

8.0 Conclusions and Recommendations

8.1 Overview

This research provides effective tools for visualizing the error between matching surfaces. At the outset, the objectives of the thesis were defined as:

- Provide information about the location of error between two patches;
- Provide characteristic information about the matching surfaces; and
- Design a method for reduction of error related data that will allow graphical presentation of data for easy visualization.

The tools discussed in this research benefit the designer by providing him with more information and insight into the characteristic differences between two closely matched surfaces. A new method of data reduction is presented which facilitates identification of points with significant error. This error might be in either the position values, surface normal values or radii of curvature values at corresponding points between the two surfaces. The use of Fourier analysis to discern qualitative information about the match between two surfaces is also discussed.

8.2 Closure

The ordinate intercept plot for vector difference of position data successfully captures the shape of the “error surface” in both parametric directions. By looking at the shape in both directions, the designer can quickly isolate areas of significant error. A high value of correlation between the values of maximum error between two patches and the ordinate intercept values substantiates or corroborates the hypothesis.

The frequency spectrum of the “error surface” is another important tool for obtaining qualitative feedback about the match. Using this tool, the designer will not be able to obtain quantitative insight into the location of error, but will nevertheless, be able to discern a good match from a not so good one just by looking at the spectrum. The “error surface” is again replicated in the frequency spectrum and validates the results obtained in the earlier section.

Ordinate intercept plot for the angle between surface normals, locates problem areas in a manner similar to that done by the ordinate intercept plot for the position error values. An important value addition in this case, is the information about the relative orientation of the two surfaces in E^3 obtained from the magnitude of the angular difference of the normals.

The last tool presented is the ordinate intercept plot for difference in radii of curvature values. This plot not only validates results obtained using the ordinate intercept plot for

position difference, but also adds value by tracking how rapidly or slowly does the orientation of the tangents to the curve is changing as one traverses along the curve.

It should be noted that the data reduction mechanism followed by each of these tools except the frequency response plot is the same and has been discussed earlier in this thesis in detail. Also, the last two methods, the surface normal error plot and the curvature difference plot require considerable judgement and interpretation by the designer to be usable as effective error visualization tools.

Based on the results presented in the earlier section and the discussion herein, it can be said that the problem of reduction of error related data to meaningful information has been solved to a satisfactory degree. Quantification of error feedback has also been achieved, i.e., the designer can estimate the location of error between matching patches with a reasonable degree of ease and accuracy.

8.3 Recommendations

A number of cases of localized and non-localized error between matching surfaces have been simulated by varying or modifying geometry in CATIA and I-DEAS. Visual perception fails to detect the magnitude of error as simulated through the course of this research. This was attempted by rendering the two surfaces together in different colors. However, it would be good to bolster these results by applying these tools to a real life

problem in geometrically trimming a reasonably complex surface and verifying usefulness of these tools.

The data used in this research is generated using commercial CAD software, namely CATIA and I-DEAS. Future work on this subject could benefit from the use of mathematical description of the original and trimmed surfaces. The mathematical formulation for implementing such a tool has been discussed. The advantage of using the mathematical description is that the designer can vary the number of points sampled, improve the resolution of results, and analyze a particular part of the patch, as and when needed. Consider the representation of a complex geometry such as a car or an aircraft as a combination of patches. This means that the whole geometry can be represented as a single surface on the parametric plane. Using these tools, the designer can quickly identify prominent areas of discrepancy and take corrective action. If needed, attention can be focussed on a particular portion by just sampling points in that region and by just varying the sampling rate, detailed information can be obtained.