

Product Profile

The problems of transferring geometric model data between CAx systems blunt the competitive edge of enterprises by forcing them to compromise in either their choice of solution or in efficiency at each stage of the development cycle. FECS' CADfix reconciles differing modelling conventions and practices by "repairing" data from a given source system ready for re-use in a given target system.

As well as for the basic capability to choose the best downstream solutions, the need to exchange geometric data occurs in a number of other contexts: the need for legacy data to be upgraded into a solid model; the emergence of component solutions based on alien modellers; the decision of an enterprise to change its CAD modeller; corporate mergers and acquisitions which require unification of modelling data. In all of these cases data exchange difficulties can present a significant impediment to cost-effective product development.

What Goes Wrong in Data Transfer

Each design, analysis, and manufacturing software tool uses modelling conventions and practices most suitable for its respective task. This is natural enough, but it often means that 'as-is' data transfer, even if in some standard format such as IGES or STEP, results in failure because, for example, different built-in tolerances in the host and receiving packages lead to duplicated or missing faces, or perhaps the host has no need of topology (and so doesn't create any) while it is vital for the downstream application. Moreover, the data transfer standards themselves are sufficiently open to interpretation to lead to ambiguities or inconsistencies which may make the received model unusable.

Figure 1 shows how wrong things can go. The original model made good sense in its host CAD package, but it has become unintelligible following 'as-is' transfer to a solid modeller using the IGES standard.



FIGURE 1 (a) as-is transfer into CAD system Y

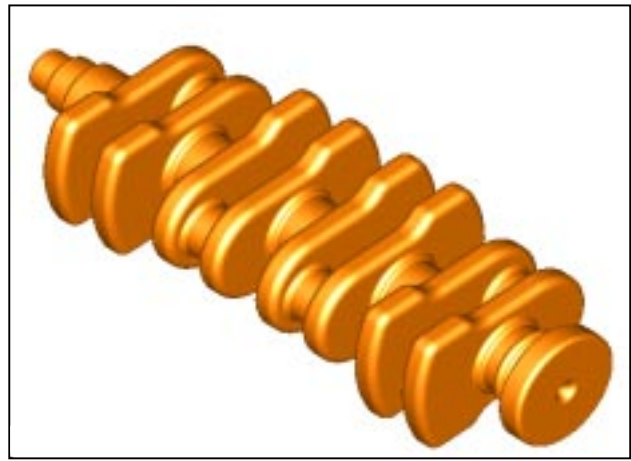


FIGURE 1 (b) after repair in CADfix

A particular geometric insanity which occurs very frequently and which is fatal for many processes downstream from CAD is "sloppiness". An edge is said to be sloppy with respect to a face which it bounds if it does not lie in the embedding geometry of the face (to within a given tolerance), as illustrated in Figure 2. Sloppiness is caused, for example, by edges having been allowed to 'drift' in the host CAD system, by attempts to un-duplicate proximate points and edges (perhaps in a data exchange process), or simply by a tolerance mismatch between the host and target systems. The process of re-binding sloppy edges to the faces which they bound is known as "Healing". Healing is, in general, a difficult mathematical and computational problem but it is probably the most important single factor in successful data exchange for re-use.

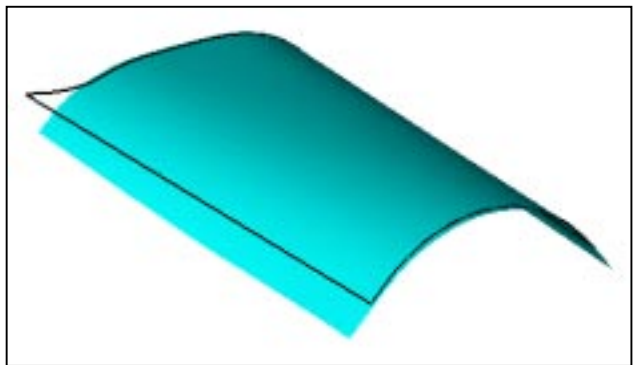
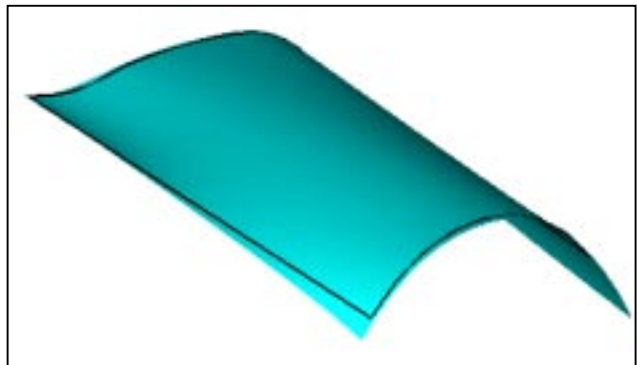
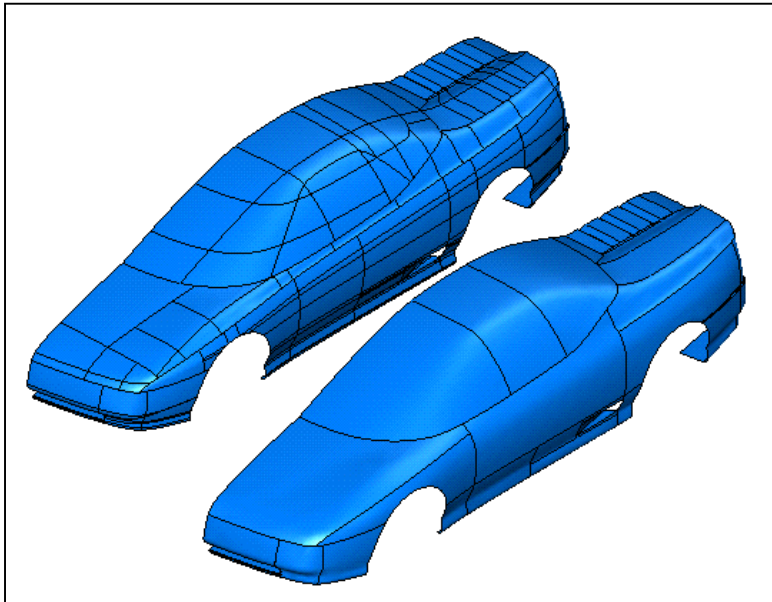


