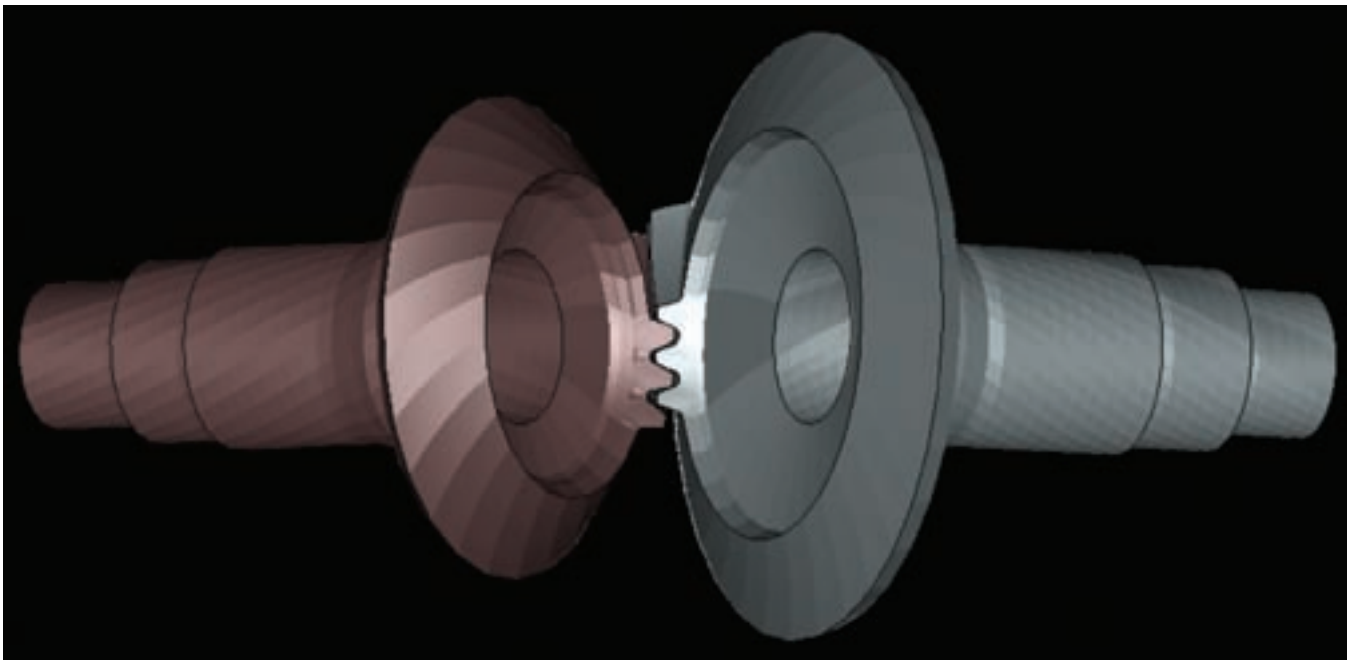
GPSys Critical to Spiral Bevel Gear Life

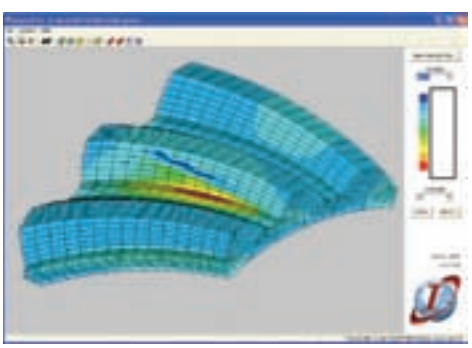
IMPACT TECHNOLOGIES CONSIDERS COMMERCIAL VERSION OF SOFTWARE PACKAGE



CAD model of a sprial-bevel gear set.

Impact Technologies delivered a software module that combines tooth contact analysis, stress analysis and fracture mechanics evaluation for spiral-bevel gears to the U.S. Navy in 2006. *GPSys* was originally developed to examine helicopter gearing.

"The ability to predict remaining useful life of spiral-bevel gearing, based on assumed initial flaws and specified mission profiles was the initial motivation behind creating *GPSys*," says Jeff Steele, manager of software and services at Impact. "For the stress analysis portion, traditional formulas in truck or automotive applications assume that the gear is very rigid and make the assumption that the flexibility is in the teeth and that the gear itself is rigid. In helicopters, this is not the case."



Calculated stress contours in a spiral-bevel pinion.

The software integrates advanced physics-based failure modeling, system vibration features, inspection and operational data and run-to-run testing to enable failure prediction on critical drive train components. According to the website, it automates the process for model generation, stress analysis and 3D fracture mechanics of spiral-bevel gears. The prognostic approach incorporates a probabilistic fusion process which can update damage models for component-specific damage states and remaining useful life predictions.

The developed technology and analytical approach can be applied to other systems. Because of this, Impact is now considering commercial versions of the software suite for other applications.

GPSys pulls together a number of software packages including *Gleason T900*, *ANSYS* and *Franc3D* and acts as the director for data communication between the modules.

"The initial work on the prognostic side was done nine or ten years ago, then the first modeling on failure progression started in 2002/2003," says Joel Berg, senior project engineer at Impact. "The Phase II program was initiated in 2004, looking at integrated software systems before it was delivered to the Navy in 2006."

Damage tolerant design and prognostics are the key aspects of the program, and the reason both Berg and Steele believe the software can be marketed effectively.

"We've developed some of these

things for the military over the years on other components such as bearings and parts of gas turbines," Steele says. "The unique thing here is that we're applying the outside framework to these high-performance gear drives. The *GPSys* has the ability to combine design parameters with assumed flaws and mission profiles to determine the likelihood of a catastrophic failure."

Berg says *GPSys* ties in with the new generation of military aircraft and control systems and onboard health monitoring systems where the military is looking at how to operate the equipment safely and when to operate certain profiles.

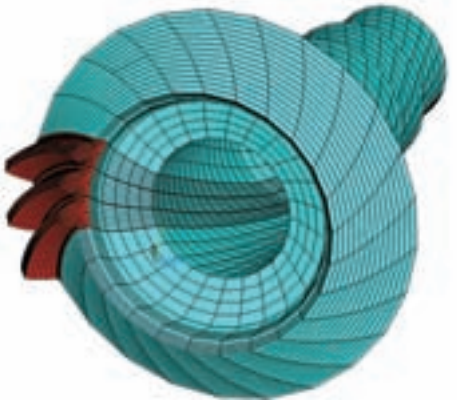
"They have the ability to predict remaining life and how they should properly operate an aircraft to get to a safe landing condition," Berg says. "With this software, pilots can plan out a safe return flight instead of losing an aircraft. That's kind of the birth of prognostics and how it is permeating through the design of these next generation aircraft."

Steele says the most important aspect of this technology is the safety of the pilots.

"They want a smart system onboard to tell the pilot to punch out, land immediately or continue the mission."

While this is prevalent in aerospace applications, Berg says the software offers plenty of flexibility and some of the tools such as the fracture analysis software do not have to be tied to gears if you have a model and load conditions.

"There are basically two systems at work here. One is an analysis tool and the other is a design tool, and both can be applied to several applications," Berg says.



3D finite element model of a spiral bevel pinion.

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