Design of Ultrasonic Motion Analysis System for Estimating Segment's Stabilization During Dynamic Condition

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While the function of central and peripheral nervous system decreases (caused by aging, vestibular deficiency or stroke), maintaining of body stability become hard. Studies indicate that movement coordination of axial segments (head, thorax, and pelvis) in a dynamic state such as walking disrupted in these pathologic conditions. In recent years goniometry and cinematography have been widely used to measure active or passive range of motion (ROM) in asymptomatic adults. The aim of this investigation is to design and implement a new method by evidence based approach for estimating the level of impairment in segment stability and improvement after treatment by measuring quality or quantity of movement among axial segments. Ultrasound based coordinate measuring system (CMS) can continuously measure motion in three dimensions during the course of time in a dynamic condition. The measuring procedure is based on the travel time measurement of ultrasonic pulses that are emitted by miniature transmitters (markers) to three microphones built into the compact device. Our system consist electronic, mechanic and software sections. Electronic board include: 40 KHz pulse oscillator, PRF pulse generator, sensor drivers, high voltage analog switches, 60 dB Amplifier, signal detector and CPU. Transmitter sensors which have been mounted on body send ultrasonic burst signals periodically and other 3 sensors which arranged on a T-shape Mechanical base receive the 3 dimensional coordinate of these transmitters. After sending 3D coordination data to PC via serial port, a complex and elaborative Visual Basic software calculate the angular dispersion, angular rate acceleration for each also calculate the stabilization parameters among segments such as Al (anchoring index) and cross-correlating between head and trunk coordinates.

Keywords: ultrasound, segment's stabilization, Goniometry, ROM, CMS, Cartesian coordination

Biologically-Inspired Patterned and Coated Adhesives for Medical Devices

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The challenge of having a medical device robustly and reversibly adhere to a tissue in a minimally-invasive way during a clinical procedure is significant and has yet to be solved. Materials that could perform this adhesion would be valuable for use in a wide array of devices, including wired and wireless endoscopes for gastrointestinal interventions; cardiovascular devices such as mobile robots that transverse the heart surface or fixation devices for open heart surgery; and for adhering craniectomy devices to the skull during decompressive treatment. Fibrillar patterned adhesives inspired by the micro- and nano-scale structures on the feet of geckos have been widely studied and synthesized and have shown great potential for reversible adhesion in dry environments. Preliminary work has also been conducted to enhance the adhesion of these materials in wet conditions by coating them with polymers that include dopamine methacrylamide (DMA), a synthetic sticky polymer inspired by the material found naturally in the holdfasts of mussels. These coated materials demonstrated wet adhesion enhancement at the nano-scale, but not at the macro-scale and not when compared to unpatterned materials. In this work, we take previously-developed gecko-inspired patterned arrays of fibers with mushroom-shaped tips which have demonstrated enhanced adhesion with respect to unpatterned materials in dry conditions and coat them with these same synthetic mussel-inspired polymers to enhance adhesion in fully-submerged wet environments. DMA-containing polymers were synthesized through a multistep process and applied to an array of micro-scale polyurethane fibers by stamping. Material samples were tested in a custom-built adhesion measurement system in contact with a 6 mm glass hemisphere in both dry and wet conditions. Flat DMA-stamped samples demonstrated as much as 7 times enhancement over uncoated samples, while patterned, coated samples demonstrated as much as 23 times adhesion enhancement. The sample also maintained 65% of its adhesive ability over 100 test cycles. These materials are the first to demonstrate reversible fibrillar adhesion in wet conditions at the macro-scale with respect to both unpatterned and uncoated materials on non-flat surfaces using intermolecular forces instead of suction forces. Versatile reversible materials capable of adhering to non-flat surfaces in wet conditions should continue to be studied for their value for a wide array of medical device applications.

