Isoparametric Mesh Generastion Of Three Dimensional Contacted Objects

M. H. Kadivar* H.Sharifi**

*Mechanical Eng. Dept.
Shiraz University Shiraz Iran
** Khod kafaee Reasearcher
Shiraz Iran

Summary
Based on the curvilinear isoparametric mapping, a method for mesh generation is proposed which can be applied to all two and three dimensional problems especially to the objects which are contacted at a point or a side or a plate. A computer program has been written which is capable of generation meshes and automatic bandwidth reduction of the objects before and after contact. The number of elements can increase without changing the number of nodes on the sides of the supper elements which is very applicable in contacted objects.

Introduction

When two objects are in contact, different problems would arise in the mesh generation of them. One of the mainproblem is the way that they are in contact and the other is their node numbering. Two three dimensional objects can be contacted at a point,a side or at a plane fig.1. In the ordinary mesh generators two contacted

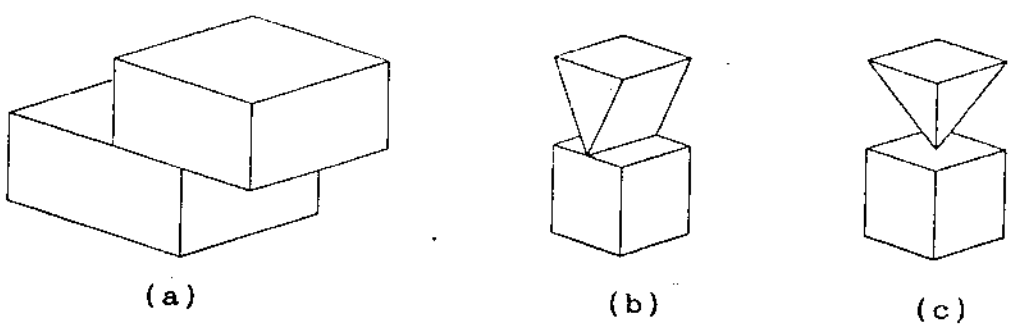


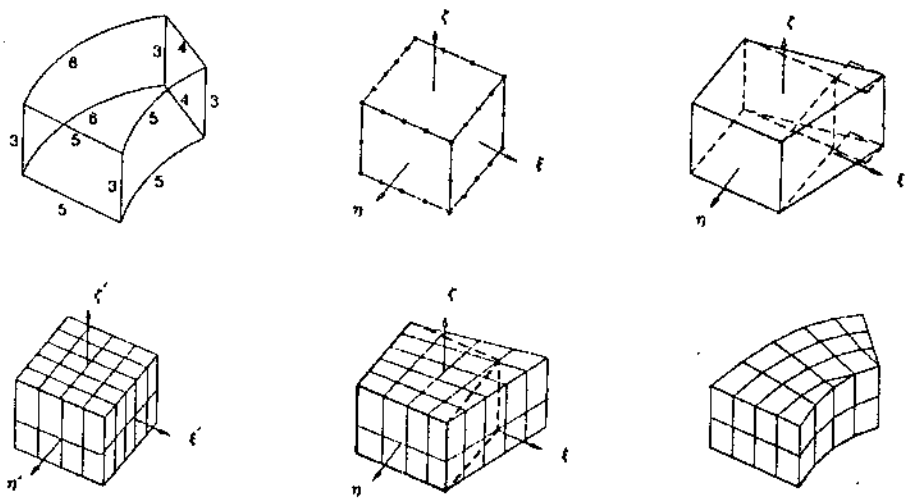
Fig.1 Different kind of the contacted objects

object can not be contacted at a point or a side, and when they are contacted at part of their plane, that part should be considered as

a plane of supperelement which causes an increase in the number of supperelements, computer time and user's inconveniences. In addition to it, when the contacted area is a point or a side and one wants smaller elements at contacted area, while the size of elements which are far from the contacted are bigger. This again needs bigger number of superelements. The authores [1], proposed a method which is capable of handelling different number of nodes on different sides of supperelement which by their applications the above mentioned difficulties can be encountered.

