The Japan Society for Precision Engineering

Introduction of JSPE Young Researcher Awards 2013

1. Tomoaki HIGO

3D Reconstruction of Specular Surfaces with Interreflection -Depth Validation by Multiple Stereo Pairs and Suppression of Interreflection by Iterative Pattern Control-

J. JSPE, Vol.79, No.11, pp.1033-1037

This paper describes an active stereo method that works with interreflection on specular surfaces. We use two cameras and a projector to take two series of images for depth maps with active stereo systems. Comparing the depth maps, we judge the validity of measured depth. For the valid depth areas, we turn off corresponding pixels of the projector and again take two series of images for depth maps that suffer from less interreflection. Iterating depth estimation and projected-pattern extinctions, we could mitigate interreflection and increase measurable areas for 3D reconstruction. Experiments show the improved results of the proposed method for specular surfaces with strong interreflections.

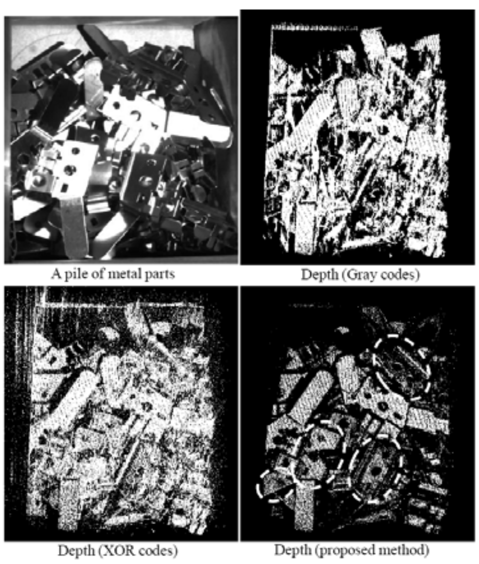

Fig.1 3D reconstruction of a pile of metal parts exhibiting significant mirror-like specularity. Our proposed method can reduce incorrect surfaces and measure regions that conventional methods cannot sufficiently reconstruct, especially inside dashed ellipse.

2. Ryota OZAKI

Automatic Detection of Nucleated Red Blood Cells from Microscope Images using Cell-Hog Feature

J. JSPE, Vol.79, No.11, pp.1074-1077

Our group is developing prenatal DNA diagnosis with Nucleated Red Blood Cells (NRBC) of fetuses extracted from blood of their mothers. In this diagnosis, it is important to detect NRBC automatically from microscope images for efficient examining. In a research, an automatic NRBC detection system is proposed with two parts. The first part extracts candidate nucleuses with rule-based algorithm. The second part discriminates cell regions with machine learning algorithm. In the second part, Cell-HOG feature specialized for detecting NRBC is developed. Cell-HOG feature is customized HOG feature that emphasizes differences between NRBC and other cells such as white blood cells, out of focus cells, and red blood cells with foreign objects. By using Cell-HOG feature, number of false positives becomes to smaller than that of HOG feature.

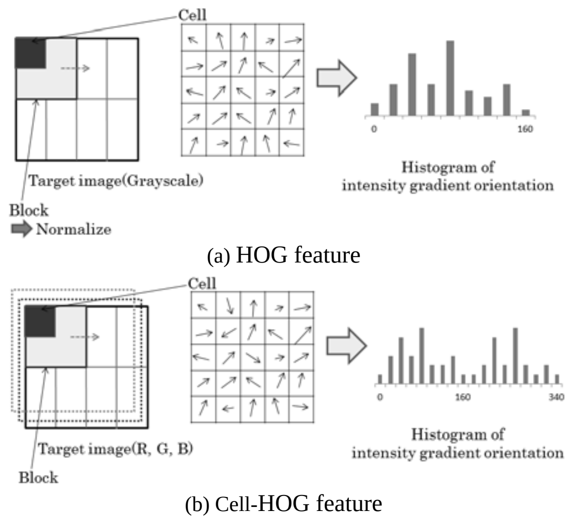

Fig.2 (a) HOG and (b) Cell-HOG features

3. Daisuke KONO

Stiffness model of machine tool supports using contact stiffness

Precision Engineering, Vol.37, No.3, pp.650-657

The stiffness of machine tool supports should be properly designed for reducing both the ground disturbance vibration and the drive disturbance vibration. However, the stiffness cannot be easily calculated from the geometry and material properties of the support. In this paper, a 3D stiffness model of a machine tool support is proposed using contact stiffness. The stiffness in each direction is assumed to be determined by the contact stiffness at the interfaces and the bulk stiffnesses of the supports and the floor. The contact stiffness model proposed by Shimizu et al. is expanded to determine the contact stiffness in the normal and tangential directions of an interface. In the proposed model, the contact stiffness is obtained by multiplying the unit contact stiffness by the real contact area. The contact stiffness of concrete is experimentally investigated to estimate the stiffness between machine tool supports and the floor, and it was observed to be the primary determinant of the stiffness of interfaces between metal and concrete. Moreover, the unit contact stiffness of concrete is discovered to be less than 1/10 of those of the metals that were used for the study. The natural frequency and vibration mode shape of a model machine tool bed are also experimentally measured and used to verify the proposed stiffness model. The comparison of the results obtained from the two procedures shows that the natural frequency and vibration mode shape of a machine tool bed can be predicted using the proposed stiffness model.

