Discrete, Mesoscale Modeling Of Composite For Attributable Aircraft

STUDENTS: Sean Phenisee (presenter) and Antonio Deleo

Why Moving Towards Attributable Aircraft?
- Operation cost: ~$27,000 per hour of flight
- Estimated lifetime cost of F-35 (2070) is $1.5 trillion according to Pentagon
- Solution: Attributable aircraft - UAS with low cost in procurement and maintenance; easily replaceable
- Low risk of losing them during a mission

Challenges From Automated Manufacturing
1) Analysis of
   - Complex joints
   - Complex structural parts
2) Defects from manufacturing process
   - Requires more testing for analyzing these structures

Project Objective
- "Develop a model to predict the mechanical behavior (damage and failure) of composite materials on attributable aircraft to reduce design iterations and high-cost experiments."

Composites And Automated Manufacturing
- The capability profile of attributable aircraft is similar to that of manned aircraft (e.g. F-35)
Advantages of Composites:
- Low density (Light weight)
- High stiffness
- High strength

Benefits:
- Lower operation cost
- Advanced operation profile

Discrete Approach for a Mesoscale Model
- Our discrete approach: explicitly model fibers (beams) and matrix (surrounding facets)
- Problem of homogenized approaches
  - The laminate/lamina is treated as equivalent homogeneous medium;
  - No progressive damage (no delamination, no matrix micro-cracking etc.);
  - Very limited accuracy
  - Tricky to model defects, complex joints

Future Work, and Acknowledgments
- Model manufacturing process
- Topology optimization

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Faculty: Prof. Marco Salviato
Graduate Students: Antonio Deleo, Sean Phenisee
Industry Partner: Daniele Pelessone (ES3)

ADVISERS: Prof. Marco Salviato (PI) and Daniele Pelessone (industry partner from ES3)
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