MODELING TECHNIQUES AND COMPUTING TIME FOR IMPACT SIMULATIONS ON WOVEN FABRICS

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INTRODUCTION

Model Impact Response of 600 Denier Kevlar KM2

One-layer fabric configuration: \( V_s = 106.3 \) m/s \( V_r < 0 \) Full-Local Model Validated

Two-layer fabric configuration: \( V_s = 162.3 \) m/s \( V_r > 0 \) \( V_s = 168.3 \) m/s \( V_r > 0 \) and \( V_s = 156.3 \) m/s \( V_r < 0 \) Full-Local Model Validated

Fabric Specifications:
- 34 yarns per inch.
- Areal density = 180 g/m².
- Single layer fabric thickness = 0.23 mm.

Modeling strategies:
- Yarn level resolution 3D FE models – Full-Local (FL) Solutions.
- Multi-scale models combining 3D undulating yarns and homogenized domains – Global-Local (GL) Solutions.

GLOBAL-LOCAL SOLUTIONS

\( \alpha-\beta \text{GL} \Rightarrow \alpha = \text{Mass Percent of Global Region}; \beta = \text{Mass Percent of Local Region}. \\

CONCLUSIONS

- Demonstrated acceptable agreement between FL and GL solutions.
- GL modeling accrues appreciable savings in computing time.

FUTURE WORK

- Perform bounding simulations to characterize the effect of scatter in yarn modulus.
- Investigate the suitability of other GL mesh configurations for reducing computing time.
- Model four-layer fabrics based on the GL technique.
- Model large-scale fabrics measuring about 18" by 18" in-plane with 10-12 layers.

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