

Getting it all: Automated CAD data-translation system converts features and drawings

by L. Stephen Wolfe, P.E.

One reason engineers are reluctant to switch from one three-dimensional mechanical CAD system to another is that models and drawings created in their original system must be converted to the format of the new one. Until recently, such conversion invariably left behind important information. For example, dimension-driven features that define a part model's characteristics such as lengths, widths, and hole diameters typically didn't translate. Instead all the engineers got from translators were "boundary representations" consisting of each part's exterior surfaces with no dimensions at all. Most CAD systems can't easily modify such parts. Although a few CAD systems can directly modify faces of b-reps models, this change process is tedious to perform.

Not only parts but assemblies also lost important information during translation. Engineers typically constrain the movement of parts in assemblies. For instance, bolts are constrained to lie on centerlines of bolt holes, and bolt heads are made to lie flush with the bolted part's surface. If parts in a constrained assembly are dragged from their proper positions, an update or regenerate command causes them to snap back into place. But these constraints aren't translated by most CAD-data translation software.

In addition to models of parts and assemblies, designers also use 3D CAD software to make engineering drawings. Drawings are made by automatically projecting views of solid models onto the plane of a drawing sheet. When changes are made to the 3D models, the associated drawing views update automatically. Until recently, such associative links between drawings and models were broken when drawings were translated from one system to another. This reality made it cumbersome to update drawings that had been translated from other systems.

The above limitations of data translation are being overcome thanks to groundbreaking work by Elysium Inc. and IBM Global Services. Elysium and IBM are in the process of translating more than 100,000 CAD drawings and models for Western Star Trucks of Portland, Oregon, a nameplate of DaimlerChrysler's Commercial Vehicle Division.



Figure 1-Western Star's class 8 truck tractors are known for their size, power, and rugged styling.

Western Star had previously used Parametric Technology Corporation's Pro/Engineer CAD software to design its line of extra heavy-duty tractors. DaimlerChrysler's Commercial Vehicles Division is in the process of standardizing on Dassault Systèmes' CATIA version five for all mechanical engineering work. Western Star currently has the 2001 version of Pro/Engineer and Pro/PDM. Rather than upgrade its Pro/E system in order to maintain old files, Western Star decided to convert its entire library of Pro/Engineer drawings and models to CATIA V5.

Western Star didn't want to settle for converting only b-rep models to CATIA. It wanted all the Pro/E model features so that parts could be easily modified and improved. Engineers from Freightliner LLC, the parent of Western Star, helped with the conversion.

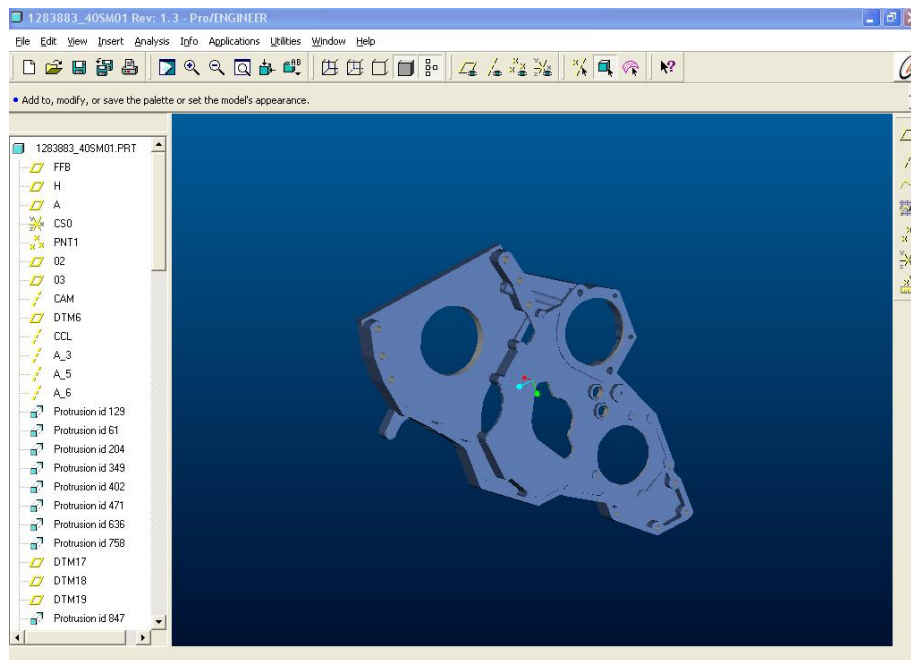


Figure 2-Western Star Trucks wanted to convert complex Pro/Engineer parts like this one including design features shown in the tree at the left to CATIA V5.

