

Analysis of dynamic back face deformation of a body armor impact by a rifle bullet using 3D-DIC

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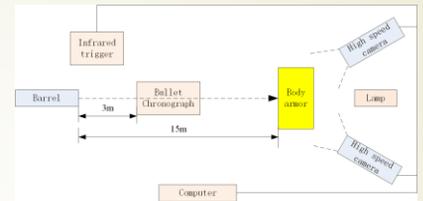


INTRODUCTION

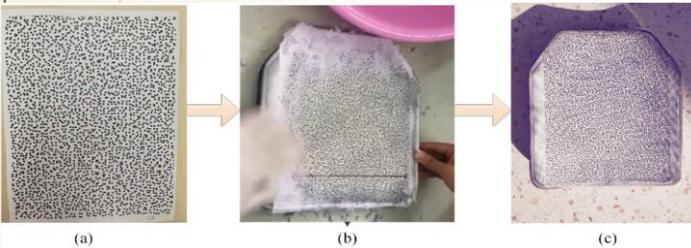
The body armor can stop the projectile, but the resultant behind armor blunt trauma (BABT) can still cause serious injury to the body. The 3D-DIC methodology was used to directly measure the shape and size of the BFD time histories, deformation velocity, acceleration and line slices profile on armor back face.

METHODS

By using the 3D-DIC technique, the ballistic impact of a rifle bullet penetrating an NIJ III level ceramic/UHMWPE body armor fixed on a shelf is then conducted. Three group experiments were conducted by firing a 7.62x39 mm bullet shooting at the center of each body armor front surface. The speeds are 675.4 m/s, 676.1 m/s and 675.1 m/s, respectively.



Schematic of the experimental setup.

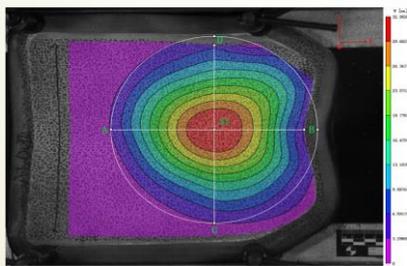


Create the speckles on the back face of the body armor

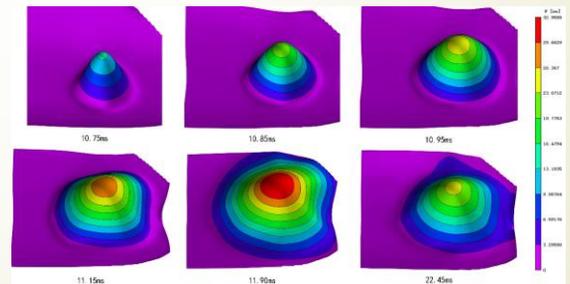


DIC test system

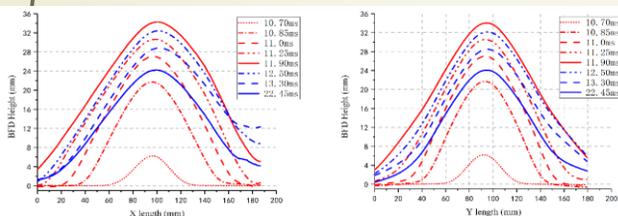
RESULTS



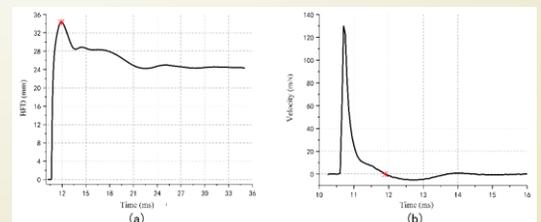
Schematic of line slices position.



The 3D shape of the BFD created by DIC software.



Line slices profile of BFD during loading and unloading.



The time history curves of (a) displacement and (b) velocity for the point of maximum BFD

CONCLUSIONS

The 3D-DIC method provides the results of full-field deformation, line slices profile of BFD, deformation velocity and acceleration on armor back face. These results could then be used to assess of ballistic performance of body armor and the severity of blunt trauma.