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Finite element analysis for tool designers

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There is a universal truth in corporate success: constant innovation is required. As global competitiveness continues to escalate, cutting tool designers face a pressing need to fast track their R&D initiatives while maintaining quality.

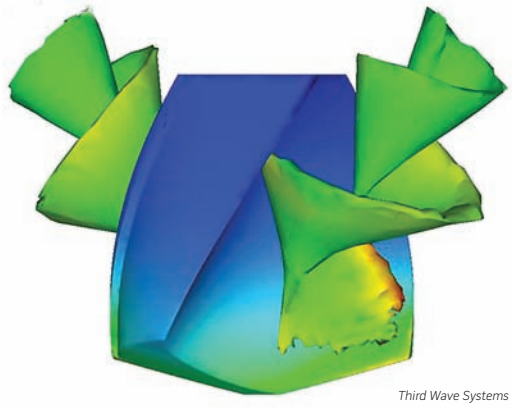
Finite element analysis software provides toolmakers with a virtual testing environment for evaluating tool designs. Whether conducting a side-by-side comparison of different helix angles or evaluating chipbreaker geometries, manufacturers can utilize FEA to more efficiently and affordably recognize promising prototypes. FEA software can also avoid costs associated with testing faulty prototypes by identifying top performers without trial-and-error testing.

FEA simulations provide more data than trial-and-error tests, including cutting forces, temperatures and stresses. This reduces design iterations and helps get tools to market faster.

"By utilizing FEA, we estimate that tooling costs for a project can be reduced 30 percent and development time can be reduced at least 15 percent compared to proceeding via conventional trial and error," said T.J. Long, engineering manager of indexable milling systems at Kennametal Inc., Latrobe, Pa.

In addition to providing more advanced modeling capabilities, FEA technology has become more industry-specific. However, this has had a polarizing effect on software applicability; technology that becomes an asset to one market may no longer be the best resource for another. FEA software best suited for toolmakers must offer the ability to quickly set up and dynamically analyze cutters under specific machining conditions.

When choosing an FEA package, it is critical to consider material-modeling capabilities. Without the ability to model the impact of tool performance when machining specific workpiece materials, FEA falls short of being an irreplaceable resource for tool design. After all, simulating the behavior of a poorly defined material does little to confirm satisfactory chip shape or tool wear for an endmill cutting cast iron or an insert turning titanium. Thankfully, FEA packages are commercially available that do incorporate material modeling within their interfaces. For example, Third Wave Systems' AdvantEdge FEM software includes a database of 140 physics-based material models, as well as the option to define a custom material model.



Third Wave Systems

Third Wave Systems' AdvantEdge FEM finite element analysis software generates a temperature profile for a drill.

However, ease of use is perhaps most important. Because toolmakers must capture an array of machining and FEA parameters—such as tool motion and tool and workpiece material, geometry and positioning—setup time can make or break the decision to adopt FEA technology. The more automated the setup, the more easily the technology can be implemented within the design cycle. Tool manufacturers with the right technology can configure, run and analyze tool performance in less time than previously required to complete process setup.

AdvantEdge FEM was developed specifically for machining, and its capabilities reflect this focus with automatically programmed tool motion for various machining processes, custom tool and workpiece geometry imports, automatically determined and applied finite element meshes, and post-processing features that enable easy analysis and simultaneous comparison of multiple simulations.

FEA technologies have gone through a remarkable evolution in just a few years, and developers are the first to tell you the work is far from finished. Therefore, as industry needs are continually refined, many FEA software developers have instituted an unofficial "open-door policy" for receiving feature and capability suggestions. For example, customer suggestions have resulted in enhanced AdvantEdge FEM capabilities, such as new user-defined material modeling(s) and residual stress modeling.

Processing performance and simulation quality have also improved via display options for viewing the chip, tool, workpiece and cutter body independently and collectively; faster mesh generation was achieved via tool truncation and selective mesh refinement; and the ability to process using multiple cores simultaneously was realized. Through collaborative customer interaction, Third Wave Systems is also beta testing a high-performance computing client, increasing the software's efficiency and effectiveness.

Make no mistake: Whatever your product, there is always room for improvement. For cutting tool manufacturers seeking a competitive advantage, FEA technology is an essential tool for better understanding the "whys" of tool performance while fast tracking the design cycle and minimizing R&D costs. The question is no longer "how can I incorporate FEA into my design cycle?" but "how can I *not* incorporate FEA into my design cycle?" CTE

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