1.0 Introduction

A considerable amount of research has been carried out to describe sculptured surfaces mathematically. Over the years, a progression of various methods starting from Ferguson patches to B-spline surfaces have been proposed to answer this problem. The endeavor has been to describe surfaces, which give the user more ability to control its shape while satisfying certain desirable continuity conditions at connections between adjacent surface patches.

At the start of the 1960's, Ferguson, at Boeing, announced a method of describing curves and surface patches parametrically. In 1967, Coons announced another method of describing a surface using the four corner point position vectors and the four boundary curves [Fari97]. These descriptions required unintuitive mathematical knowledge in order to design with and proved difficult to control. However, the idea of parametric description of entities was retained and has since become the standard for mathematical description of curves and surfaces. The problem of interactive control of curves and surfaces was overcome when Bezier introduced the concepts of shape control and well-behaved curves and surfaces based on control points. However, all the above methods had connectivity problems when putting curve and surface segments together. Therefore,

the concept of a 'spline' was introduced into the area of geometric modeling. Gordon and Riesenfeld first introduced B-splines into geometric modeling [Fari97]. B-splines incorporated the same aspects as those in the Bezier scheme, but with superior controllability and eliminated the connectivity problem [Yama88].

Since their introduction, B-splines have become a standard for representing geometry. Most complex sculptured geometry can be represented as B-spline surfaces [Rock89].

As research progressed, more solutions were sought to problems like surface intersection and surface trimming, i.e., finding curves of intersection and finding ways to trim portions of a surface.

Figure 1.1 displays the iso-parametric curves of two intersecting surfaces. The points of intersection are also shown. The portion of the *surface A*, lying within the cylindrical *surface B* has to be trimmed. Figure 1.2 displays the wire frame of an aircraft with a wing intersecting the fuselage. The points of intersection are shown. The unwanted portion of each wing is to be clipped at the intersection curve.

A majority of the research carried out in the area of trimming of surfaces has been primarily towards parametric delimiting, which will be referred to as graphical trimming or visual trimming. Surface trimming can be also be characterized under another heading called Geometric trimming, where a new parameter set is defined to describe the trimmed patch, one which is different from that for the original surface. Thus, the trimmed patch is

given a separate mathematical identity rather than it being a subset of the original surface as is the case in visual trimming and this finds use in many applications. Once a trimmed surface has been fully defined, it is available for use as input in aerodynamic or hydrodynamic codes, catering to the needs of the aerospace, automotive and the ship building industry; in hydrostatic and structural calculations for ship surface design; in finite element analysis; in conceptual design, in computation of surface areas and volumes; in NC programming; etc.

Figure 1.1: Two intersecting surfaces along with the points of intersection. [Appl89]

Figure 1.2: Figure showing the intersection points when an aircraft wing and the fuselage intersect [Appl89]