CATIA ATTRIBUTE TRANSFER TO MSC/PATRAN FOR AIRCRAFT STRUCTURES

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ABSTRACT

GKN Westland Helicopters has adopted Catia as the main repository of geometric data. All future aircraft will be generated with Catia as Exact Solids on a One-Model per Part Basis. This data is then used within Catia to create a FE Degenerate Geometry Assembly of the Parts within an Aircraft Module. The Part Information and attributes, such as plate thickness and beam cross sections, are stored as Attribute Data with Catia. This information is then transferred to MSC/PATRAN via. Bespoke software that extracts the Attribute Data from Catia and writes a data file which is imported into MSC/PATRAN.

Within MSC/PATRAN our PCL code is used to import the Attribute Data and store it as Properties, Arbitrary Beam Sections and Client Data. As the Global Location of the Beam Cross Sections are known then the Beam Orientation and Offsets can be generated automatically and assigned to the properties.

To assist in the checking and use of this data we have generated our own PCL Functions to access and Display this Data, and in particular to display the Beam Cross Sections on the Geometric Curves imported from Catia.

Currently GKN Westland Helicopters is involved in a project, which is using data from Catia for the definition of the Aircraft Structure. As this is an existing aircraft the Catia Definition is a mixture of Exact Solids and Surfaces. This project will give us a good test platform with which to evaluate the process, highlight any problems and determine the best practice methods to be used in future projects.

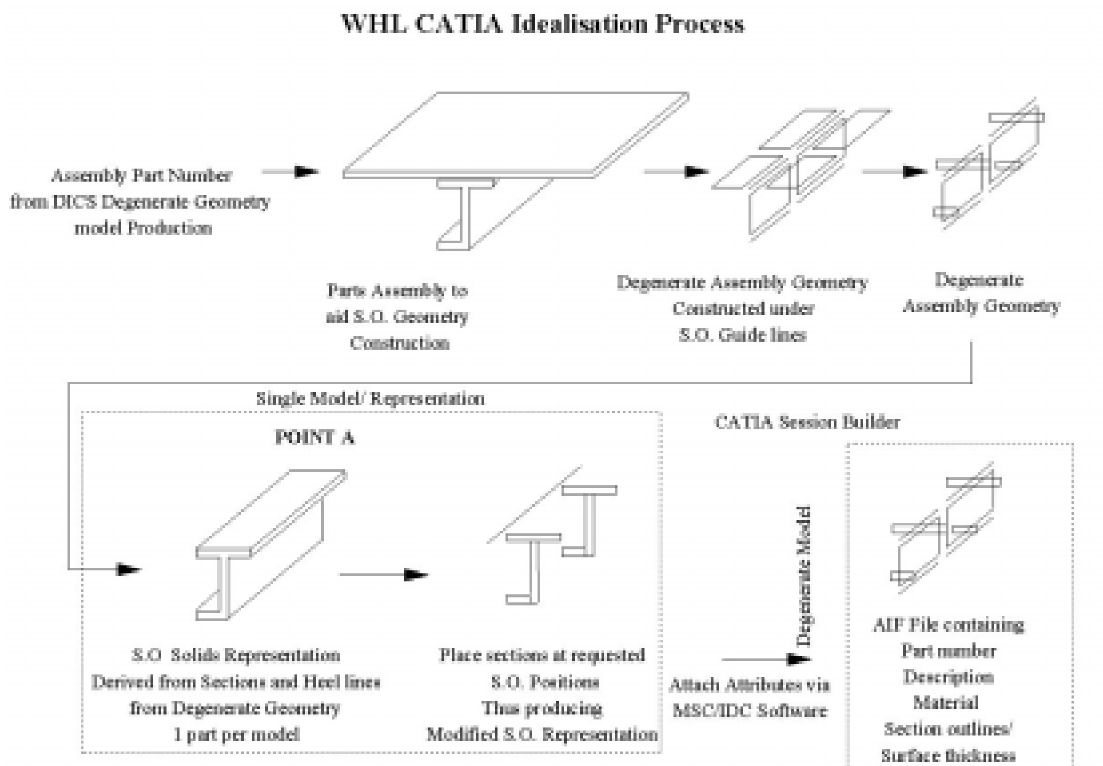
Introduction

GKN Westland Helicopters has adopted Catia as the main repository of geometric data. All future aircraft will be generated within Catia as Exact Solids on a One-Model per Part Basis. The Loads and Dynamics Models required do not require this level of detail, so degenerate assembly models consisting of curves and surfaces are created within a Catia Model, with attributes assigned from the Exact Solid Part.