An automated solution

Freightliner solicited bids on conversion services from several companies and selected IBM Global Services to do the work. IBM had prior experience with Elysium's software and decided to employ Elysium's CADfeature product as part of an automated system for converting Western Star's Pro/Engineer archive. CADfeature is a stand-alone application capable of translating both part features and assembly constraints among a number of 3D CAD systems, including Pro/Engineer and CATIA V5. CADfeature employs the application-programming interfaces (APIs) of each CAD system to read data from the originating system and write it to the target system. In addition to Elysium's software, CADfeature also runs licenses of the source and target systems. This approach provides Elysium's customers with unequalled accuracy because the fidelity of each translation is guaranteed by the CAD-software developers.

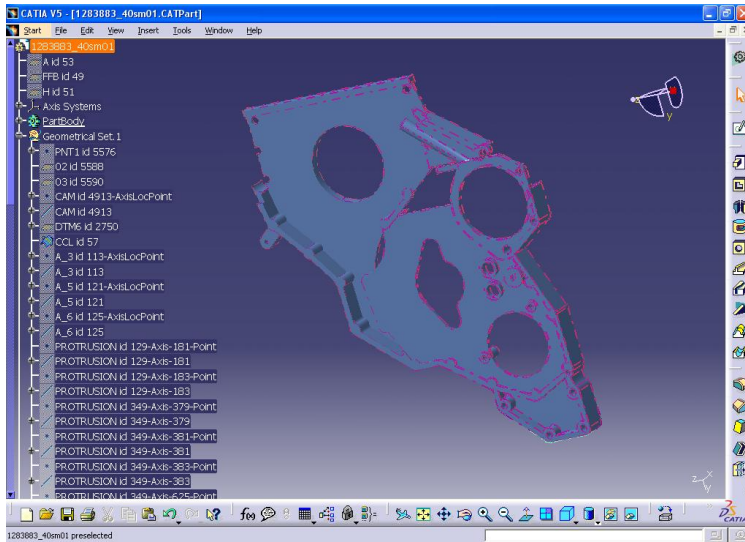


Figure 3-The part from figure 2 converted to CATIA V5 including all parametric features.

Not all features from Pro/Engineer can be mapped one-for-one to CATIA V5. For example, Pro/Engineer has an offset feature that enables a depression or protrusion to be created by offsetting a surface. CATIA V5 has no such feature, according to Keith Stratton, technical project leader for IBM. CADfeature enables users to map Pro/E’s offset feature to multiple offset surfaces in CATIA. The part geometry looks the same, but the CATIA feature tree will show multiple surfaces instead of a single object.

CADfeature allows users to specify how dissimilar feature types should be converted. These specifications can be made interactively from the CADfeature user interface or in an automated fashion through CADfeature’s API.

Because Western Star had so many files to convert, IBM opted for a fully automated approach. Using CADfeature as a base, IBM was able to develop a fully automated system for converting Pro/Engineer parts and assembly models to CATIA V5 with all of the associated features and assembly constraints. Western Star supplied IBM with nine gigabytes of test data. It also provided detailed requirements about its PDM system, which requires a standard CATIA “start part” to be used for all models, so that all models and drawings produced would be ready for uploading to the SDMARAGD PDM vault.

IBM also used the Pro/Engineer and CATIA Application Architecture APIs to develop software for converting Pro/Engineer drawings to CATIA V5 while retaining full associativity between drawings and models. The result is a system for data conversion of unparalleled accuracy and completeness if the original Pro/Engineer models and drawings are well constructed.

CADfeature doesn’t convert Pro/Engineer’s sheet-metal features such as bends to CATIA V5 format because there is no API to extract them. Sheet-metal parts come into CATIA as featureless b-rep solids. Stratton says V5 can turn the b-reps into sheet-metal parts automatically in about a minute.

