



## More Efficient Laminate Analysis

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**The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a fully automated method for achieving 3-D structural analysis of composite laminates.**

### Overview

Lamination includes various techniques of manufacturing materials in multiple layers or 'plies.' Laminates are commonly used in the automotive, aerospace, medical and consumer industries. A simple example is plywood.

Structural analysis of more complex laminates that include tens or hundreds of different layers is challenging and typically aided by computerized Finite Element Analysis (FEA). Two-dimensional FEA methods based on plate and shell theories may be reasonably accurate and efficient, but generally do not apply to whole structures and require manual preprocessing. In contrast, fully automated three-dimensional techniques are possible in principle but rarely practiced due to high computational cost.

The choice between 2-D and 3-D FEA amounts to an unsatisfactory tradeoff between generality and computational efficiency.

### The Invention

UW–Madison researchers have developed a method for analyzing composite laminate structures that combines the generality of 3-D FEA and efficiency of 2-D FEA whenever it is applicable. The new method works by substituting the laminate layers with much simpler virtual material models having matching characteristics (e.g., overall material properties and relationship between stresses and strains). The updated model can then be analyzed via fully automated 3-D FEA.

The virtual models may be referred to as ABD-equivalent models, as they result in the same ABD stiffness matrices as the real laminate and can act as substitutes if plate-shell assumptions apply.

### Applications

- New or add-on software package for FEA
- Structural analysis of car shells, airplanes, sporting equipment and other laminate materials

### Key Benefits

- General and efficient
- Achieves fully automated 3-D analysis
- May be used in any suitable computer aided engineering system (CAE)

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### Stage of Development

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The researchers have implemented the new method in their own software and tested various simulation conditions to determine accuracy.

## Additional Information

### For More Information About the Inventors

- [Vadim Shapiro](#)

### Tech Fields

- [Engineering : General engineering technologies](#)
- [Information Technology : Computing methods, software & machine learning](#)

For current licensing status, please contact Emily Bauer at [emily@warf.org](mailto:emily@warf.org) or 608-960-9842

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