Extended isoparametric method

In the curvilinear isoparametric method [2], the supperelements should have equal number of nodes on their opposite sides. In the extended method [1]; fig.2(for simplicity, the nodes on the foure sides are equal); the supperelement would be transfer to ξ-η-ζ



Procedure of discretization when the number of nodes on the base plane is different

Fig.2

coordinte. In this coordinate because the number of nodes on opposite sides are not equal, these sides would be extended such that the number of nodes on all the opposite sides become equal and the cube would be change to hexahedron. The hexahedron would be transfered to a cube in ξ'-η'-ζ' coordinate. This cube which has the same number of nodes on it's opposite sides would be discreticized by ξ'=const., η'=const. and ζ'=const. After discretization it would

be transfer back to ξ-η-ζ coordinate, the extra parts would be cancell out and refinement would be done[1]. After refinement the final transformation would be applied, all these steps are shown in fig.2. Based on the extended isoparametric method, a computer program is written which is capable of handling all kind of contacted objects where the contacted point or side can be asumed as a hypothetical plane and the discretization can be than. For example in fig.1 a-c ; which is a general different kind of contacted objects; only two supperelements have been assumed for each cases and they were discreticized and are shown in fig.3. Because the contacted point or line is assumed as a hypothetical plane, and because each side can have different number of nodes, by assuming different number of nodes on the hypothetical plane different number of elements can be obtained while the number of

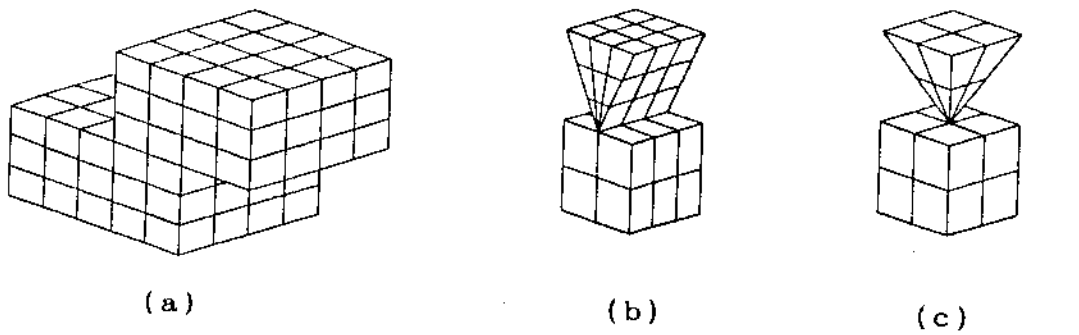


Fig.3 Discretization of the objected shown in fig.1

nodes on the sides are equal. Fig.4 is showing a pyramid which is at contact with a cube at a point. Fig.4-a is the supperelements, fig.4-b and 4-c has the same number of nodes on their sides but different number of elements at the contacted point.