Better than outsourcing

Prior to the development of CADfeature, the only way to convert fully featured CAD data with associative drawings was to have operators interactively recopy CAD models and drawings using the target system. This manual “remastering” process is costly and error-prone, even with careful checking.

Because IBM’s system completely automates conversion of Pro/Engineer data to CATIA V5, it’s faster, more economical, and more accurate than remastering CAD data interactively using low-cost foreign labor. The IBM-Elysium system is capable of converting 4,200 files in about 60 hours of around-the-clock operation using two IBM Intellistation computers.

The cost to DaimlerChrysler of IBM’s conversion service was less than half the cost of conventional outsourcing, a savings of \$1.2 million. Because the automated conversion system applies consistent rules for converting features and mating constraints and eliminates human error, it produces consistently better and more accurate results than manual remastering.

For additional information about CADfeature, contact Elysium, Inc., 100 Galleria Officentre, Suite 426, Southfield, Michigan 48034, USA Telephone: +1-248-799-9800 Web site: <http://www.elysiuminc.com>.

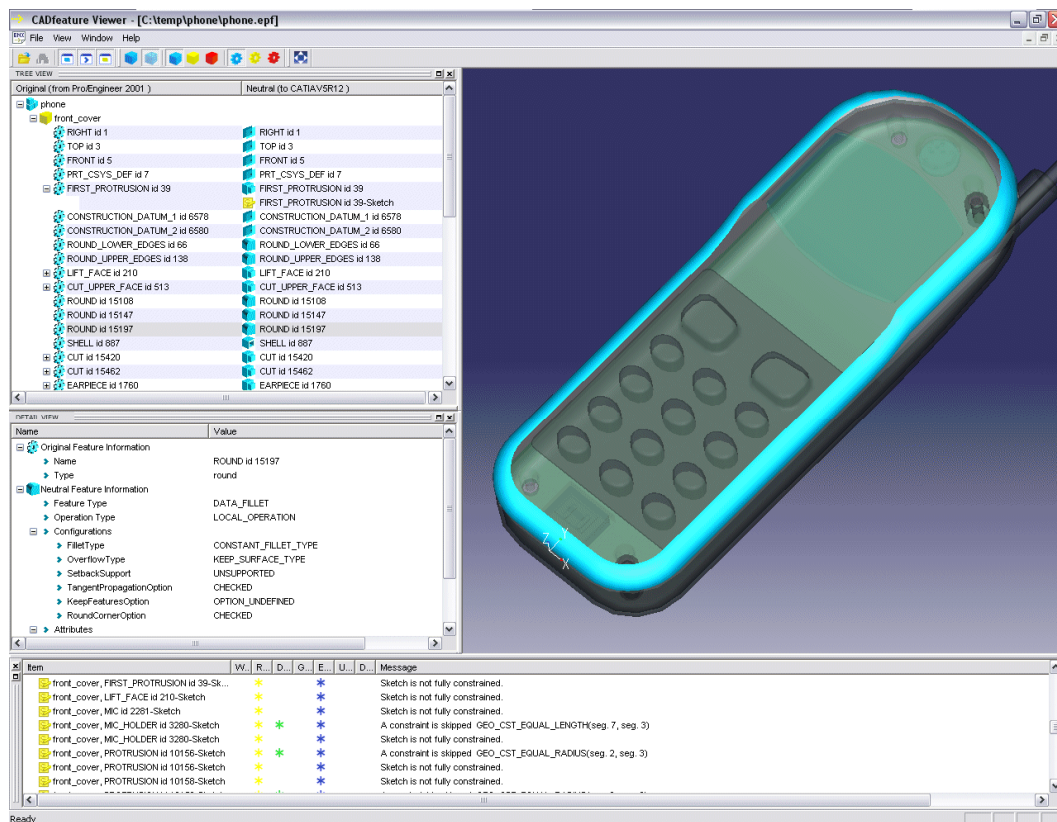


Figure 4-Elysium's CADfeature software enables designers to translate dimension-driven features of solid models from one system to another.