These degenerate assembly models, along with the associated attributes are then transferred to MSC/PATRAN, where the appropriate Finite Element Mesh is generated. These Elements will then have the correct properties and materials based upon the Catia Data.

To assist in the checking and use of this data we have generated our own PCL Functions to access and Display this Data, and in particular to display the Beam Cross Sections on the Geometric Curves imported from Catia.

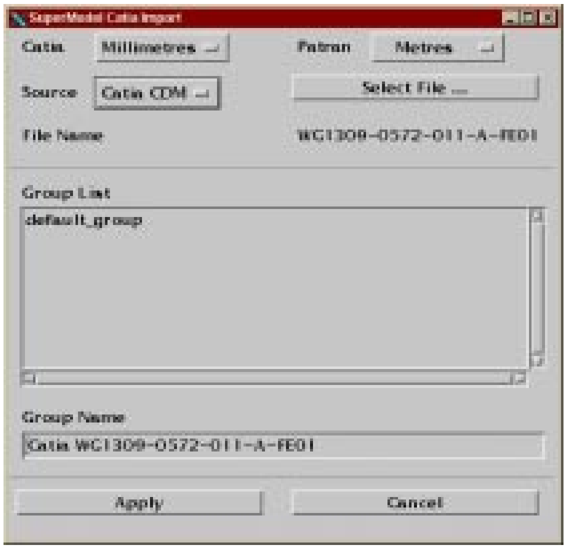
Catia Modelling

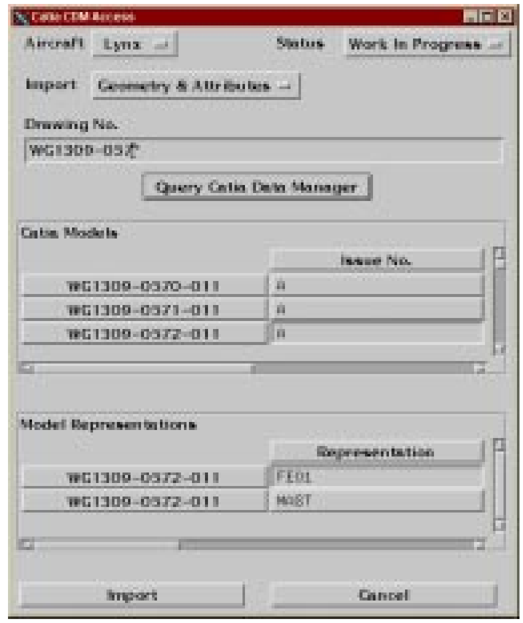


Catia – Link Interface

The Catia Link Interface is split into two parts. Part 1 consists of new tools to allow the Catia User to assign the attributes to the Degenerate Assembly Model; an External Interface to the Catia Data Manager, and an Attribute Data Extraction Program. The Second Part is a modification to the CatXpress program to allow it to be run in batch mode and to extract a Catia specific Label that is then stored within the MSC/PATRAN Database attached to the MSC/PATRAN Geometry. A PCL function was also supplied which provided the access to the Catia Specific Labels. These labels are used to provide the link between the MSC/PATRAN Geometry and the Catia Attributes Data.

Within MSC/PATRAN the User accesses the following forms, which allows MSC/PATRAN to interrogate the Catia Data Manager and then import the Data into the MSC/PATRAN Database. You should note the Units conversion as traditionally the Catia Models are in Millimetres while the Finite Element Models are in Metres.



