Reorganizing CAD Assembly Models (as-Designed) for Manufacturing Simulations and Planning (as-Built)

ABSTRACT: A CAD assembly model is a collection of components, comprised recursively of various levels of individual parts and sub-assembly models. Although the overall geometry in the CAD assembly model accurately represents the final finished product, this model is often meaningless from a manufacturing planning and simulation point of view. The grouping of the components into sub-assemblies and the assembly sequence implied by the CAD model does not accurately represent the manufacturing/assembly sequence or process. Reordering, regrouping, and modifying existing sub-assemblies, or creating new sub-assemblies in the CAD model may be needed to ensure this correspondence for simulation or assembly planning tools that derive the manufacturing sequence directly from the CAD system. Although this task can be performed using the existing functionality of the CAD system, it quickly becomes unwieldy for large industry-grade models due to the assembly constraints and relationships in place during the model creation. In industry today, there are several digital mockup and assembly planning tools that greatly outstrip the ability of CAD systems in loading complete models and creating assembly plans. Methods to organize the CAD model assembly quickly and easily for use in these systems, and to record the "as manufactured" assembly in the CAD data format are needed to close the loop and ease the transfer, storage, and maintenance of model data between the CAD systems, PDM systems, and these new age planning and mockup systems. In this paper, a new hybrid method is proposed to provide this functionality. Of key significance is the fact that using this approach, polygonal representations of any new or modified sub-assemblies designated in the reorganized hierarchy can be produced and that the original constraints used in the original assembly are transformed in a consistent manner to the new components. In addition, corresponding property files for the new components can be created for use in the assembly planning tool. In order to validate this hybrid approach, the time required to rearrange the assembly hierarchy and output the required information using both methods are compared–1) the traditional method using the CAD system alone, and 2) the new hybrid system. A statistical analysis using three treatment factors indicates that if the number of components is more than 15, then it is far more efficient to use the hybrid method over the CAD system by itself. This hybrid method implementation has now been used very successfully in virtual assembly simulations of many industry models, some with several hundred components, provided by various industry partners.