

Modeling the behavior of dry sand with DEM for improved impact prediction

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Modeling pumpkin ball [a basketball filled with dry sand ($3/4^{\text{th}}$ volume)] of mass 9.3kg. To screen and work on different console (user interface) designs for passing safety related test before physical assembly level prototypes are available much later in the development cycle. Creating a standard simulation model that would capture the forces imparted on any impacting surface due to inertia and behavior of sand particles inside a basketball. Scope limited to create a standard simulation model to include the combined effect of basketball stiffness and sand particle behavior during impact. Different modeling techniques to capture the physics of the problem were evaluated concluding on use of DEM formulation. To validate the simulation model, two experiments were carried out. In one case ball tied to a rope hung 74" from fixed end was hit on a square steel plate held by a fixture at four corners. Acceleration data on two locations of ball and on steel plate near impact point was captured. In another case the same setup was used and the ball was impacted on a concrete wall. acceleration values on ball was recorded. Acceleration data was used as the key parameter to correlate simulation model to lab test considering noise factors in physical test . The final simulation model is used to predict the behavior of electrical parts and weld strength (ultrasonic weld) between the console plastic parts. Further lab test is carried on product level to ensure the accuracy of the simulation results. Compiling the output of simulation and physical test, simulation model created can be used further to verify the designs for failure much earlier in the console (UI) design and product development cycle thus reducing overall development time and reduced prototyping cost and time.