事例研究

# パラメータ成立範囲によるロバスト設計法と耐震設計への適用

## A Robust Design Method Using Parameter Ranges and Its Application to Seismic Design

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Recently nonlinear simulation has been introduced into, for example, fluid analysis carried out for the design and development of spacecraft, leading to studies of the computation of robust design solutions that can withstand external disturbances. As the technology becomes more advanced and specialized, however, organizations have become more siloed, making it difficult to share information with designers in other fields. As a basis for considering parameter design, the present study describes the computation of ranges of parameter values satisfying multiple restrictions. One feature of these effective parameter ranges is that they enable multiple results to be evaluated together; another feature is that it becomes easier to share the results with other designers. To verify the effectiveness of this method, it was applied to a seismic simulation of timber structures to compute parameter ranges that would avoid collapse in a major seismic event and avoid damage in a moderate seismic event. A multilevel orthogonal array was used to improve the reproducibility of the results of the study, and a supercomputer was used to shorten the computation time. Reproducibility was studied using the shape retention method of quality engineering, and found to be high.

**Key words** : Taguchi methods, quality engineering, S/N ratio, multilevel orthogonal table, parameter range, nonlinear simulation, timber structure, seismic design, supercomputer

## 1. 宇宙機開発におけるロバスト設計の課題

### 1.1 宇宙機システム開発における課題

宇宙機システムは，打ち上げた後は修理が出来ないため，設計・製造から運用に至るまでのさまざまな外乱（材料，加工，運用，環境等のばらつき）を考慮し，それに耐性を持つロバスト設計の導入が重要である。

近年では，宇宙機を構成する，熱，構造などの各専門分野において，流体解析や機構解析などの非線形シミュレーションの導入が進められている。しかし，技術が高度化・専門化すれば組織のサイロ化が進行し，自己の権限や利益を守るために排他的にな

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