

## *AMPS Product Whitepaper...a letter to engineers*

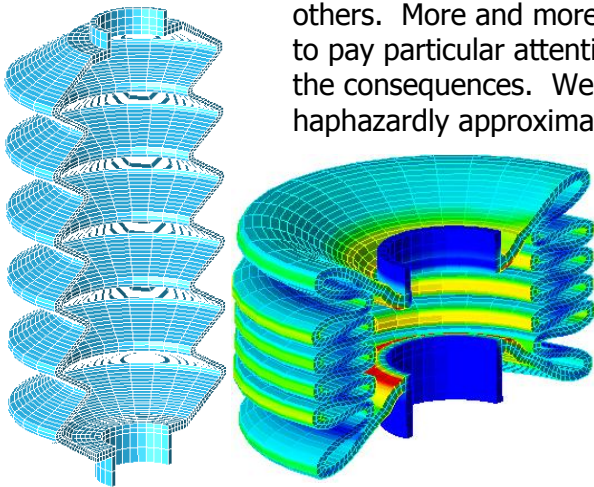
We crawled out of the sea. We made tools; we started making things. As those things became bigger and more complicated, master builders - with practical experience combining engineering and architecture - met the need. For all these early years the evolutionary course of designing and building evolved only trial-and-error, improving incrementally year-by-year, build-by-build.

All this empirical evidence fueled the advancement of science during the Renaissance, when, for the first time, mathematics was used solve real-world problems. But it wasn't until the 1800's and the Industrial Revolution that mathematical formulae would commonly be used to assist with design, and engineering would emerge as a separate profession.

In the 1940's NYU Professor Richard Courant fit structural engineering formulas into matrices of partial differential equations to evaluate structures by what he called "finite element analysis" (FEA). All calculations were done by hand.

Then came the Computer Revolution. In the early 1950's researchers at the University of California, Berkeley, pioneered computerized numerical analysis and wrote programs to solve the large systems of equations necessary for modeling structures. After years of tinkering with FEA code in-house, Professor Ed Wilson released his SAP finite element code to the public domain in 1970.

Amazingly this very same SAP code, written way back at the dawn of the computer age in the now-ancient language of FORTRAN, still survives at the heart of many commercial FEA programs today. The code being old is not the only problem - what makes matters even worse is that these products now carry a multitude of scars from years of work-arounds and patches performed by the SAP-based marketers struggling to keep their aging products relevant in the face of engineers' growing needs and expectations. Once-mighty SAP has become a bloated patchwork-quilt of kluges, with masked, cascading errors which vary with the task and are nearly impossible to account for. The SAP scions may have done the best they could to keep their products afloat, but we engineers now pay stiff penalties for the compromises they made in that pursuit.



As engineers we need to have confidence in the answers we provide for others. More and more these answers come from software, so we need to pay particular attention to this "man behind the curtain" - we live with the consequences. We need to *know* that our analyses aren't being haphazardly approximated by the drifting, accumulating errors

concomitant with long-in-the-tooth code and years of band aids and fixes. Hard-fought but defective answers, no matter how well-intentioned, are worse than guesses because they're taken as fact. Therefore, the most insidious outcome of these misguided calculations is that you seem to have made all the right moves, yet behind-the-curtain calculation-drift has taken your answers wide of

the mark. And what's most dangerous is you *think* you know - **you don't know you don't know.**

Welcome to the 21<sup>st</sup> Century - we now have a new, modern tool to take up the fight. The development team at AMPS, led by Dr. Ted Lin, PE (Ph.D. Engineering Mechanics, MS Computer Science, U.Texas) took a fresh look at FEA and built **AMPS For Engineers™** from the ground up using modern computer architecture, writing all new code in contemporary language. AMPS integrated all those features that had been patched onto SAP over the years, and in addition suffused **AMPS For Engineers™** with the latest engineering technologies. At the core: **MultiBody/MultiPhysics (MB/MP).**