FIGURE 2 a) and (b): Sloppiness: before and after healing

Beyond the problems of data transfer already described lies consideration of the use to which the transferred data is to be put. A coherent, healed model may still not be suitable for the application at hand: some transformation may be necessary. For example a CAM application might require the removal of necks, cusps, and other tangencies, or a CAE package might require dissection or consolidation of the model into simplified regions to obtain an appropriate mesh. Figure 3 illustrates a typical transformation for the purposes of finite element analysis.



**FIGURE 3 (a) and (b):
Repaired model and Transformed model**

The CADfix Solution

CADfix approaches the problem of data exchange with some humility in acknowledging that fully automated translation for re-use is a difficult problem which is not always solvable. Ambiguities, inconsistencies, and pathological geometries will turn up, and when they do the engineer needs to be able to see what has happened and to be guided towards a suitable repair. CADfix supports this paradigm by automatically translating whenever possible but providing comprehensive sets of visual diagnostics and repair tools when things go wrong. Such an approach is in marked contrast to 'black-box' point-to-point (eg PARASOLID-to-ACIS) translators or IGES and STEP readers which abandon the user to find his or her own way out of trouble using whatever resources are at hand - a time consuming and expensive task.

CADfix makes available to the user a hierarchy of automatic and semi-automatic tools, themselves composed of user accessible atomic functions, in taking a model through a five stage translation process. Each stage of the process may be run automatically using the expertise of a user configurable "Wizard", or interactively for specialised repair. A batch mode is also offered for when there is confidence that a "Wizard" sequence will be successful (diagnostics are still provided, though, just in case!)

The CADfix Translation Process

The five stages of translation operated by CADfix are: Import, Repair, Transform, Prepare for Export, and Export.

CADfix will import native data from a number of CAD systems but otherwise STEP or IGES data will be accepted. At this stage the model is usually read straight into a CADfix database, although some minor processing, such as the closing of loop boundaries, may optionally be carried out.

The Repair stage of translation aims to restore the model to the form originally intended by the designer. This primarily involves topological repairs such as eliminating duplicated points and edges, bounding surfaces, building a solid from a set of unconnected faces etc. Note that Repair stage can itself introduce sloppiness when, for example, moving an edge from its original position on a surface to some intermediate position between it and its close-by duplicate.

At the optional stage 3 of data translation, Transform, joining and cutting tools may be used to manipulate the model into a form which can be handled more effectively by the target application.

The next stage, Prepare for Export, is where the hard work of satisfying the geometric demands of the target system is done. Here, built-in expertise about the target is applied, for example, to adjust NURBS representations and adhere to required tolerances. Healing is often necessary at this stage to correct any geometric drift that may have been imported or introduced in the Repair or Transform phases. It has already been remarked that the general healing problem is a hard one, and CADfix employs novel techniques to reach the most appropriate solution, which may involve the adjustment of the embedding geometries of faces incident on offending edges.

The fifth and final stage of translation is Export, where the Prepared model is written to a file in the required IGES, STEP, or native format.

Making Geometry Data Exchange Work

As CAD data is put to more and more uses, and as enterprises seek to employ best-in-class solutions, interoperability between CAX systems has become an important topic. Because neutral data formats such as STEP and IGES have not, and will not, solve all the problems of transferring geometric model data for re-use, data repair and transformation tools have an important role to play in maintaining enterprise wide efficiency. CADfix is a flexible and easy-to-learn tool which does not claim to solve automatically all the difficulties, but which shows a clear way forward in even the knottiest of cases.

For further information contact
FEGS Ltd, Oakington Cambridge CB4 5BB
+44 (0)1223 237 111 sales@fegs.co.uk
www.cadfix.com