Computers in engineering

Anark aims to make better use of CAD data

Anark has been working in the real-time 3-D application development arena since 1994, and in that time it has noticed a gap between current 3-D CAD tools and collaborative product data management (CPDM) products. The company intends to bridge that gap with the recent release of its Anark Core Platform.

Core is a software platform that allows users to safely and efficiently distribute use-appropriate CAD data throughout their supply chain and support organizations.

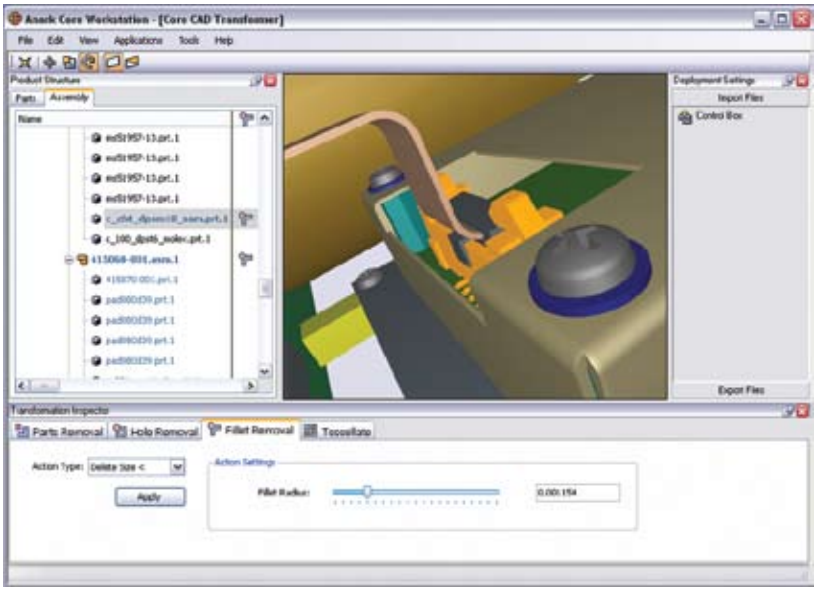
"At the heart of what we do and what we're trying to solve with the Anark Core Platform is really the ability to help customers innovate in their design process all the way out to their communication," said Steven Collins, CEO, Anark. "That really is fostered by collaboration. If the data is not sharable for a variety of reasons within departments among OEMs to their suppliers, ultimately it's going to make it really difficult to collaborate."

With the Core Platform, the company sought to address what it deemed to be two major market problems. The first being the time and cost associated with getting CAD data out of programs such as CATIA or PRO/Engineer and repurposing and sharing the data in an appropriate form.

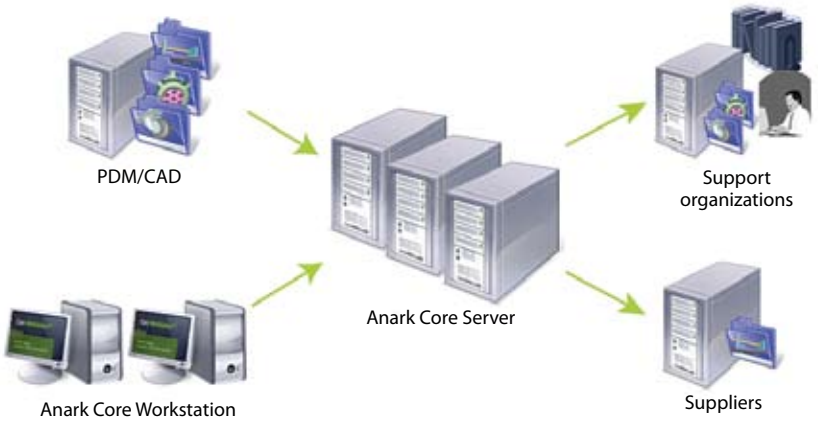
"Conventional CAD tools are expensive and highly technical, so if you're not an engineer and you've got CATIA as your only instrument to repurpose your CAD data, you're probably in trouble. It's going to be really difficult to do and people are just simply not going to do it or do a very good job at it," Collins said.

The other problem Collins noted is that conventional CAD transformation tools often leave intellectual property exposed.

"At the Paris Air Show, there are 20 products that were debuted in an Anark updated application," Collins said. "All the marketing folks, in addition to wanting to be able to articulate the value props visually of their new products, wanted to be able to make sure they weren't divulging specific design elements that their competitors could come up and take photographs of in their booth and...walk away with some of their design components for their own use.



The Anark Core Workstation allows users to cost-effectively produce transformed, use-appropriate CAD geometry for supply chain and support applications throughout the enterprise.



Anark Core Server is a scalable server system for high-volume, high-change environments. It allows manufacturers to cost-effectively automate the transformation and delivery of use-appropriate CAD geometry throughout the enterprise, supply chain, and support organizations.

"This is a really big problem. In the automotive industry alone, it's probably a $12-16 billion problem a year, so this is something that we've also made an attempt to try and guard against with Core."

The Core Platform consists of two main components that can be configured to match organizational needs.

Anark Core Workstation, which serves as the foundation of the Core Platform, provides users the ability to import CAD data, identify parts, instances, assemblies, and geometry features, and then modify or remove as necessary.