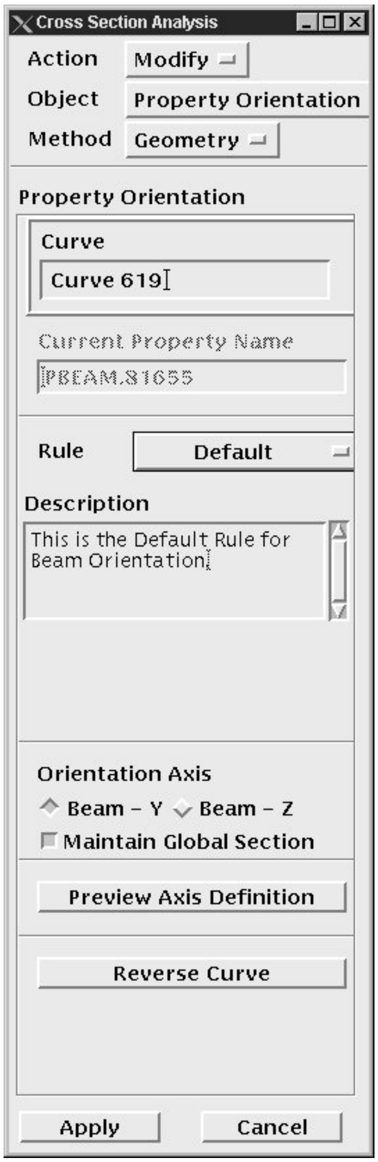


The sequence of events during a Catia Import is as follows. First the CatXpress File is imported, and the geometry definitions are created. Then the Attribute File is scanned and the link between Catia Part Ids and MSC/PATRAN Part Ids is created. Then the MSC/PATRAN Group is scaled to the correct units. Finally the Attribute File is imported and the relevant properties are created. Within each Attribute Definition a Material Code is specified. This Material Code is used as a reference to a record within a MVision Databank. A MVision DPI interface program is used to extract the Material Definition that is then stored within the MSC/PATRAN Database. If a clean Attribute Import is achieved then the property combination routine is initiated.

Beam Property Tools

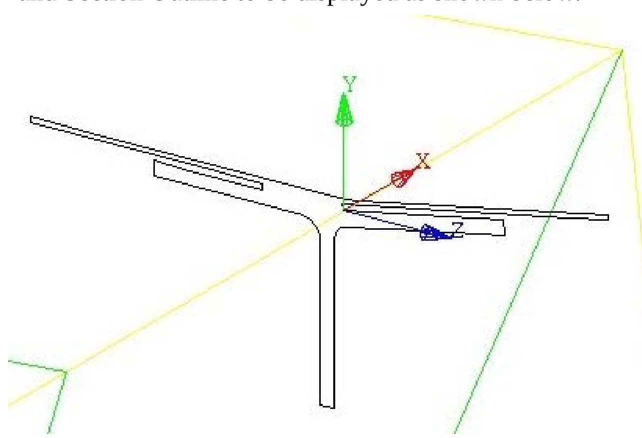
Several Tools have been developed to provide additional functionality within MSC/PATRAN to allow the User to manipulate the Beam Properties. For each curve a default orientation vector is defined based upon the surfaces attached to the curve. Thus when the Beam Cross Section Attributes are transferred from Catia, in the form of a Global Definition, its location relative to the specified curve can be used to determine the beam offset definition.

Beam Orientation Tool



Because a default orientation vector is used then a PCL function has been defined which allows the User to change the orientation vector.

The Form shown here allows the User to change the Orientation Vector assigned to a Curve or Finite Element Beam. There are various rules available which define the method used to evaluate the orientation vector.
Selecting a Curve or Beam Element will cause the Axis Definition and Section Outline to be displayed as shown below.

