3D SHAPE RECOGNITION USING ANSA SCRIPTS

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ABSTRACT –
Creating adequate mesh according to the mesh rules is important in order to assure the quality of simulation results since simulation results may vary depending on mesh. Not only simple features such as fillets, flanges, chamfers, and emboss but also other features and complex features such as thin planes, tapered tubes, ribs, and grooves can matter. Recognizing features and controlling mesh for them automatically help to reduce time spent on manual mesh modifying work dramatically.
In this paper, ANSA scripts are used to develop algorithms to recognize the various specific features from shapes of input CAD models automatically in order to control mesh for fulfilling the need in creating mesh with detailed mesh rules for the specific features.
The goal of the feature recognition with ANSA scripts described in this paper is to automate mesh creation procedures according to specific mesh rules.
We plan to use the algorithms developed with ANSA scripts for our entrusted analysis operations as well.

TECHNICAL PAPER -

1. INTRODUCTION

It is time consuming to create adequate FEM mesh according to the mesh rules where the ideal mesh should be different for each analysis phenomena, such as crash, structural, thermal, and fluid phenomena. (1) It is important to create ideal mesh according to the mesh rules in order to assure the quality of simulation results since simulation results may vary depending on mesh. Not only simple features such as fillets, flanges, chamfers, and emboss but also other features such as thin planes, tapered tubes, ribs, and grooves can matter. Recognizing features and controlling mesh for them automatically help to reduce time spent on manual mesh modifying work dramatically.
ANSA can recognize and control mesh according to mesh rules for various features such as fillets, flanges, chamfers, and so on. However, it is difficult to recognize features and control mesh meeting all mesh rules that a variety of analysis engineer have for each analysis phenomena.
We have developed automatic mesh generation system using ANSA scripts to fulfil the needs in creating mesh according to specific mesh rules.

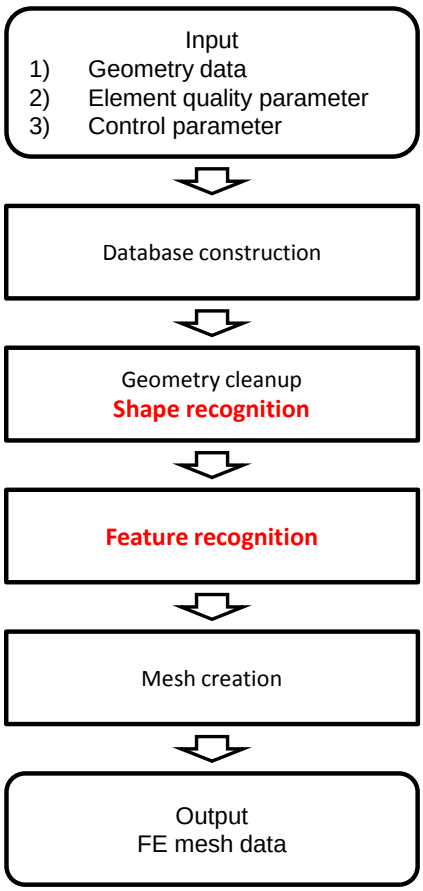

Figure 1 – Main procedures of automatic mesh generating system using ANSA script.

2. 3D SHAPE RECOGNITION

We have developed 3D feature recognition system using ANSA scripts. We used ANSA script functions such as ProjectAndMarkPoints to recognize input model face shape to comprehend its characteristics.
Although ANSA can recognize features such as fillets, flanges, and chamfers, We needed to develop our own feature recognition algorisms to recognize them as well as features such as thin planes, ribs, and grooves.
Typical face shape and feature examples are shown in Figure 2.
To recognize these features, we used characteristics of each face. Characteristics we check are as follows:

- max and minimum curvature of face
- length of perimeters
- average curvature of perimeters
- position and number of hot points on perimeters
- length ratio of equivalent perimeter pairs
- circle shape (center point and radius)
- inner angle of hot points
- area of face
- angle difference between normal vectors within face
- average, max, and minimum contact angle of the contact face on perimeters
- cross sectional shapes.

Which characteristics we check for each features are shown in Table 1.