Anark Core Server is a scalable server system for high-volume, repeated applications. It allows manufacturers to

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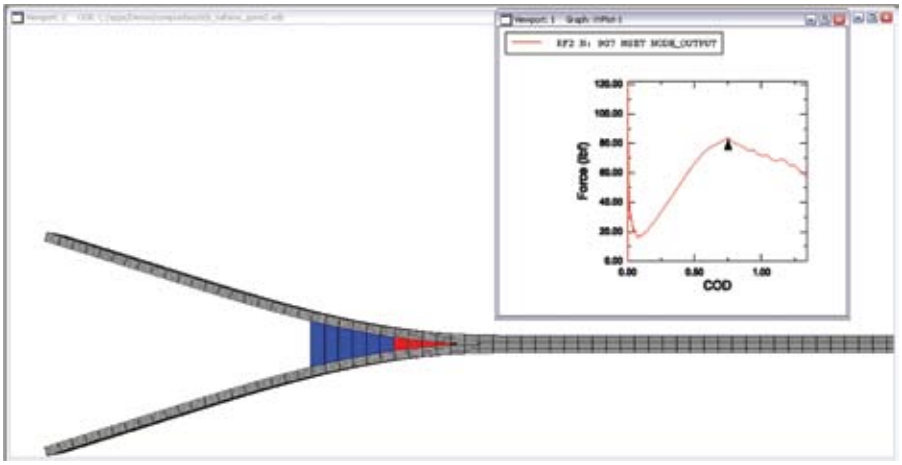
automate the cost-effective transformation and delivery of use-appropriate CAD geometry throughout the enterprise, supply chain, and support organizations. Core Server automates the transformation process based on recipes that allow users to reapply a set of user-defined transformation operations, eliminating the need to manually rework product data as it evolves or requirements change.

"Repurposing our CAD geometry for use in real-time 3-D training applications is very expensive and time consuming," said John Reasoner, Principle Multimedia Engineer for Simulation and Training Solutions at **Rockwell Collins**. "The Anark Core Platform solves both problems, enabling us to quickly transform our CAD data into the useful lightweight form we need, and making the removal of sensitive product design elements easy and straightforward."

Matt Monaghan

Assessing the strength of Z-pinned composites

Z-pinned composites are finding increased use in aerospace for load-bearing parts. Z-pins are a discontinuous trans-laminar reinforcement. While the fibers in laminated composites lie roughly in a plane, the Z-pins drill down vertically, or at an angle, through the thickness of the laminated composite part. The Z-pins, which are small micro-pultruded composite rods, reinforce the bonding matrix of the composite, essentially pinning the laminates together and reducing the potential for delamination.



Z-pins are represented in Abaqus as cohesive elements. This image shows the failure (shown in blue) of the Z-pins as the crack propagates through the Z-pinned specimen.

There is a tradeoff in strength, however. Z-pinning can increase the resistance of a composite part to delamination, but that increase comes at a cost of reduced in-plane strength. The Z-pins can disrupt and distort the in-plane fibers, causing waviness that degrades compression strength and fracture that reduces tensile strength. Generally, these tradeoffs are acceptable since composite delamination is one of the main failure modes of composites today.

Verifying the behavior of Z-pinned composite parts has previously been done through expensive and time-consuming physical testing. But engineers at **ATA Engineering** of San Diego, CA, have established a cost-effective, time-saving simulation methodology for the materials by using Abaqus FEA software from the **Simulia** brand of **Dassault Systèmes**.

The engineers at ATA began by creating an FEA model that simulated the delamination of a Double Cantilever

Beam (DCB) specimen without Z-pins. The simulation was compared to testing performed by **Adtech Systems Research** in cooperation with a **U.S. Air Force** Research Lab program.

The physical DCB specimen on which the model was based was 9 in long, with a rectangular cross-section 1 in wide and 0.4 in deep. It was 0.12 in thick and was comprised of 24 0° plies. The 2-D model incorporated the length, the thickness, and the plies of the physical DCB. The model used elements that simulated the composite fiber and special cohesive elements to simulate the bonding of the composite matrix.

The specimen was created with an initial 1-in crack (by means of a Teflon tape separator); the FEA model replicated the initial crack with a region of debonded nodes. One end of the DCB was held fixed, and displacement loads were applied to the other end. The software ran the simulation with a capability that performs Virtual Crack Closure Technique (VCCT) analysis to predict crack growth from the debonded region.

Results from the analysis matched physical test results very well. The tests and the analysis were run at varying displacement rates from 0.1 in/min to 60 in/min. For the slowest rate, the test showed an initial peak load of 70 lb. The Abaqus simulation had an initial peak load of 78 lb. The subsequent loads for crack propagation after the peak showed a strong correlation between the analysis and the tests.

Once the engineers had successfully simulated the behavior of the unpinned part, the engineers added additional, vertical cohesive elements to model the Z-pins. They then re-ran the simulation to see how the part strength changed. This time, after the peak initial load, the physical test sample had a second peak load of 75-85 lb at a crack tip opening displacement (COD) value of 0.7 as the crack propagated through the Z-pinned region. The simulation matched these values closely, reaching the second peak of 80 lb at the same COD value.

The engineers at ATA plan to continue this study and examine Z-pinned end-notch-flexure (ENF) coupons and finally T-section joints, such as those at a spar-lower skin joint section in aircraft. The goal is to fine-tune properties for the Z-pin cohesive elements in the models through additional DCB tests. The engineers will then apply those properties to predict ENF tests and T-section joint failures, enabling more accurate computation of margins of safety for Z-pinned composites.

Kyle Indermuehle, Project Engineer, ATA Engineering, wrote this article for *Aerospace Engineering*.