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Golf Shaft Fitting Calibration System

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Abstract

The calibration system was developed for golf shaft fitting to the club or blade. The system provided the best line and angle of golf shaft to fit into the club slot. This yielded the best controlling for the impact point between the club and the golf ball, including obtained the minimal swaying of golf shaft after the club hit to the ball. The proposed system was consisted of two components: the hardest line tuning and the best line calibration tool. The hardest line tuning was applied to search for the line that indicated the most strongest of the shaft, which contributed the minimal bend within the given certain forced pressure. The best line calibration tool was employed to determine the best angle for fitting the shaft to the golf club which reflected the minimal swaying while hitting to the ball. In this manner, the golfers could control the desired range and direction of the ball.

Keywords: Golf Shaft; Golf Fitting; Calibration System

1. Introduction

At present, golf sport is very popular, while. Engineering technology has been applied to maximize the golfers' ability, but only the improvement of human performance is not enough to make a golf stroke to reach its highest potential. It could be developed the golf equipments to suit with each golfer for instances: grip sizes, golf shaft materials, and shaft's length even though the clubs or blades. These could be adjusted to each golfer to meet the maximum potential of each golf stroke which is depending on the grip size [1]. The suitable grip effected to the stroke quality for examples: too small grip forced the golfers too tighter grip more than normal. Thus, unsuitable grip reduced the performance of the stroke. Furthermore, the tiny

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grip changed the holding position during the swing cycle led ball flew away from the desired line by missed-angle of the club. On the contrary, too big grip made the hand angle couldn't rotated normally during the swing cycle and also reduced the feeling of club. Shaft attaches with the club is the part to impact the ball. The club has many sizes depends on driving characteristic and range. The angle and the speed impact of the club indicated the range of each stroke. The angle and the gutters effected to the spinning ratio of the ball. The shaft length was also affected to the range of driving and the accuracy of the impacted point between the club and the ball. The longer shaft gave more range but difficult to control the ball. In contrast, the shorter one gave more accurately but lesser range. In the processing of golf shaft, it's couldn't perfectly control all the molecules of the material to form a golf shaft. Thus, in every position of golf shaft would not bounce equally. In general, the golf shafts have their own strongest line. Most of the golf fitter employed that line at the center of club fitting, unfortunately, it's not the exactly best line. At the impact moment, the force transferred from the club to the ball that reflected and bounce back. If the line of shaft [2] was not properly fit, it would make the club blend or having a small bounce. This made the ball flew away from the desired line. On the contrary, if the line of shaft was properly fit, it would minimally affect on the club bouncing. Thus, the ball would be hit straight a headed where the golfers intend to drive off [3].

Fig. 1.Golf equipments: (a) grips, (b) iron wedge, (c) drivers, and (d) shafts

2. Shaft fitting

Custom-fitting is the process of equipment selection to suit for the characteristic of each golfer. According to each golfer, different height affected to the swing output. Despite to the golfers of equal height, due to their arms length are not the same that would also effect to the swing performance. Thus, the custom-fitting would be the best way to address each golfer for the most suitable golf equipment. Golf shaft is very important part and needs to calibrate for controlling the range and impact point between the club and the ball. In the golf shaft fitting process, it's not only concerned the shaft length but also its bouncing or swaying due to the improper alignment of the material molecules during the building processes. The proper line or angle of golf shaft needed to be calibrated before fitting it with the club.

The swaying of the shaft occurred when the golfers swing the shaft to drive the ball. The inertia of the shaft and the club would blend the shaft back. The unbalance shaft with improper molecule alignments affected to the swaying of the shaft and club which made the impact point and angle shift away from the desired point. This implied that it couldn't perfectly control the ball in both of range and direction [4].

Fig. 2.Equipment of Loft and Lie Measurement

Fortunately, to control the ball in both of range and direction, the golf shaft fitting calibration system was developed and proposed to derive the perfect line for fitting the club to the shaft. If it was perfectly fit, it would completely transfer the force from the club to the ball within the best control of the impact point and angle. The accelerometer was employed by attaching at the shaft's tip to monitor the different swaying patterns. The best derived angle indicated the minimal shaft's swaying or the narrowed-oval or even perfect line. After this procedure, the club attachment could be done within the right angle. In this manner, the golfer could perfectly control the impact point and angle between the club and the ball. In this fashion, in every stroke could be possibly to control the range and the ball direction

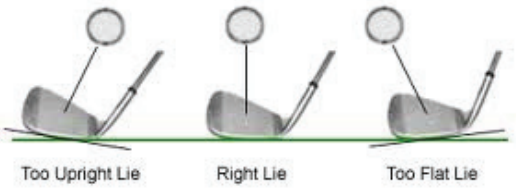

Fig. 3.The possibility of directions of the golf ball at different impact points: (a) Too upright lie, (b) Right lie and (c) Too flat lie

3. Calibration system

Theoretically, proper shaft fitting is one of the main solutions that leads to completely control the range and the golf ball direction. In general, the golfers that ignoring of the process to find the best alignment attaching to the club would making error to the impact point between the club and the ball. The proposed calibration system could bring to the best impact point. The following steps were given to determine the best angle. Firstly, attached the golf shaft to the hardest line tuning tool. It was the station for capture the shaft which could be rotated by using the weight at the end. Secondly, attached the load cell at the shaft's tip for reading the applied force. Thirdly, to rotate the shaft in the interval step of 5 degrees and read the pressure value from the load cell at the shaft's tip. The highest pressure angle was the strongest line of the shaft. On the other hand, the least bend was the hardest line as shown in Fig. 4.