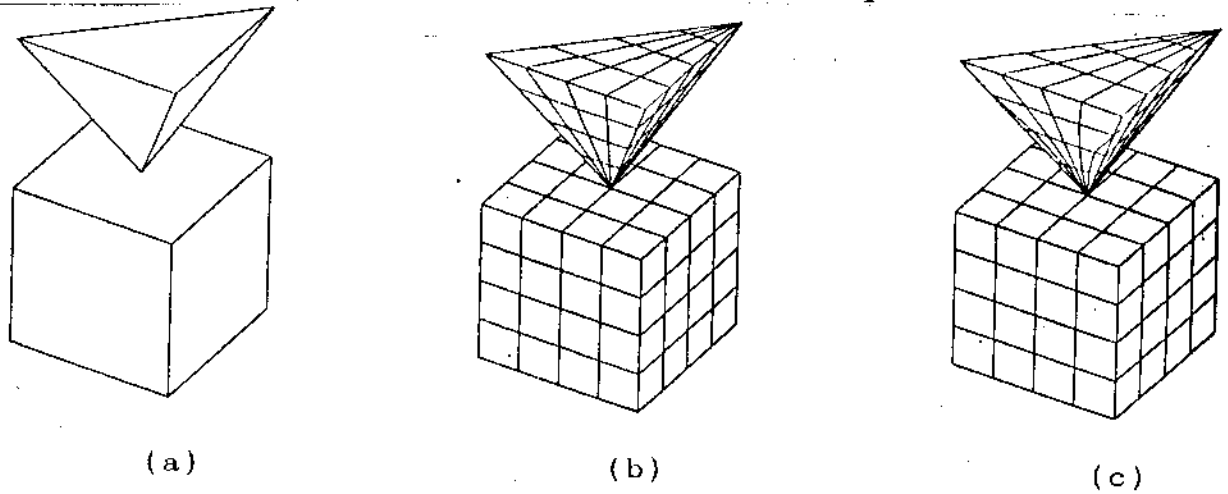
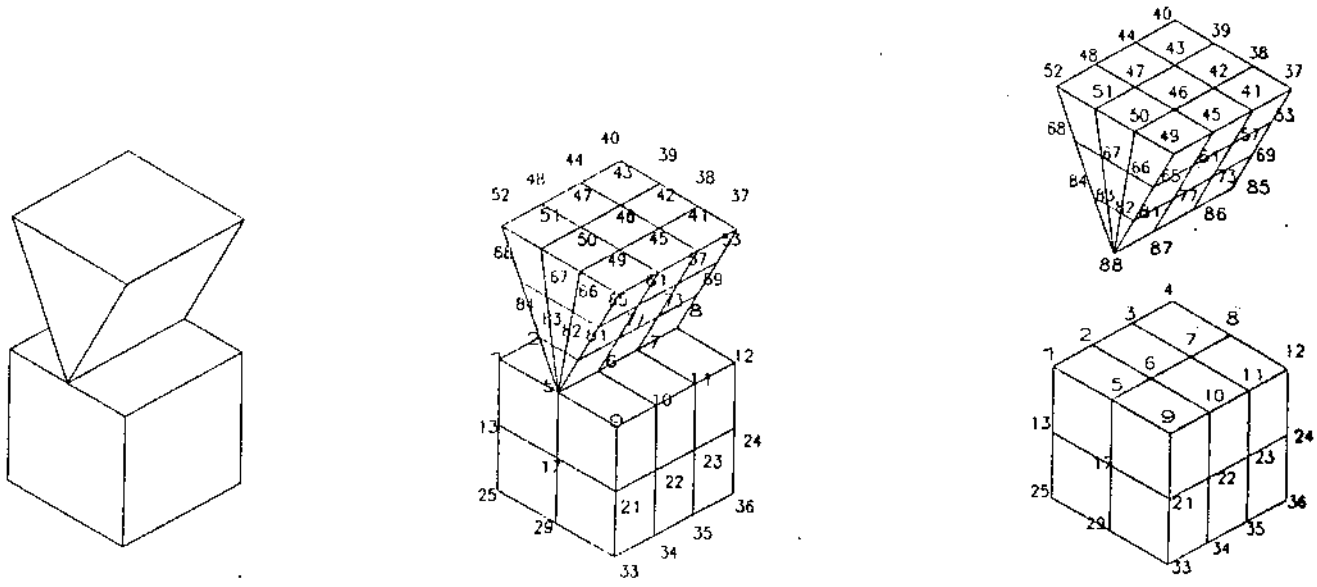


Fig.4 Equal num.of nodes on the sides but different nom.of elements

In the proposed method, for numbering the nodes, the coordinates of nodes are compared together.It means that instead of comparing the nodes on the sides of the supperelement, which is used in ordinary generatores, if the coordinates of the nodes are equal the same number of nodes would be applied. Therefore while compatibility has been considered, the supperelements can be contacted at a point, or even if they are not connected, numbering can be done fig.5. Based on the work of Collins[3], the algorithem has an automatic bandwidth reduction which can be applied on the objects berfore and after contact fig.5.



(a) (b) (c)

Fig.5 Numbering of nodes before and after contact

References

1. Kadivar, M.H.; Sharifi, H.; A New versatile two dimensional mesh generation, Proceeding of the third international conference on advances in numerical methods in engineering, theory and appplication (1990)

2. Zienkiewicz, O.C.; Philips, D.V.; An automatic mesh generation scheme for plane and curved surfaces by isoparametric co-ordinates, Int. J Numer. Method eng., 3, 519-528(1971)

3.Collins; .J.; Bandwidth reduction by automatic renumbering; Int. J. Num. Mech. Eng. 6, 345-356 (1973)