

R&D Division Project Summary

University of Houston researcher Dr. S.S. Wang is developing a suite of computer models that will help evaluate and predict the performance of ballistic body armor designs. Actual ballistic lab tests will be used to verify and calibrate the models. In addition, he and his colleagues will be evaluating the way the materials involved degrade with normal wear.



The first step is understanding the behavior of the underlying materials (Kevlar, Zylon, nylon, fiberglass and various hybrid fabric systems). Standardized tests will be developed to measure their response, yielding equations that can then be incorporated into computer models. The new test protocols will also make it easier to compare the performance of new materials and hybrid systems as they arise.

Next, a set of models for describing the way yarns behave in woven fabric will be constructed. Current models emphasize the way yarns hinge about each other where they cross in the weave. The new models will account for inter-fiber slippage, friction, and the effects of the structure of the weave itself.

The behavior of visco-elastic materials used in soft armor behave can be surprising when strained at the very high speeds of ballistic impacts, where many interactions are taken to be adiabatic. Accurate models will need to take this into account, so parameters describing the way fibers stretch and fracture, and the way they slip against each other will be developed. This will help predict the penetration characteristics of various fabrics depending on the speed of impact.

It will then be possible to determine the way layers of fabric interact, especially the way that the layers slip and stick as they rub together, and the way that energy moves through the fabric in both transverse and planar waves. Of particular interest will be the performance of hybrid materials, including both individual layers made up of two or more kinds of yarns, and layers of different materials.

Then too, there's more than the vest in question: there's the person wearing it. Almost nothing is known about the way flesh behaves behind soft armor, and yet the performance of the armor depends on being backed up by the relatively solid bulk of the wearer's body. This research will shine light on the armor/body interface, with an eye towards developing analytic and predictive models of armor performance, as well acquiring a better understanding of how the energy of the impact is dissipated in the body, and how this results in the sometimes-deadly blunt trauma that results.

Finally, lab testing will be done to help understand the environmental effects of storage and use on the materials. Currently, the mechanisms of how the materials age and degrade are not well understood at either the chemical or physical levels, and it's not possible to predict how long a particular material will remain effective in the field. The results of this research, useful in its own right, will also be incorporated in the computer models.

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