Evaluation of Finite-Element Analysis Software Packages by Accuracy and Efficiency

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Abstract

In current mechanical design world, FEA software packages are often employed in the analysis of complex structural components to apply complex loading conditions and predict stresses and displacements. The FEA provides quick solutions to optimize and validate each design step efficiently by allowing quick turnaround times and prompt implementation of analysis result in the design process. When the FEA is used properly, it brings a great productivity helping design engineers reduce product development time and cost. On the contrary, misapplication of FEA may lead to flawed design decisions, which are very expensive to correct later in the design process. Therefor the interpretation and accuracy of analysis results should be carefully evaluated when it plays a major role in the decision making process.

The FEA works by breaking a real object down into a large but limited number of elements. The structure is discretized and not based on continuous solution. This nature of FEA can cause an error function and unstable solution when not enough number of elements is employed for its calculation. On the contrary, overloaded number of elements can cause unnecessary extended time and costs for calculation. Therefore the number of elements and its accuracy of analysis should be carefully considered for its optimized results. Even though modern commercial CAD/CAE packages provide generally acceptable results with fairly simple FEA environments, there has not been a study comparing its performances side by side. The performance of the FEA packages can be determined by different ways, such as 1) accuracy of calculation results, 2) resemblance of real world - not overly simplified loads and restraints, and 3) efficiency of utilizing number of discretized elements. In this study, a comparison of five widely adopted commercial CAD/CAE packages is provided with a large number of FEA verification models, which compare analysis results with theory cases found in common engineering references. The performance of each packages are presented by 1) accuracy over limited number/size of elements and 2) calculation speed over limited number/size of elements. The results provide an alternate approach to measure the performance of FEA software packages.

Biography

SAMSON LEE is currently a faculty member in School of Engineering and Technology at Central Michigan University. He earned his M.S. and Ph.D. in Industrial Education and

Technology at Iowa State University. His research and teaching interests are in artificial intelligent for mechanical design and manufacturing, signal processing for machine condition monitoring, and verification of CAE tools for mechanical design process. He can be reached at samson.lee@cmich.edu .