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Regularization of triangular latticed shell members and panels for Bézier surfaces

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Abstract

Since complex building shapes have become able to be materialized owing to development of computational modelling and construction technique, there is an increasing interest in obtaining rational shapes considering cost and constructability of free-form surfaces. Discretization to latticed shell is one of the effective solutions for cost reduction, and uniformity of discretized members is a key factor to reduce the number of types of members and joints. Moreover, regularization of members is expected to avoid buckling of long members and construction difficulty due to short members.

Ogawa et al. [1] formulated a shape optimization method of latticed shells for maximum linear buckling loads and uniform member lengths, where the difference between the maximum and minimum lengths are used for the regularization of members.

As the extension of member lengths, we can consider the shapes of enclosed areas by the members. Schaefer [2] proposed a regularization method for triangulated surfaces, where initial triangles are classified using k-means clustering and the positions of the vertices are re-located to match the case if the triangles are substituted by canonical polygons of the clusters. However, this method inevitably alters the geometry of the surface,

In this paper, a new method is proposed for regularization of triangular latticed shell members and panels whose design surface is a tensor product Bezier surface. By carrying out clustering and optimization alternately, better solutions can be achieved compared with the case of conducting both only once. In addition, we introduce a continuous relaxation method instead of k-means method to conduct clustering of members or panels.

References

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