EFFECTS OF DYNAMIC FRICTION ON OBLIQUE IMPACT BEHAVIOR OF GOLF BALLS

K. Arakawa
*corresponding.author k.arakaw@riam.kyushu-u.ac.jp
a Research Institute for Applied Mechanics, Kyushu University
6-1 Kasuga-koen, Kasuga, Fukuoka 816-8580, Japan

KEYWORDS
Energy and friction in sport and leisure activities, oblique impact, golf ball, dynamic friction, sliding velocity, contact area

ABSTRACT
A previous study [1] investigated oblique impacts of a golf ball of mass \( m \) (46 g) and radius \( r \) (21.3 mm) with a rigid target inclined at an angle \( \theta \) (30°) (Fig. 1a) and demonstrated the following: (i) the contact force \( N \) and area \( A \) rose in the early phases of the impact and then reduced in the later phases (Figs. 1b and c); and (ii) the angular velocity \( \omega \) can depend on \( A \) and the ball centre velocity \( u_b \). However, the dynamic friction \( F_d \) causes the shear deformation of the ball, and consequently the discrepancy between \( u_b \) and the contact centre velocity \( u_c \). This study used the analytical model proposed for the dynamic sliding friction on lubricated and non-lubricated inclines [2,3]. The contact area \( A \) and the velocity \( u_c \) were used to describe the dynamic friction force \( F_d = \lambda A u_c \), where \( \lambda \) is a parameter related to the wear of the ball surface [4]. This study proposed an elastic sphere model to understand the mechanism of shear deformation during oblique impacts.

Figure 2 shows the tangential ball centre velocity \( u_b \) and contact centre velocity \( u_c \) for \( V_i = 37 \text{ m s}^{-1} \). \( u_b \) reduced in the initial phases of the impact, rose in the intermediate phases, and then reduced again in the final phases, whereas \( u_b \) showed the opposite trend.

REFERENCES