ACC100 Crash Energy Management

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This presentation does not contain any proprietary or confidential information

AUTOMOTIVE COMPOSITES CONSORTIUM

Purpose

- Develop predictive computer software tool for crash of structural composites
- Experimentally obtain properties as input to predictive model
- Develop associated models for properties as input to predictive model
- Facilitate next steps for projects

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Team Members

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Materials Working Group - Purpose

- **Develop and demonstrate the technology required to apply production feasible structural composites in crash and energy management applications.**

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Barriers

- **Understanding of the energy absorption mechanisms and associated material models**
- **Material characterization methods**
- **Knowledge-base of crash performance**
  - **Structural shapes and materials**
- **Validated design tools and design practices**

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Approach: Work with these organizations

- **Oak Ridge National Lab**
- **Universities**
  - University of Michigan, Northwestern University, University of Utah, University of Nottingham (UK), Rutgers, RPI, South Dakota School of Mines
- **Partnered with NSF projects at Rutgers and RPI**
- **Suppliers**
  - Vectorply, HITEC Corp., A&P Technology, Excel Pattern

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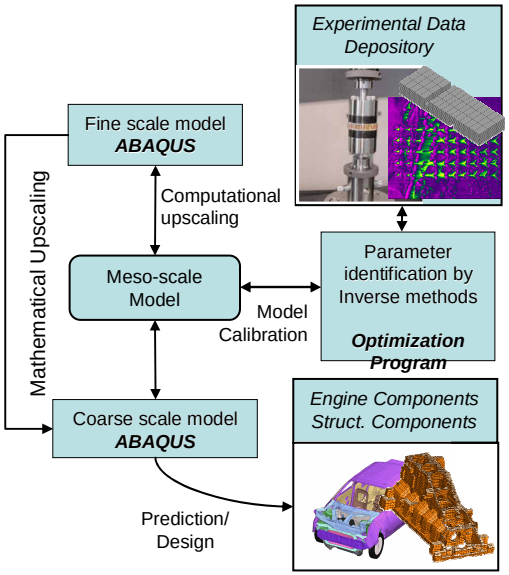
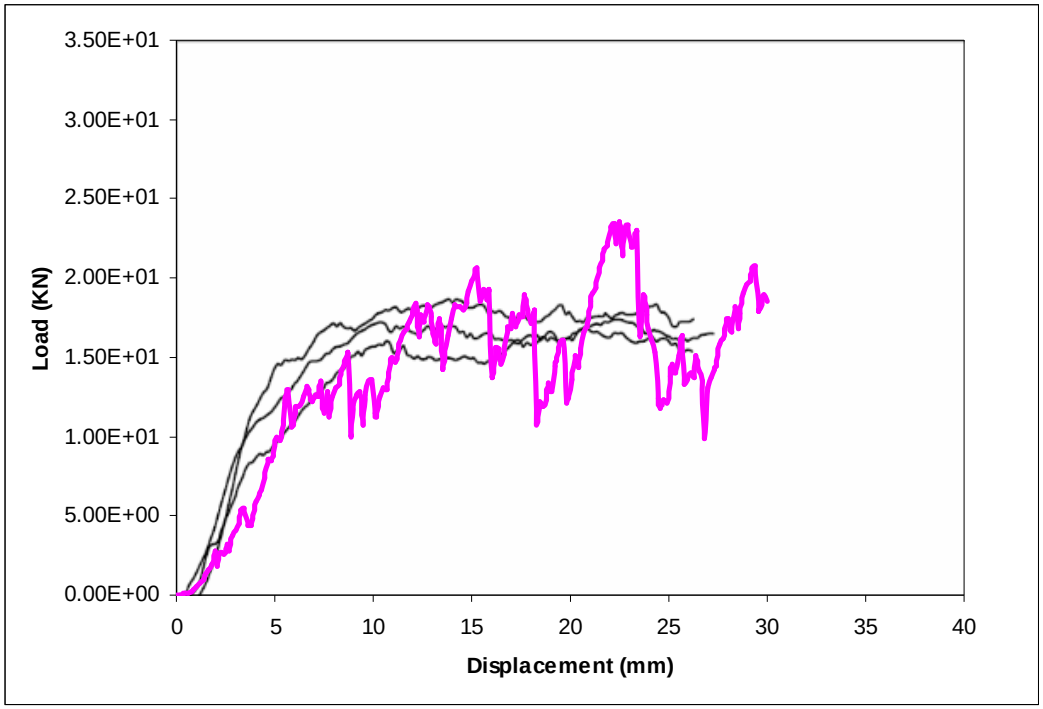
Accomplishments

- Multi-scale predictive software has been demonstrated for quasi-static tube crush for tri-axial carbon fiber braid



Multi-scale Design System developed at Rensselaer



Comparison of the multiscale simulation and experimental results for circular tube made of 60º braid architecture in quasi-static loading

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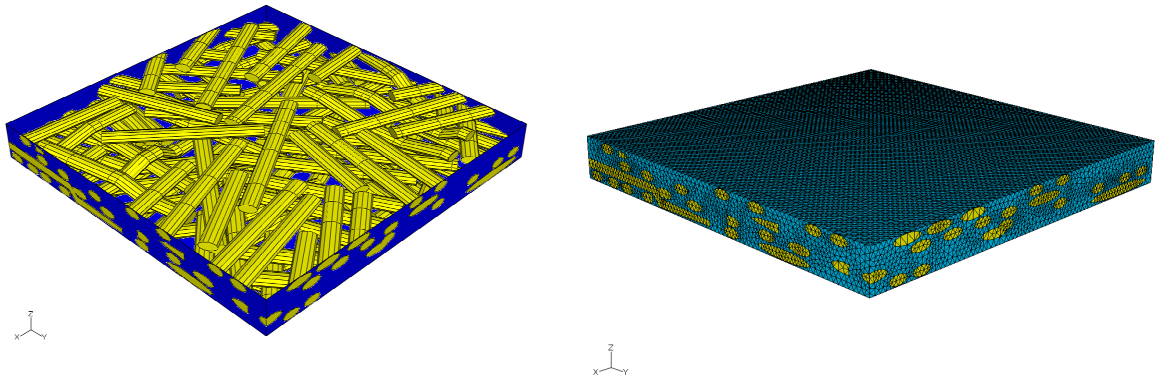
Accomplishments

- Random carbon fiber crush prediction software development continued: Random fiber unit cells have been automatically generated up to 37% fiber content using a novel Hierarchical, Micro Experimental and Computational Characterization (HiMECC) method



HFVFSI-algorithm generated Representative Volume Element of 36.7% volume fraction random composite (eliptical cross-section bundles)

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Accomplishments

- Strain-rate dependent experimental data has been obtained to extend quasi-static codes to dynamic simulation
- Interface properties were obtained to characterize fiber-matrix failure mode
- New projects were initiated to investigate scale effects of brittle composite materials and to develop methods to predict insitu matrix properties of composites

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Technology Transfer

- Current software development activities at the universities are using the Abaqus finite element package which is known to have a strong support program for universities
- The final development step will be to implement validated algorithms into LS-Dyna, the most commonly used crashworthiness package used in the auto industry

Activities for the next fiscal year

- Further develop multiscale predictive model to include time dependent data
- Develop method to predict insitu matrix properties
- Investigate scale effects for properties of brittle materials
- Further develop random carbon fiber predictive tool
  - Obtain validation data for random tubes