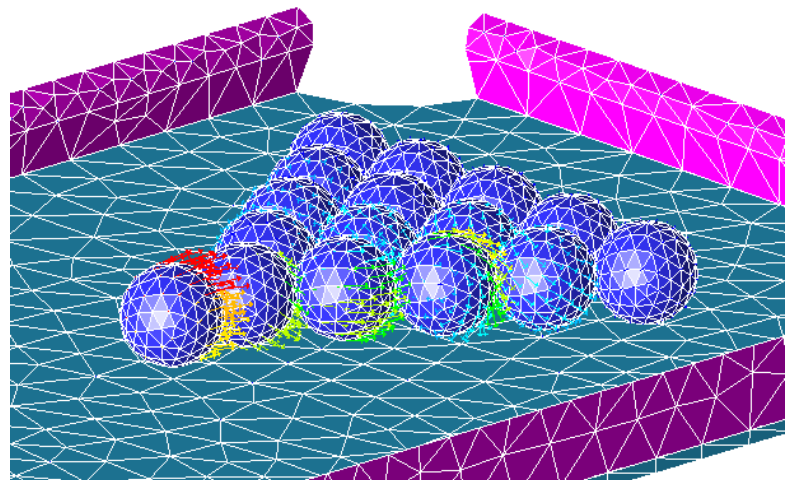
With **MultiPhysics** all energies are considered in the same manner mathematically - every factor is seamlessly integrated with its neighbors in a continuous stream of coherent equations, in what Steve Robbins, the Editorial Director of Desktop Engineering Magazine, referred to as a "unified math solution." **MultiBody** means interactions between multiple separate parts are accurately predicted without the need to additionally define that interaction. If you've got assemblies, or systems, this is what you need.

Unleashing the power of **MB/MP** allows **AMPS For Engineers™** to readily solve the gamut of complex problems, including couplings of heat transfer, non-linear, fluids, and contact - with much higher accuracy and much greater speed. **AMPS For Engineers™** is the **21<sup>st</sup> Century tool** for FEA. It's elegant. It's efficient. It's accurate. And it is **FAST.**

New code and modern architecture served to make **AMPS For Engineers™** very fast - but AMPS took yet another quantum leap forward with its proprietary thread-pooling technology which automatically detects the number of processor cores you have available and distributes the workflow among them. This is **true** multi-threading (not just locally-parallelized like everyone else) - try that with FORTRAN! **AMPS For Engineers™** flat-out flies down this multi-lane data highway, solving a blazing 11 million equations per hour on an 8-core machine while most FEA solvers struggle to achieve only a fraction of that speed.

And **AMPS For Engineers™** isn't just processor-fast - it's *design process-fast*, the FEA tool to get your job **done.** And you get **design headroom**, because you can't afford to stop everything and move your analysis over to some other, more-advanced software package every time your thinking evolves.

When you're doing a stress analysis problem using **AMPS For Engineers™** you can keep moving forward with confidence, even after you realize you need to step it up and couple heat transfer, electrical effects, fluids for subsequent analyses. No matter where a problem might take you, no matter how deep you need to go, you can count on **AMPS For Engineers™** from start to finish. Now you'll be able



to meet, or exceed, your design goals in a fraction of the time - and when answers come faster you'll be able to do more analyses, test more ideas, and make more improvements. Plus you can animate and visualize your results. The bottom line - **AMPS For Engineers™** will make you a better engineer.

**AMPS For Engineers™** allows you to take on the challenges of our highly competitive world head-on, enabling solutions from boutique to global. For large-scale manufacturing applications **AMPS For Engineers™** can optimize material-use and create value that extends through the entire supply chain: fewer raw materials to buy, lower inbound transportation costs, lower handling costs during manufacturing, less scrap and waste, and lower transportation costs getting finished goods to market. For complex, esoteric applications **AMPS For Engineers™** has the suite of tools and the raw power to handle any problem, or combination of problems, imaginable. Linear, non-linear; plastics, elastomers, fluids, plasmas; heat transfer, contact, magnetic, electric, electro-magneto, shock, nuclear - you name it.

**AMPS For Engineers™** does come with its own solid modeler, but even if you are already using SolidWorks, Inventor, ProENGINEER, etc., you can still benefit from **AMPS For Engineers™** superior FEA capabilities. By simply importing your ACIS or STEP files into **AMPS For Engineers™** you will realize significant improvements in accuracy and speed over what you are using for FEA now. Time is so valuable – why not use the fastest, most comprehensive, tool available?

**AMPS For Engineers™** was created **by** engineers **for** engineers, and they've vowed to keep exceeding expectations of what FEA software can do. They're not just product developers, they're FEA enthusiasts committed to solving the toughest problems faster and with higher accuracy. They want to hear more from working engineers about the challenging problems they face so they can keep improving the way those problems get solved.

Check out <http://www.ampstech.com> for example solutions, tutorials, and more details about AMPS Technologies and how it all works. The latest version of **AMPS For Engineers™** has just been released and it's available for a free trial at [www.ampstech.com/testdrive.htm](http://www.ampstech.com/testdrive.htm) - so go ahead, take it out for a spin. But hold on to your hat - you're going to like it a lot!

*Philip Mische, AMPS Senior Applications Engineer, is a mechanical engineer. Involved with FEA since the early days of Algor in 1988, Mische has extensive design and construction experience with large-scale automated theatrical effects for Broadway, Las Vegas, and touring shows. He has also taught Thermodynamics, Fluid Mechanics, and Thermal Engineering.*

