Topology Optimization of Free Formed Shells using Improved ESO

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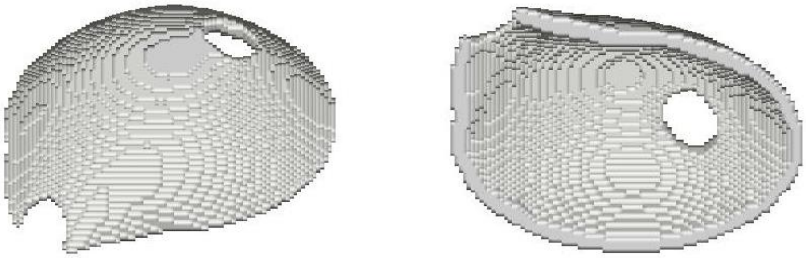
Abstract

Concrete shell structures that can realize free curved surface have created many attractive architectures to date. However, in design of such continuum shell structures, it is difficult to find an optimal morphology analytically. Because, in the optimal analysis, shape, thickness and topology of shell structure become design variables simultaneously.

Therefore, we proposed that a simple method to find an optimal morphology of shell structure. In this method, a rectangular design domain given boundary condition and body forces is divided by voxel mesh, and strain energies of the elements (voxels) are obtained by voxel finite element method. Next, the elements with small strain energy are removed gradually by Improved ESO (IESO) method[1,2,3], and then an optimal morphology of shell structure that shape, thickness and topology are optimized appear. In this paper, several numerical examples and application examples will be shown in order to verify the effectiveness of the proposed method.

As you can see Figure.1, we can create a shell that is various forms.



upper view lower view

231step $C/C^0 = 0.017$ $\left(\bar{V}_r = 0.07,\ \lambda = 0.01,\ b_r = 1\right)$

Fig.1 Optimal configuration

References

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