Chapter VI
Feature Interactions

ABSTRACT

Feature interaction tends to have a wide range of consequences and effects on a feature model and its applications. While these may often be intended, it is also true that feature validity can be violated, one way or another, by feature interactions (Shah & Mäntylä, 1995, Gao & Shah, 1998, Lee & Kim, 1998). They may affect the semantics of a feature, ranging from slight changes in actual parameter values, to some substantial alterations to both geometry and topology or even complete suppression of its contribution to the model shape.

To certain extent, successful applications of feature recognition and feature-based techniques have been hindered by interactions among the features. Feature interaction was first studied in relation to feature recognition systems. As an alternative to feature recognition, feature-based design methodology has also become prevalent in recent years. Although a number of successful and commercially available feature-based design systems have been reported, current CAD technology is still unable to provide an effective solution for fully handling the complexity of feature interactions. Very often in a feature-based design system, the interaction between two features gives rise to an unintended feature, nullifying the one-to-one mapping from design features to manufacturing features. The resulting manufacturing feature is usually of a form that the system cannot handle or represent. Thus feature interaction resolution is equally essential for a feature-based design system (Dereli & Baykasoğlu, 2004).

As discussed in Chapter IV, features can be represented either as a set of faces or as a volume. The interactions between surface features are different from those occurring between volumetric features. This chapter discusses different types of interactions that arise from these two feature representation schemes and uses the interacting entities to classify them. There are two types of surface feature interactions, basic feature interaction...
and complex feature interaction. Three types of basic feature interactions are discussed. They are nested, overlapping, and intersecting types. Interacting patches are used to classify volumetric feature interactions. These interacting patches can be of a containing, contained, or overlapping type. The significance of feature interactions lies in their effect on the machining sequence of the features involved. This is also discussed in this chapter. When features are close to each other but do not share any geometric entities, interactions may also happen for structural reasons. This type of feature interaction can be called interaction by vicinity. The main aim of this chapter is to take a holistic approach toward feature interaction solutions. The example parts used are from the “Catalogue of the NIST (National Institute of Standards and Technology) Design, Planning and Assembly Repository” (Regli & Gaines, 1996). A case study is provided in the end of the chapter.

**SURFACE FEATURE INTERACTIONS**

Surface features are readily available in a design model and they are the first type of features dealt with in the development of a feature recognition system. Surface feature interactions were also first studied by the researchers.

**Surface Features**

Surface features have been discussed in comparison to volumetric features in Chapter IV. This chapter discusses feature-feature interactions in a 2½D component. More specifically, a face in a 2½D feature is categorised as a top, base or side face. The top face is always open. A base face for a feature is opposite to the top face. The feature is blind if a base face exists; otherwise, the feature is through. The remaining faces are referred to as side faces. All side faces on a feature collectively form the boundary of the feature. If the boundary is closed, the feature is a closed feature; otherwise it is an open feature.

**Classification of Surface Feature Interactions**

In the following discussions, the interactions between surface features can be defined on the basis of interacting entity, I. An interacting entity is a collection of geometrical elements which are shared between the face(s) of the two surface features. Symbolically, the interacting entity between features $F_1$ and $F_2$ is expressed as, $I_{1-2}$ (or $I_{2-1}$). An interacting entity can be a wire (i.e. one or more than one consecutive edges) or a face. Two classes of surface interactions are thus defined: basic feature interaction whereby the interacting entity is a wire, and complex feature interaction whereby the interacting entity is a face.

**Basic Feature Interactions**

An interacting wire can be open or closed; in the latter case it becomes an interacting loop. There are three types of basic surface feature interactions, nested, overlapping, and intersecting, partially dependent on the property of the interacting wire (Xu, 2005).
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