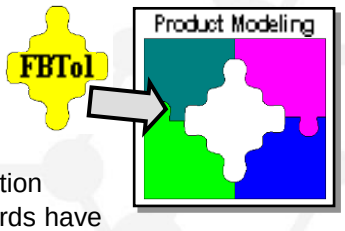
KANSAS CITY NSC National Security Campus

FEATURE-BASED TOLERANCING (FBTol™)

FBTol is a technology that reduces the complexity of representing feature-based semantic product and manufacturing information (PMI) within a model-based environment.

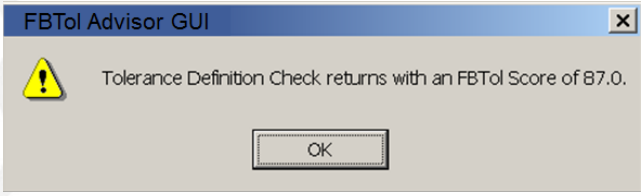


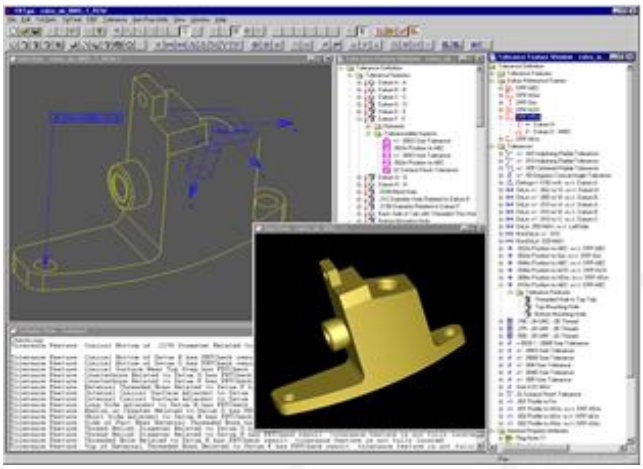
Background

Fabrication of a nominally perfect part is impossible; however, industry can fabricate parts that fit and function if one can successfully communicate design intent of allowable deviations to all those that are responsible (e.g., engineers, manufacturing and inspection personnel, suppliers) for the realization of the product. National and International standards have defined a universal symbolic language, including consistent syntax and semantics, to communicate this design intent. The language (e.g., ASME Y14.5) has been rigorously studied and applied by manufacturers around the world. Typically, syntax of this information is humanly communicated via 2D static drawings or more recently through 3D annotations shown on a model. The industry of product definition is shifting to 3D annotations that are associative to a part's geometry for better human consumption. Although some level of semantics can be computer-readable, a well-known but unsolved issue amongst CAD systems and product data exchange mechanisms is their inability to advance the representation of non-shape information beyond the current confines of decorative human-readable annotations. Experts recognize that a robust, machine-readable, feature-based semantic tolerance definition is the missing piece toward obtaining a trusted product model that can achieve digital product realization or a model-based enterprise and the communication thereof.

Description

Developed by computer scientists, process and quality engineers, and dimensional metrology analysts for applications with unusually complex and/or challenging tolerance specifications, FBTol can augment any solid-model based system with a complete and unambiguous representation of intelligent tolerances. FBTol uses the notion of “Tolerance Features” to enhance the solid model’s shape with an explicit definition of dimensional and geometrical tolerances. Because of FBTol’s feature-based semantic definition, FBTol can implement an innovative tolerance definition checking algorithm resulting in an FBTol tolerance definition checking score. Other features include interactive and automatic tolerance feature recognition and the ability to automatically infer and apply appropriate tolerances to features. This allows users to more intelligently apply tolerances to their own designs or to check existing part tolerance definitions before design release or product fabrication and inspection.





Honeywell

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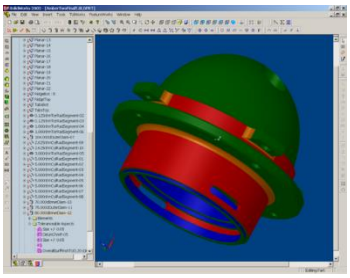
FBTol core technology is built around the creation and manipulation of four primary objects: tolerance shaped features, datum reference frames (DRF), tolerances and specifications, and general property attributes (e.g., notes). Furthermore, FBTol's open architecture allows downstream applications to successfully access correct machine-readable tolerance information directly from the product model while providing an intelligent tolerance capability for other model-based applications that need a complete and unambiguous definition of tolerances.

FBTol functionality has been exposed via a graphical user interface known as FBTol Advisor. The Feature-Based Tolerancing Advisor is a software application for augmenting correct tolerance definitions to a solid model shape. Its approach encourages the creation of valid designs and takes advantage of tolerance checking algorithms, automatic tolerance feature recognition, and tolerance inferencing capabilities.

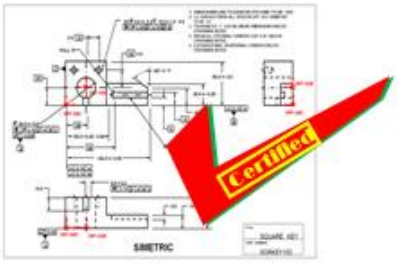
Advantages

Model Based Engineering (MBE) hinges on a trusted product model for confident reuse throughout the enterprise. FBTol plays a unique and vastly important role in product model validation. The primary business benefit of using FBTol is to identify and resolve incorrect, incomplete, or ambiguous product tolerance definitions (PMI) issues before the product definition is released to the next state of the product realization life-cycle. FBTol mitigates the risk of significant downstream costs attributed to the propagation of misapplied or incomplete tolerances and prevents others from using ambiguous or esoteric design definitions.



The use of FBTol allows users to progress to the next generation of product definition: the transition from solid modeling to product modeling. FBTol provides full semantic tolerance definition by creating and representing 3D functional tolerances completely and unambiguously. FBTol semantics allow it to recognize tolerance features and infer correct tolerances automatically. Most importantly, FBTol provides product design validation and grades part tolerance representations, the results of which are communicated by a colorized model. A side benefit of FBTol's semantics is that it produces characteristic tagging. This tagging is an early definition of a unique identifier to support inspections. FBTol can provide the semantics for displaying 3D graphical annotations, provide explicit tolerance data for next generation applications and automation, and supports the generation and/or validation of complete and unambiguous exchange for PMI.

Use Cases



- Existing tolerance definition – performance of piece part tolerance analysis that will validate, check and score the current tolerance scheme of an existing drawing and suggest an improved tolerance scheme to return a perfect score
- New tolerance definition with known critical tolerances – inference of the remaining tolerance scheme after the user creates the crucial tolerances to communicate product requirements of fit, function, and form
- New tolerance definition – inference of complete initial tolerance scheme, allowing for modifications as needed
- Characteristic tagging – use as a model-based characteristic tagging in support of product inspection and/or validation

Licensing Technologies

The National Security Campus licenses these codes for commercial use, internal use, and government and academic use to encourage scientific collaboration aimed at further development and derivative applications.

Keyword List

FBTol, Tolerancing, PMI, Feature-Based Tolerancing, Tolerance Checking, GD&T, ASME Y14.5

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