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Three-dimensional mesh generation using the crossed circles method

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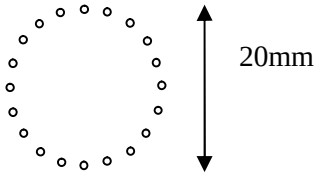
ABSTRACT

1. Introduction

Delaunay method [1] is a powerful method for triangulations. The quality of mesh generated by this method, however, depends on the allocation of nodes. For getting suitable allocations, Bubble method [2] was developed. In Bubble method all nodes should be defined in advance. Especially it is important how to determine internal nodes. We developed a new algorithm that creates internal nodes in two-dimensional mesh generation and we called this method "crossed circles method" [3]. This method is based on Delaunay method. In this study we developed three-dimensional crossed circles method.

2. Two-dimensional crossed circles method

Figure 1 shows the example for studying mesh generation. In this example 20 nodes are allocated on a circumference of which diameter is 20 millimeter.



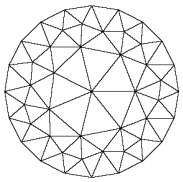


Fig.1 Nodes on a circumference Fig.2 Mesh created by Crossed circle method

Figure 2 is the result of mesh generation using two-dimensional crossed circle method [3].

3. Three-dimensional crossed circles method

In this study, we propose three-dimensional Crossed circles method for tetrahedron elements. When a node except vertexes of tetrahedrons is located in a circumscribed sphere of a tetrahedron in the three-dimensional Delaunay method, these elements are swapped as shown in Figure 3. After this swapping process, circumscribed spheres are calculated for three tetrahedron elements. If the center of circumscribed

sphere is included in the other spheres, it is investigated if the existing node is near here. If there is no existing node, the center-of-gravity point of the triangle of which convexes are the center of circumscribed sphere is added.

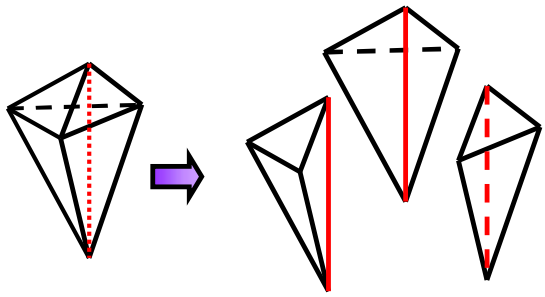
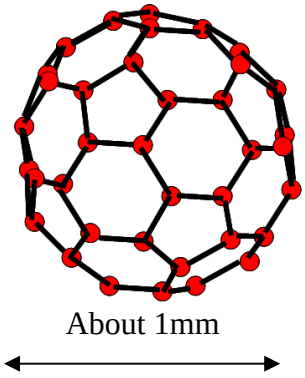


Fig.3 Swapping of tetrahedron elements

Figure 4 is the example of mesh created by three-dimensional crossed circles method. This example is a structure that has 60 points on a sphere like “fullerene”. In this case, diameter is about 1.0mm. Figure 5 is the mesh created by the crossed circles method.



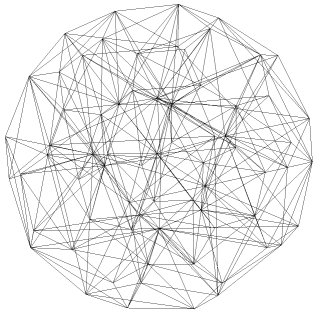


Fig. 4 Structure like Fullerene Fig.5 Mesh created by Crossed circles method

4. Conclusion

We proposed the three-dimensional crossed circle method and showed the validity of this method using developed program.

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