotic mechanisms (e.g., the da Vinci robot from Intuitive Surgical), limitations in the fundamental hardware impose constraints on the system capabilities and ease of use. While sensing, control, and computation hardware for robotically assisted surgery continue to improve, actuator technology remains relatively unchanged. This paper reviews the state of the art in actuators for surgical robotic devices and therefore elucidates the need for further actuator technology development. A physics-based actuator taxonomy is presented followed by a classification of the prominent research areas in surgical robotics. Using this taxonomic framework, we review the present role of actuator technology in surgical robotic devices.