AUTOMATIC CALIBRATION SYSTEM FOR 20 kg WEIGHTS BY ROBOT AND WEIGHT MAGAZINE

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This paper presents the method that can calibrate the weights (10 kg ~ 20 kg) automatically by a 3-axis robot, three weight carrier magazines. So the operators do not need to take an effort to align weight on the pan of the balance manually during calibration procedure, and can calibrate the weights automatically during night. The weight calibration system consists of a 3-axis robot, a weight magazine, and operating software to avoid temperature and air flow effect from human. At first the calibration system moves weight on the magazine to the pan of balance. Second measures the mass of the weight, and then moves the weight to the original position on the magazine automatically. This automatic moving method not only avoids the introduction of excess uncertainty, but also improves productivity. Hereafter the similar system can be applied to the calibration of other range weights (1 mg ~ 5 g).

Keywords: Weight; calibration; robot.

1. Introduction

Weight is material measuring of mass, regulated in regard to its physical and metrological characteristics: shape, dimensions, material, surface quality, nominal value, density, magnetic properties and maximum permissible error.

Substantial investments in newest robot technology combined with decades of experience have opened a new area in weight calibration. Computer-controlled processes exclude any human errors, and lead to consistent and reproducible results with low uncertainty values.

Before automatic calibration system for weights by robot system was setup, calibration for weights is performed manually. It may be bothering to see if the position of weight on the pan is correct or not, and if the display of balance is stable or not. 10 kg and 20 kg weight are too heavy to move on the pan, so operator can be injured by dropping weight. This paper introduces a method that can calibrate 10 kg and 20 kg M_1 class rectangular bar weight automatically with robot system. So the operators don't need to write down the display of the balance, take an effort to see until the display of the balance become stable during calibration procedure, and move weight during calibration procedure.

2. Automatic Calibration System

2.1. Outline of the system

The weight calibration system consists of an electric balance, a 3-axis robot arm, a robot handler, three weight carrier magazines, and an instrument for measuring air density. The 3-axis robot arm (X-axis: 1 600 mm, Y-axis: 1 000 mm, Z-axis: 500 mm) with its associated control unit moves weights between the weighing pan and weight magazine. There are 18 weight positions (3 X 6) in the carrier magazine, so this system can calibrate 18 M_1 class rectangular bar weights in consecutive order (Fig. 2). In order to calibrate weights, the carrier magazine has to be moved inside the system such as Fig. 1. The balance model is XP26003L (Mettler-Toledo; 25 kg / 1 mg). The operating program coded with Labview 8.5 can control movement of robot and acquire data from the balance and environment measuring device. Fig. 1 shows picture of the automatic calibration system. The Head and weight handler for M class weight should be assembled before calibration, and start program, Assembled device moves weight to carrier magazine and weight pan. When the F class weight need to move, head, weight handler for M class weight (Fig. 4), and weight handler for F class weight (Fig. 5) should be assembled together by program.

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Fig. 1. Automatic calibration system for M_1 class 20 kg weight.

Fig. 2. Weight carrier magazine.

Fig. 3. Head for handler.

Fig. 4. Weight handler for M class weight.

Fig. 5. Weight handler for F class weight.

2.2. Experimental results

Experiments were performed to show the effectiveness of the developed new automatic method. 10 kg and 20 kg M_1 class weights were used in the experiments. The same weights used in manual method were calibrated automatically with developed automatic method. Figure 6 compares experimental results of the two methods. As Figure 6 shows, the correction differences between the manual method and the automatic method were 0.000 g and 0.002 g in 10 kg and 20 kg respectively. The results are quite satisfactory. In addition, due to the impact of the weight on the pan, standard deviations of the corrections for manual method were bigger than those for automatic method.

Fig. 6. Comparison of calibration results of the automatic and manual method.

3. Conclusion

Experiments were performed to show the effectiveness of the method that can calibrated the weights (10 kg, 20 kg / M_1 class) automatically by robot and carrier magazine. This automatic moving method not only avoids the introduction of excess uncertainty, but also improves productivity. No distinguishable discrepancy was observed between the automatic and manual method.

4. Future Work

It is not easy to calibrate the different dimension weights, because it has different x, y, z position. A simple device has been designed to measure dimension by type.

Hereafter the similar system can be applied to the calibration of other range (500 ~ 20 kg) of weights. For below than 5 g of weight, the system has to be changed from this system. Other experiment that the structure of the system is applied has been doing now. The new system will be completed by the end of this year.

References

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