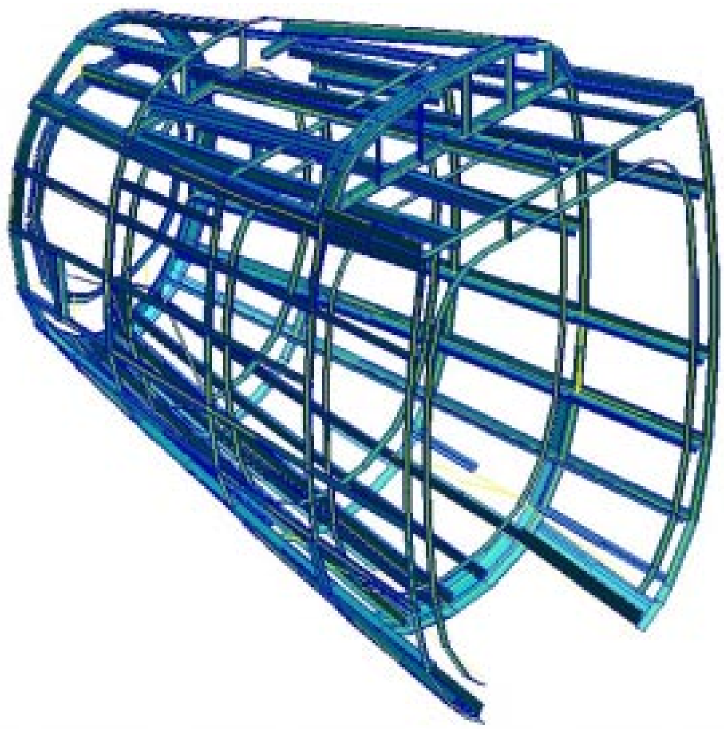


When a new orientation definition has been defined pressing the Preview Axis Definition Button will update the display so the User can evaluate the effect of the modification.

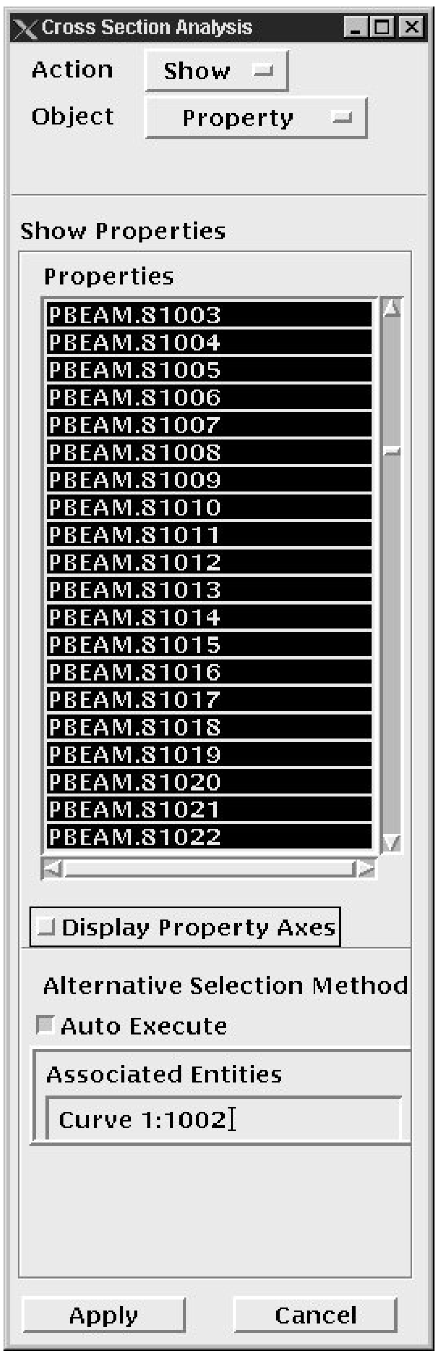
For Catia Attribute Definitions the Maintain Global Section toggle is always active and cannot be turned off so irrespective of the orientation definition the Global Location of the Cross Section is maintained.

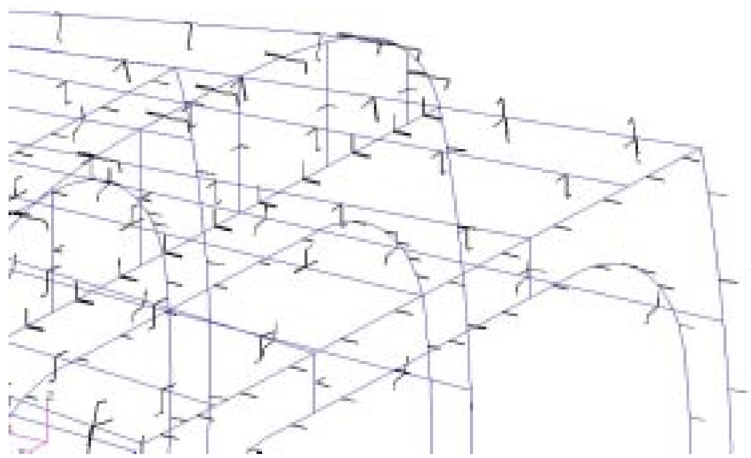
Show Property

Within Basic MSC/PATRAN a Function can display the Cross Sections on Beam Finite Elements as shown here, but this is not available when the properties are associated with Geometric Curves. So a PCL Function was defined which will display the 2D Cross Sections onto either the Geometric Curves or the Beam Finite Elements. The User can either pick the Curve / Beam Elements required via the select data box or the Properties required via the list box.



