PR-3

Posture Estimation of Transferring Care-receiver Using Tactile Sensors in Nursing-care Robot RIBA

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In order to realize safe and comfortable transfer by using nursing-care assistant robot RIBA, the motion controller must be designed by taking into consider both physical and mental states of the care-receives. As the first step toward this research goal, we propose a new posture estimation method, in particular, estimation method of the waist position and angle of the care-receivers by using the tactile sensors on RIBA's arms (Fig.1). The proposed estimation method is evaluated on the basis of the computational time and accuracy.

The estimation method consists of two steps. First step is to detect the contact points from the sensor data. Second step is to identify the position and orientation of the care-receiver's upper and lower bodies by approximated plane model. As shown in Fig.2, we get the contact area and pressure information from the tactile sensors of RIBA. The clustered contact points representing the same contact area are calculated using labeling method in the sensor coordinate system. Representative normal vector is calculated by grouping the normal vectors of contact points on each arm. The position and orientation of the care-receiver's upper and lower bodies are approximated as two planes which are characterized by two representative normal vectors. The waist position is calculated as the intersection of three planes; two approximated planes and the vertical plane passing through two representative contact points which are average of contact points on each arm. The waist angle is calculated as the angle between two approximated contact planes.

The effectiveness of the proposed method was evaluated by experiments. 32 data (4 postures for 8 healthy subjects) was gathered using RIBA (CoreDuo 2GHz). The waist positions and angles are calculated using another PC (Matlab on Core i7 3.2GHz). Mean squared error of the waist position was 74.9 [mm] and mean absolute error of the waist angle was 10.2 [degree]. Estimation error of the waist position should be reduced within 50 [mm]. Average of the computing time was 2.4 [msec]. It is, therefore, expected that this method can be used in real-time control because RIBA's control cycle is 10 [msec].

Improvement of estimation accuracy of the waist position, and verification by real-time motion control are our future works.

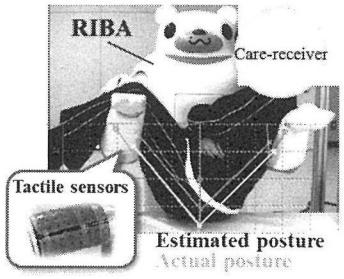

Fig.1: RIBA and tactile sensors

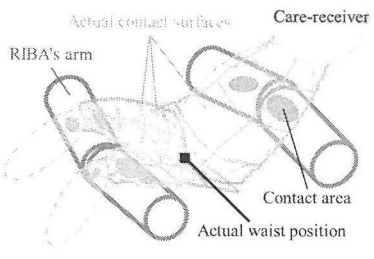

Fig.2: Contact surfaces and sensor information

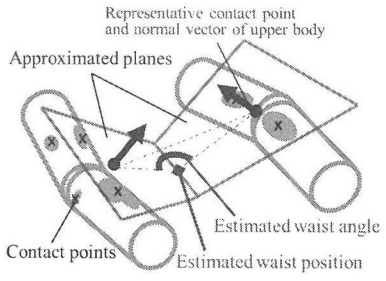

Fig.3: Concept of proposed methods