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学 位 論 文 の 概 要 及 び 要 旨

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題　　目　A Study of Person Recognition Using Body Sway Observed from Overhead Camera
(頭上カメラから観測された身体動揺を用いた人物認識の研究)

学位論文の概要及び要旨

Person recognition using a camera is an important technique for developing large-scale automated computer systems. There are two interesting and important tasks in person recognition: specifically, person re-identification and gender classification. Existing methods use gait features—mainly those that represent large swings of the limbs—for both identifying people and classifying their gender. The problem with the use of gait features is that the performance of identification and classification decrease when a person stops walking and maintains an upright posture. To extract informative features for person re-identification and gender classification, it is important to measure small swings of the body, which are referred to as body sway. This thesis reports three techniques for identifying people and classifying their gender using body sway observed from a camera.

The first part describes the extraction of features from the body sway observed from an overhead camera for the purpose of identifying people. To represent identity from body sway, bodies are spatially divided into regions in a video sequence and local movements are temporally measured in the body regions. The power spectral density is estimated from the local movements as features for identifying people. To evaluate the identification performance when using the body sway features, three original video datasets of body sway sequences were collected. The first dataset contains a large number of participants in an upright posture. The second dataset includes variation over the long term. The third dataset represents body sway in different postures. The results on these datasets confirm that the local movements can represent features that are informative for person re-identification.

The second part describes person re-identification in the case of self-occlusion, by using body sway measured at the head using an overhead camera. To represent the identity of people, as reflected in body sway, it is important to estimate appearances of a person accurately from images. Defects caused by self-occlusion in such images frequently degrade the performance of one of the existing methods of identifying people because that method uses whole-body regions to identify people. To solve the problem of self-occlusion in this context, silhouette sequences of regions at the head are computed by applying a

segmentation technique. To reflect people's identities using body sway, the head region is spatially divided into local blocks and movements inside the blocks are temporally measured. The results of experiments show that the proposed method can improve the performance of the existing method of identification from 17.3% to 57.9%.

The third part discusses whether it is possible to classify the gender of a standing person from a video sequence containing body sway, observed from an overhead camera. A spatiotemporal feature is designed for representing body sway using the frequency analysis of time-series signals derived from the local movements. To evaluate the classification accuracy of the proposed method, video sequences of body sway were acquired from 30 females and 30 males using an overhead camera. The proposed method achieved 90.3±1.3% accuracy for the gender classification of a standing person. The accuracy of the proposed method was compared with that of existing methods that use other spatiotemporal features. The proposed spatiotemporal feature extracted from body sway significantly improved the accuracy of gender classification.

Throughout the research described in this thesis, body sway was used for person re-identification and gender classification and enabled significantly improved performance, compared with existing methods, when people maintain an upright posture. The proposed techniques help with recognizing and understanding people. In the future, the author expects that the techniques will contribute to the development of security systems and marketing analysis systems in research and business fields.