The display obtained is shown below.



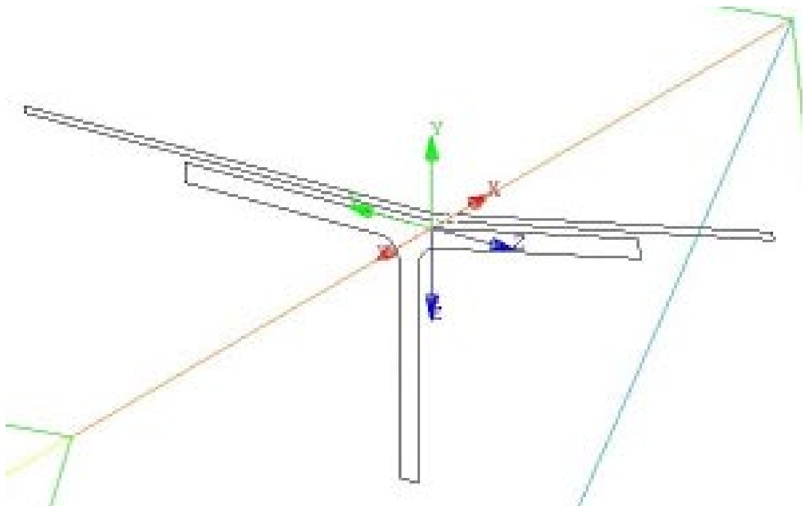


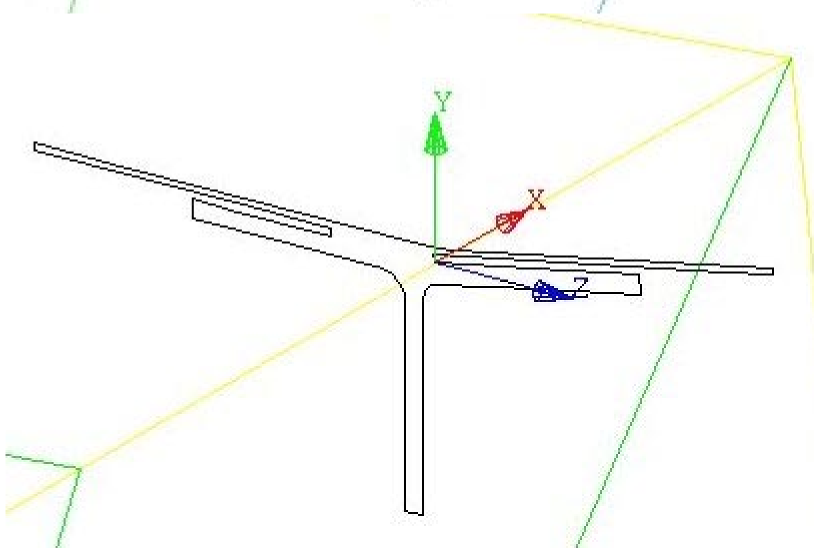
Property Combination

Within the Catia Degenerate Assembly Model there are locations where several parts will be modelled within the Finite Element Model as a single entity. To cater for the transfer of all the Part Attributes, these areas are modelled as duplicate curves and surfaces.

Initially within MSC/PATRAN these duplicated curves and surfaces are replicated with the appropriate properties and description store in the database. Two functions have then been generated with PCL to detect the duplicate geometry and combine the relevant properties. The first function is the simpler process, as it detects duplicate surfaces, finds the thickness of each surface and produces a single property using the combined surface thickness. It also updates the property description and parts list to contain a list of all the combined parts.

The second function is a more complex process, as it detects the duplicate curves, finds the cross section definitions and creates a single cross section. The MSC/PATRAN Cross Section Analysis can only analyse a single cross section, so any gaps between boundaries have to be removed. An example of this function is shown in figures below. The small gaps are merged, while for larger gaps a filler region is generated.