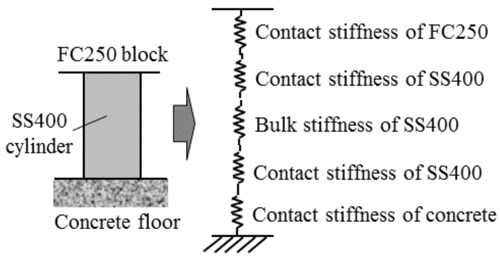

Fig.3 Stiffness model of supports

Introduction of JSPE Takagi Awards 2013

1. Deterioration of the Lubricant for Hydrodynamic Grooved Bearing -A Difference of Simple Heat Deterioration of the Lubricant and the Deterioration by Consecutive Driving in the Bearing-

Hideaki OHNO and Susumu MATSUMOTO (Panasonic Factory Solutions Co., Ltd.)

J. JSPE, Vol.79, No.6, pp.523-528

Hydrodynamic grooved bearings are widely used in the HDD(Hard Disk Drive) mechanism for rotary precision, noise reduction, and superior shock-resistance. Therefore, many studies have been made, but most of them have dealt with the bearing design or vibration analysis. This report studies the viscosity increase of the lubricant that affects the life of the hydrodynamic grooved bearing, which compares the viscosity increase in the continuous driving test in the bearing with that in the accelerated high temperature test.

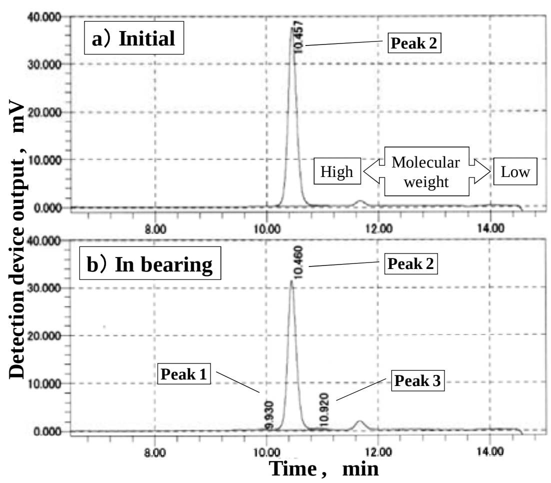

Fig.4 A comparison of the chromatogram (Initial and 80 °C x 22,850 hours later)

The viscosity increase of the lubricant in the accelerated high temperature test is bigger than that in the continuous driving test in the bearing. Both tests generate the same materials. So, Marangoni effect causes the smaller viscosity increase of the lubricant in the continuous driving test in the bearing. The temperature gradient in the bearing causes the low evaporate materials with high viscosity to move to the gas-liquid boundary, which prevents the low viscous material from evaporating, resulting in the smaller viscosity increase. Therefore, the life of the lubricant in the bearing is longer than what is expected by Arrhenius equation in the accelerated high temperature test.

2. Video Signature Robust to Modifications for Large-scale Video Identification

Kota IWAMOTO, Ryoma OAMI, Takami SATO and Toshiyuki NOMURA (NEC Corporation)

J. JSPE, Vol.79, No.11, pp.1089-1095

This paper presents comparative evaluation of a robust frame-level descriptor for video identification, called a Video Signature, which was previously developed by the authors and was accepted as part of a new ISO/IEC standard "MPEG-7 Video Signature Tools". The Video Signature is designed for video copy detection from a large-scale database, with robustness to various modifications, including caption overlay, camera capturing, compression, and color changes, working at extremely low false positive rate. It represents intensity differences between various sub-regions in a frame, which are configured at variety of scales, shapes, and locations in the frame, to provide robustness and uniqueness to the descriptor. The intensity differences are quantized into ternary values, resulting in a compact representation of 76 bytes per frame. Furthermore, a confidence value is calculated for each frame, which is used in the matching process to significantly reduce false positives. An experiment to identify videos under nine types of modifications was carried out to compare the performance of the Video Signature to that of the conventional color-based and spatial visual features. The results show that the Video Signatures improves the detection rate for all modification types compared with the conventional features, in particular significant increase by 38.8% for caption overlay and 61.8% for camera capturing have been achieved. We also present a system for structuring a large-scale video database using the Video Signature, developed for efficient management of video contents. The details of the system are explained and its feasibility as an application is shown.

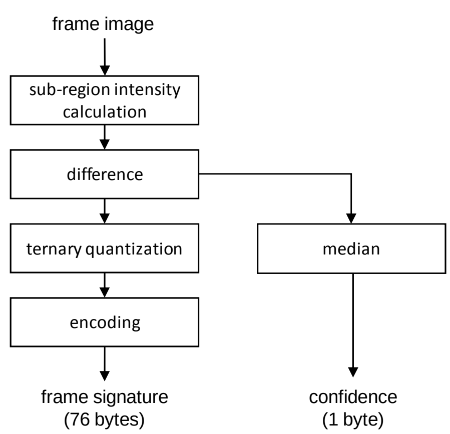

Fig.5 Video signature extraction