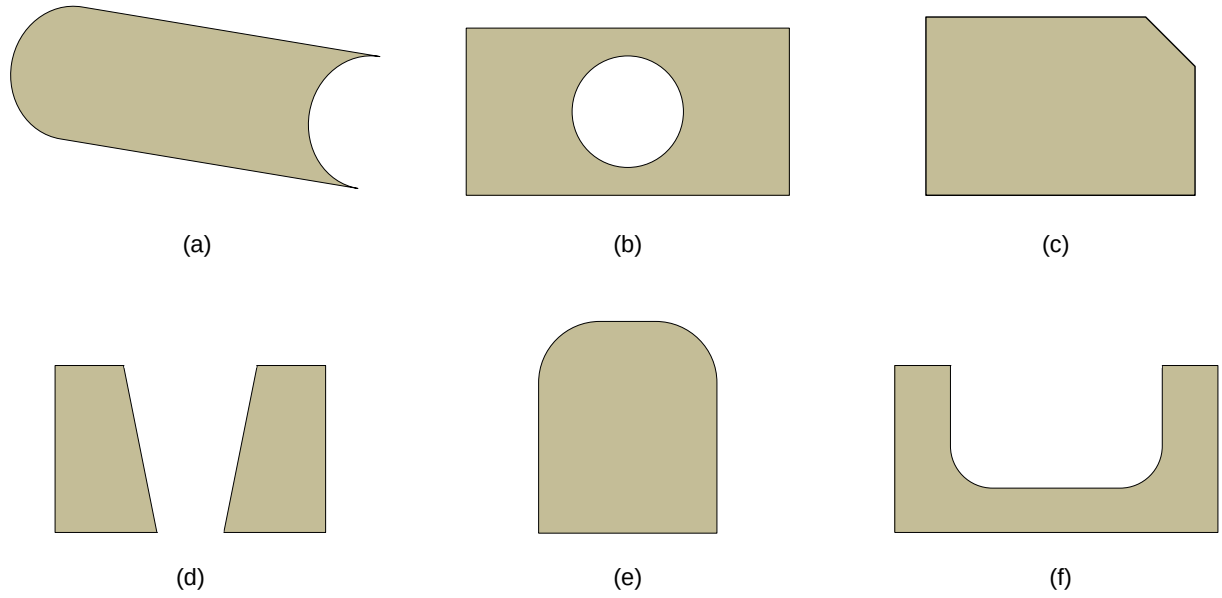

Figure 2 – Face shape and feature examples. (a) fillet, (b) hole, (c) chamfer, (d) tapered holes, (e) rib, (f) groove

Table 1 – Face characteristics used for recognizing features.

	Features									
Characteristics	fillet	flange	hole	chamfer	general face	thin plane	tapered tube	emboss	rib	groove
Curvature (max/min)	✔	✔		✔	✔	✔	✔	✔	✔	✔
Perimeter's length	✔	✔	✔	✔		✔	✔	✔	✔	✔
Perimeter's average curvature	✔									
Hot point on perimeter (position & number)	✔	✔		✔	✔				✔	✔
Length ratio of equivalent perimeter pair	✔					✔	✔		✔	✔
Circle shape (center point and radius)			✔				✔	✔		
Inner angle of hot point	✔	✔		✔	✔	✔				
Area of Face	✔	✔		✔	✔					
Angle difference between normal vectors within face		✔	✔	✔	✔		✔	✔	✔	✔
Contact angle of the contact face on perimeter (ave/min/max)	✔	✔	✔	✔	✔		✔	✔	✔	✔
Cross sectional shape				✔			✔	✔	✔	✔

As shown in Table 1, we used characteristics of face to recognize which face consists of which feature. It only refers to simple features that could be recognized by checking one face and the neighbouring faces.
In addition to simple features, we also developed feature recognition system using ANSA scripts to recognize composite surface features such as a bolt seating surface. They can be recognized with combination of faces and their cross sectional shape as well as characteristics of each face.
An example of composite shape is shown in Figure 3. In this composite shape, for example, the scripts recognize an upper plane face, a lower (base) face, upper fillets, lower fillets. Flow of fillets, and cross sectional shape.

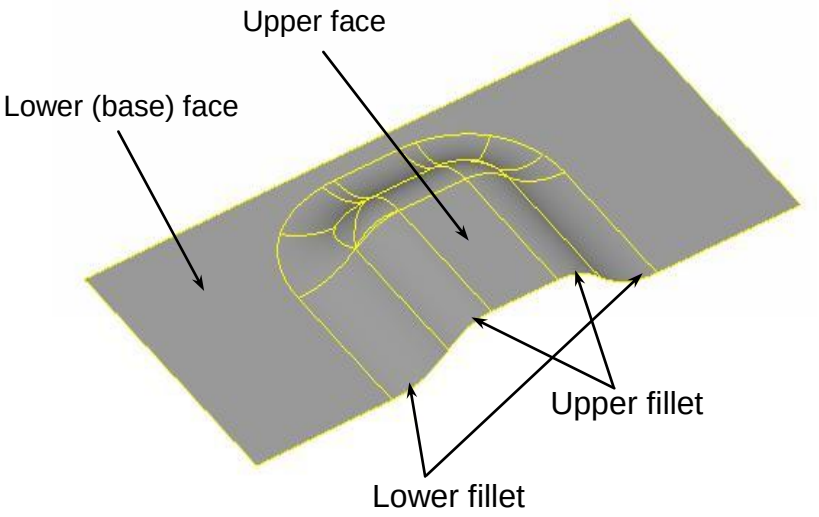

Figure 3 – Example of composite shape.

3. CONCLUSIONS

In this paper, ANSA scripts are used to develop algorithms to recognize the various specific features from shapes of input CAD models automatically in order to control mesh for fulfilling the need in creating mesh with detailed mesh rules for the specific features.
Using the feature recognition with ANSA scripts described in this paper, we achieved to automate mesh creation procedures according to specific mesh rules.
We plan to use the algorithms developed with ANSA scripts for our entrusted analysis operations as well.

REFERENCES

(1) Current Trends and Issues In Automatic Mesh Generation, Kenji Shimada, Carnegie Mellon University, 2006