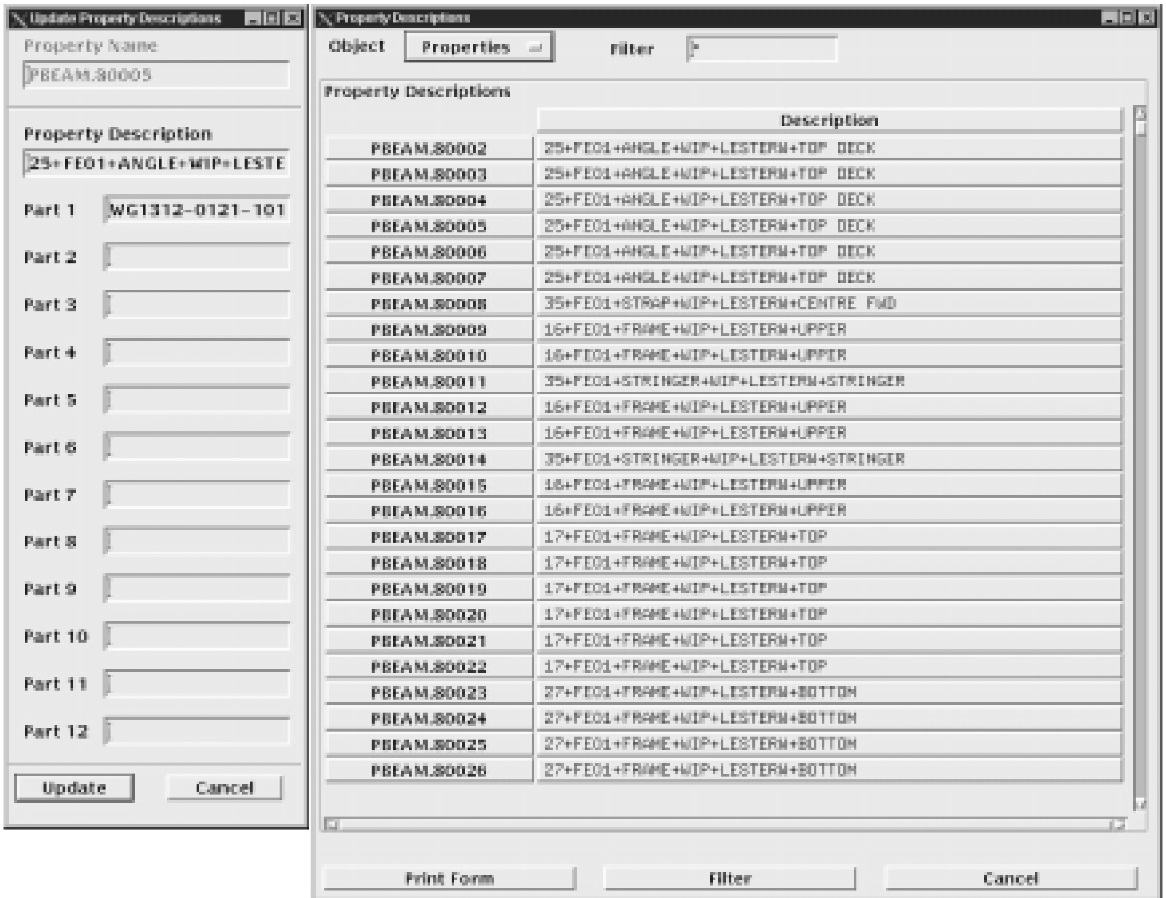




There are times when the combination fails. In this case the outline geometry is stored in a group ready for the User to generate the combined section by hand. We are currently getting about a 1% failure rate, which means that for each Model region the User has only one or two sections that need to be generated by hand.

Property Descriptions and Part List

Part of the Attribute Read Function is to store the Part Id and Description for each entity. This data is then available for interrogation by the User. The forms shown below show a list of property names and their relevant Description text. Picking a row will display the Part List for this property. Where properties have been combined then there will be multiple parts in the List.



An alternative view of this data is available where the Part Names are sorted and the properties attached to each Part Name are listed.

Conclusions

Currently GKN Westland Helicopters is involved in a project, which is using data from Catia for the definition of the Aircraft Structure. As this is an existing aircraft the Catia Definition is a mixture of Exact Solids and Surfaces. This project will give us a good test platform with which to evaluate the process, highlight any problems and determine the best practice methods to be used in future projects