

A Series of Studies on Analysis and Generation for Structural Shapes and Systems

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In this study, some computational morphogenesis procedures for a large spatial structure satisfying the structural rationality were proposed as follows.

1. For the membrane structure, the finite element technique with coordinates assumption was proposed, and the simultaneous analysis on the form finding and the cutting patterns was performed.
2. For the structural optimization, the autonomous decentralized finite element technique was proposed, and was applied to the form finding analysis for a general structure.
3. For the structural optimization, the importance using decent solutions was clarified, and the structural morphogenesis examples using these solutions were shown for a free-form surface shell. The decent solutions have comparatively high evaluation value including a global optimal solution (pareto optimum solutions) and local optimal solutions (local pareto solutions) and those neighborhood solutions.

The proposed procedures used the mathematical programming and the heuristic multipoint search approach. In the membrane structure analysis, the mathematical programming was used. The heuristic multipoint search approach adopted the genetic algorithm technique and the swarm intelligence technique with a manipulation of the decent solutions search.

These procedures can be applied to the structural morphogenesis (generation of structural shapes and systems) in the design support of the architectural designs and the structural systems.