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MULTI-DISCIPLINARY ROBUST OPTIMIZATION OF SPORTS DYNAMICS SYSTEM

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In most sports movement, mechanics (dynamics) govern the phenomena, and mechanical analysis and optimization technique of computational mechanics are useful tools. However, most difficult part of sports mechanics is treatment of human. The difficulty of designing sporting goods is that sports is multidisciplinary problem of human and goods that interact each other. The behavior of artifacts is simple and can be analyzed using FEM, but the behavior of human is complex, and there is an individual difference in movement of player, and even within one player,there are dispersion in movement.

In this paper the robust optimum design of golf club is carried out considering the individual swing characteristics. Bending rigidity, inclination of bending rigidity and torsional rigidity of the shaft are taken as design variables. 9 clubs are designed and manufactured based on the L9 orthogonal array. Based on the measured swing data, response surface of swing characteristics are generated. The behavior of golf club is analyzed using FEM analysis with beam elements and point mass for head, and giving forced displacement and forced rotation at the grip. The behavior of human body is analyzed using multi-body dynamics. The dispersion of the swing is measured based on the measurement of professional players, and modeled by adding standard deviation to the original swing using Fourier series functions and principal component analysis. Using that dispersion the maximizing head speed with respect to design variables while minimizing the head speed with respect to dispersion is carried out.