8th. World Congress on Computational Mechanics (WCCM8)
5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 –July 5, 2008
Venice, Italy

MULTI-SCALE CONSTRUCTION AND LARGE-SCALE SIMULATION OF DYNAMICALLY LOADED STRUCTURAL FABRIC

*** David A. Powell[1], Tarek I. Zohdi[2] and Charbel Farhat[3]**

[1] University of California, Berkeley
6181 Etcheverry Hall
University of California
Berkeley, CA 94720-1740
dpowell@me.berkeley.edu

[2] University of California, Berkeley
6117 Etcheverry Hall
University of California
Berkeley, CA 94720-1740
zohdi@me.berkeley.edu

[3] Stanford University
Building 500, Room 501G
488 Escondido Mall
Mailcode 3035
Stanford University
Stanford, CA 94305
cfarhat@stanford.edu

Key Words: *Fabric, Fiber, Multi-Scale, Impact, Simulation.*

ABSTRACT

Ballistic fabrics such as Kevlar and Zylon are finding new uses not only as shielding for personnel but also in commercial and military aircraft protecting flight critical components in the event of a high speed ballistic impact. Since experimental tests on these materials are often expensive and time consuming, a model amenable to large-scale numerical simulations would provide an ideal alternative. A novel approach, and matrix-free solution methodology, has been developed to deal with multi-scale ballistic fabric extracting information from the micro-scale fibril material properties to build the macro-scale sheet. The stochastic nature of the material, due to the random variation in the yarns caused by the weaving process, is built into the model. These variations are critical to capturing the heterogeneous damage and failure of the material as seen in experimental tests. Further applications cover a range of fiber-based materials including composites and fibrous biological tissues.