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METHOD OF PREDICTING URINARY VOLUME BY UTILIZING THE ABSORPTION SPECTRUM OF URINE

Abstract:

Urinary incontinence is one of the serious problems encountered while providing nursing care to older patients. In clinical situations, caregivers use ultrasonic sensors for monitoring accumulated urinary volume in the bladder so that they can take older patients to the toilet before urinary incontinence. However, if the caregiver is delayed in checking the accumulated urinary volume, the patient may experience urinary incontinence. While making nursing schedules for excretion management, caregivers may find it useful if they could predict the accumulated urinary volume in the bladder immediately after urination. Hence, in this study, we propose a prediction method based on the urinary accumulation model and absorption spectrum of urine.

The urinary accumulation model contains three parameters: the time when urine starts to accumulate after urination; the amount of urine that can be accumulated in the bladder; and the time constant of urine accumulation. Thus, if these parameters can be determined immediately after urination, the accumulated urinary volume can be predicted using this model. To determine the values of these three parameters, we used the absorption spectrum of urine, as an explanatory variable, in the ridge regression technique. The values of the three parameters (as objective variables in the ridge regression) were obtained from output signals of the ultrasonic sensor using the internal point method.

To evaluate the proposed method, we performed a validity experiment with a male subject in his 20s. The ultrasonic sensor was attached to subjects to measure accumulated urinary volume in the bladder. The subject was asked to rest during measurement. Urine samples were collected at arbitrary intervals. Absorption spectrum analysis was performed with the urine samples. The volume of the sampled urine was measured using the measuring cup. After urination, the subject was asked to drink 300 ml of water and rest again. The above procedure was repeated. In this experiment, we obtain 42 datasets in total from the subject. We calculated the rate of error between volume of the collected urine and the urinary volume predicted by the proposed model at the time of urination. Our results showed that the average error rate for the proposed method was 22.22% and for the

ultrasonic sensor was 24.14%. This result indicates that the proposed method may be useful for predicting the accumulated urinary volume in the bladder.

Keywords:

urine accumulation, absorption spectrum, ridge regression, hyper spectrum camera, ultrasonic sensor

JEL Classification: I19