

Development of a System for Measuring the Three-axis Pedal Force in Cycling and Its Applications

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Abstract : For cycling, the analysis of the pedal force is one of the important factors in the study of exercise ability assessment and overuse injuries. In past studies, a two-axis measurement sensor was used at the sagittal plane to measure the force only in the anterior, posterior, and vertical directions and to analyze the loss of force and the injury on the frontal plane due to the forces in the right and left directions. In this study, which is a basic study on diverse analyses of the pedal force that consider the forces on the sagittal plane and the frontal plane, a three-axis pedal force measurement sensor was developed to measure the anterior-posterior (Fx), medio-lateral (Fz), and vertical (Fy) forces. The sensor was fabricated with a size and shape similar to those of the general flat pedal, and had a 550g weight that allowed smooth pedaling. Its measurement range was ± 1000 N for Fx and Fz and ± 2000 N for Fy, and its non-linearity, hysteresis, and repeatability were approximately 0.5%. The data were sampled at 1000 Hz using a signal collector. To use the developed sensor, the pedaling efficiency (index of efficiency, IE) and the range of left and right (medio-lateral, ML) forces were measured with two seat heights (low and high). The results of the measurement showed that the IE was higher and the force range in the ML direction was lower with the high position than with the low position. The developed measurement sensor and its application results will be useful in understanding and explaining the complicated pedaling technique, and will enable diverse kinematic analyses of the pedal force on the sagittal plane and the frontal plane.

Keywords : cycling, pedal force, index of effectiveness, measuring

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