

RESEARCH BRIEF

GEOMETRY BASED SEARCH SOFTWARE

The problem

If two products are similar, it is possible to reuse information about one to derive corresponding information about the other one. There are many applications where this reuse of information can be of significant value.

For example, many job shops allow designers to submit a 3D model of a part to be machined over the Internet and provide a cost estimate based on it. The cost estimate depends on the geometric details of the object. Because automated procedures are not available for accurate cost estimation, people perform this task.

In the Internet era, designers solicit many quotes to make a decision and the cost of manufacturing a new part can be estimated by finding previously manufactured parts that are similar in shape to the new part. If a sufficiently similar part can be found in the database of previously manufactured objects, then the cost of the new part can be estimated by suitably modifying the actual cost of the previously manufactured similar part.

The challenge

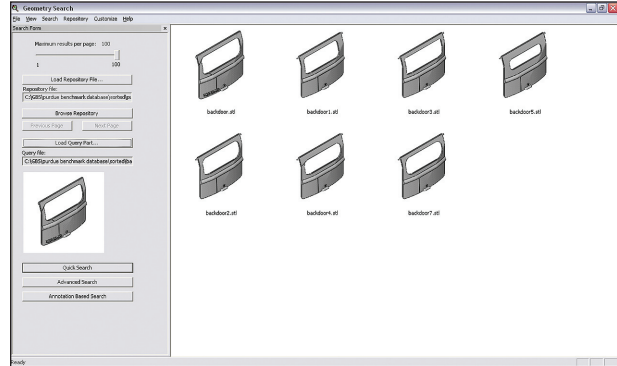
Three-Dimensional Computer Aided Drawing (3D CAD) systems are frequently used to generate models of parts and assemblies. Manufacturers routinely set up CAD model parts and assemblies databases to help them estimate manufacturing costs and reuse designs. For example, a database can be searched for similar parts, and their manufacturing costs can be used to estimate the cost of new parts.

Current search software for these databases is inefficient and inaccurate. This is because the 3D CAD model is projected on two-dimensional planes to create 2D images, which are then compared with 2D images of the existing parts and assemblies. In addition, the search filters in conventional software are not customizable.

Because of these limitations, most users manually browse CAD models to locate similar parts. This is very time consuming and slows the decision making process.

The potential

A search tool that can help locate parts and assemblies with similar application-specific features will help signifi-



GBSS overcomes the shortcomings of existing technology. It has the unique ability to search for objects using 3-dimensional models instead of 2-dimensional images.

cantly and allow engineers to spend more time on creative aspects of their jobs. A shape similarity-based search tool would improve decision making in design and planning functions.

The research

Professor **S.K. Gupta** (ME/ISR) heads a team that has developed geometry based search software (GBSS). GBSS overcomes the shortcomings of conventional CAD systems with the ability to search for objects using 3D models rather than 2D images.

This search tool locates existing parts similar to the new part based on geometric attributes. It creates “signatures” for each of the parts in the database and stores the signatures along with the solid model of the part. A signature is a list of geometric attributes that describe the part and depends on the application. These pre-computed signatures reduce the time required for comparison. The search tool then compares the signature of the query part with each of the signatures of the database parts to determine if the parts are similar.

There are two different searching techniques. “Feature-Based” uses information obtained from feature-based modeling software such as Pro/E or SolidWorks to assess similarity between parts. “Gross-Shape Based” uses several signatures to identify existing parts similar to the query. The signatures are applied sequentially to improve the efficiency and accuracy of the comparison.

GBSS is customizable, allowing the user to select the feature characteristics to be considered and the weight each is to be given during selection. Manufacturing information such as tolerance or surface finish that is associated with a feature also can be used. Thus two parts having the same shape but largely different tolerance requirements will not be considered as similar. Also, because GBSS uses feature information obtained from a feature tree, it can be easily extended to use assembly feature information obtained from an assembly tree.

The software can be used to perform quick cost estimation by finding similar designs and examining their costs. GBSS creates a repository of 3D CAD models for different parts, identifying each model with a unique signature. The signatures are extracted from a stereo-lithography file of the model and are stored in the database. A search query on the database is translated into these signatures and the database is then searched for the closest match. GBSS then uses intelligent combinations of these signatures to give accurate results.

GBSS provides both a quick and an advanced search that can be tailored to the user's specific needs. Overall, GBSS can offer more precise and time efficient control over manufacturing and design processes.

A U.S. patent application is pending.

Sponsors

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Award

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