Fig.4.The Load Cell attached to the shaft's tip

After that, marking the derived strongest line on the shaft then brought it to the best line calibration tool. The shaft's swaying was measured by attaching the shaft grip to the holder which can be rotated within 360 degrees. At the other end, attached the accelerometer and the iron club dummy within the equal weight to the normally clubs. During the simulation of the swing cycle, the accelerometer the acceleration of the shaft's tip was detected by the accelerometer.

Fig. 5. Sensor installation and station golf's shaft with the Holder

The accelerometer's structure was consisted of the spring and the weight tip. Whenever the movement occurred the weight tip would press to the other side and turned back to its own position after no more forcing by the spring function. The constant velocity is the zero acceleration, this measured value is not changed [5].

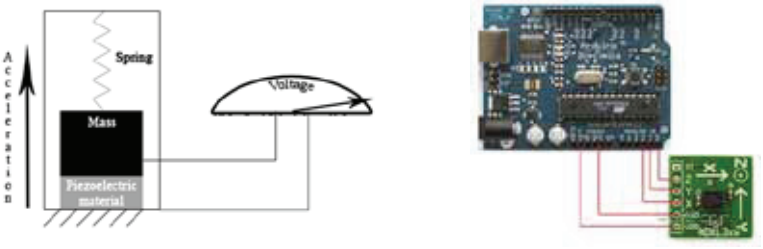

Fig. 6. Accelerometer's structure: (a) Principle of Accelerometer and (b) Accelerometer

Lastly, Fig. 7.1 to 7.3 are shown as the remaining processes. Then, the accelerometer was taken to attach with the microcontroller to convert and transform the signal to the x-y coordinate. The derived

coordinate was sent to PC via RS-232 for data processing and displaying. The swing cycle was simulated by pulling the golf tip at the end with the attached accelerometer. Level the swing cycle and forced it bounce around 10 – 15 cm for clearly view the image of the shaft swaying. Then the derived image was safe in the given file folder.

Fig. 7.1. The captured image by program

The shaft was rotated within the interval step of 5 degrees to find the best swaying pattern. The best pattern was derived from the narrowest-oval or even perfect line. The shaft was forced to bounce around 10-15 cm in every its rotation. Test it literally until getting the best angle of swaying or the best alignment line to fit to the club. Then, the club was attached perpendicular to the best alignment line.

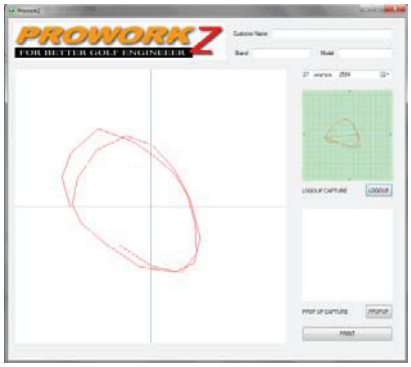

Fig. 7.2. Shaft's rotation image

Fig. 7.3. The best derived swaying angle image

4. Results

The image of the shaft fitting calibration before the process as depicted in Figure 8 implied that the range of delta Y was greater than the post process from 210 to 37. It could be said that before process, due to it's too much swing during the swing cycle would make the club improperly hit to the ball. The hitting point was not in the center of the club surface that led the ball not perfectly flew to the desired direction. On the other hand, after the shaft has been fit to the best alignment line. The swaying could be better effected than the previous one. According to the best shaft fitting, the club would hit the ball at the center and meet the desired range and direction.

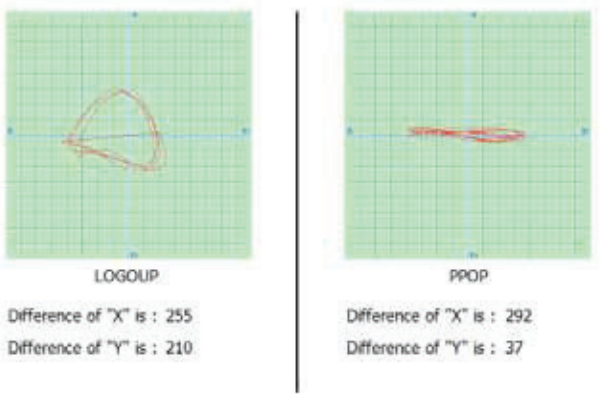

Fig. 8. The image of shaft fitting: (a) before calibration and (b) after calibration

5. Conclusion

The developed golf shaft fitting calibration system was proposed for providing the best line and angle of the shaft for a suitable fit into the club slot. The system was composed of two components: the hardest line tuning and the best line calibration tool. The derived best line and shaft's angle implied the most suitable golf shaft fitting which decreased to the minimal swaying while impacted the ball at the center point of the club surface. In this manner, ignoring of golfers error, the proposed system would enhance the potential of the golf equipments to perfectly control the desired range and the ball direction.

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