

Through its extensive collaboration in academic and European projects and joint studies, ESI Group's biomechanical activities have led to many capabilities in PAM-CRASH for modeling the human body, including active musculoskeletal models, as well as modeling of bone fracture and ligament injury. MIZUNO Corporation found it appropriate also for modeling inoffensive body impacts found in sport.

MIZUNO Corporation applies advanced technologies to superior quality sporting goods in order to design products with unique features that enhance athlete's performances. Among its numerous studies on footwear development, MIZUNO Corp. has been using PAM-CRASH in their quest for improved results in numerous applications.

Soccer: Improving Speed and Control

Computer simulation reveals phenomena that cannot be measured with real-life testing. Using PAM-CRASH, MIZUNO Corporation has simulated the impact of a soccer player's shoe on a soccer ball in order to improve both speed and control.

When a player kicks the ball, he needs to be able to deliver top speed. Therefore, a high reflection coefficient of the shoe's upper (top of the shoe) is important. Furthermore, he needs to be able to control the soccer ball's direction and spin. The longer the contact time between the upper and the soccer ball, the more control the player gets.

In order to provide the best compromise to its demanding customers, MIZUNO Corporation used PAM-CRASH to simulate the contact between the upper and the soccer ball (Fig.1), using various materials and geometries. The two parameters sought were the reflection coefficient of the upper and the contact time. The valuable output data allowed MIZUNO Corporation to choose optimal materials for the 'shoot' area (infront and instep kick areas) and the 'pass' area (inside kick area), as shown in Fig.2.

MIZUNO Corporation uses PAM-CRASH to improve sports footwear performances

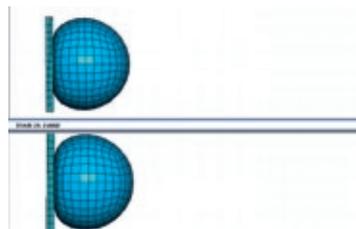


Fig. 1 The simulation of the impact between the upper and the soccer ball

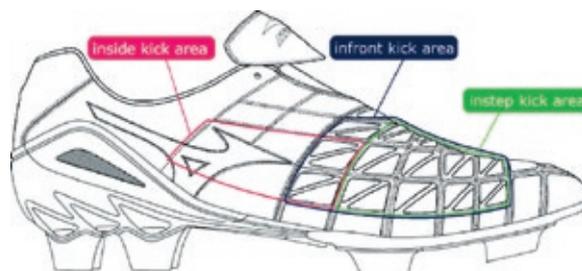


Fig. 2 The design of the upper

More support in side-stepping

In most sports such as soccer, volleyball, tennis and basketball, player movements are often made in cross directions. If the shoe upper is excessively deformable, the shoe will not sufficiently support the foot in the cross direction. Therefore, shoe design must be such that a sturdy material is set in a way that will not interfere with running, but will help the upper to support the foot. In order to identify the specific location of this reinforcement, MIZUNO Corporation has measured lateral movements of a professional athlete, and simulated the motion with PAM-CRASH. The Finite Elements Model (FEM) for the lower leg consisted of the bones, soft tissues, shoe upper and shoe sole (Fig.3). Through simulation, the value and direction of the stress in the upper were calculated (Fig.4). The highest stresses were revealed in the area of the fifth proximal phalanx in the upper, and a significant deformation of the upper appeared during sidesteps. In order to control deformation and reduce power loss, the shoe was reinforced at this specific location (Fig.5).

Through these two similar yet very different studies using ESI Group's human modeling capabilities, MIZUNO Corporation has been able to provide its demanding customers with yet more comfort and performance in high-end sporting footwear.

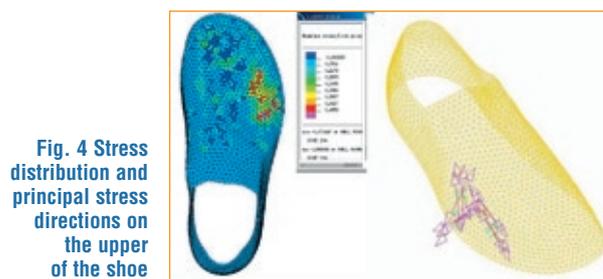


Fig. 4 Stress distribution and principal stress directions on the upper of the shoe

Fig. 3 The FEM lower leg model

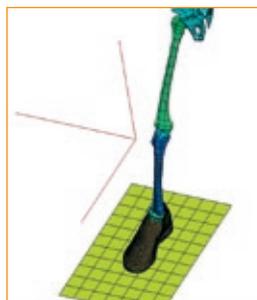


Fig. 5 The volleyball shoe. The seam is embroidered on the upper.



About MIZUNO Corporation

MIZUNO Corporation's principal activities are the manufacture and sale of golf, baseball and other sports equipment, sportswear and footwear. The operations are carried out through two divisions namely: Sporting Goods and Other. Sporting Goods division deals in golf goods, other sports goods, sports wear and shoes. Other operations include sports facilities such as management of track fields, tennis courts, gyms, golf driving ranges and golf courses. These products are also marketed in European and American countries as well as in Asia.