Maximum stiffness and minimum weight designs of laminated composite shells using praticle swarm optimization algorithm

楊博仁、賴

E-mail: 9512637@mail.dyu.edu.tw

摘 要

本文主要運用簡化的三維殼元素，發展一套能準確分析複合材料殼構件〈圓柱型殼與球狀型殼〉的3-D殼元素有限元素法。對於有曲率殼構件的分析結果，此有限元素法的3-D殼元素優於2-D殼元素；此外，本文之理論結果優於其他研究之分析結果與實際值，證實本文應用3-D殼元素有限元素法於複合材料殼構件的力學行為分析是可行的。因此，利用本文所提出的有限元素法，搭配最佳化設計方法進行複合材料殼構件之最大勁度設計與輕量化設計，並將理論分析和最佳化的結果與實驗?進行比較。 在最佳化設計方面，本文以粒子群最佳化演算法(PSO)進行兩種最佳化問題之設計，即為複合材料圓柱型殼之最大勁度設計在不等厚度之情形下與複合材料圓柱型殼和球狀型殼之輕量化設計在強度限制下，以離散的設計變數〈層組的角度與厚度〉進行最佳變數的搜尋。並以例子說明對稱之複合材料殼構件在不同的受力情形、長寬比(B/A)、半徑-長度比(R/A)、長厚比(A/H)的情況下進行最佳化設計。除此之外，運用雙基因演算法(DGA)和混合型粒子群最佳化演算法(HPSO)與粒子群最佳化演算法(PSO)之搜尋結果進行比較，探討其演算法之優劣性。如此，以複合材料殼構件運用多種演算法進行搜尋效果比較，以達到設計目標與節省成本之目的。

關鍵詞 : 複合材料 ; 殼構件 ; 首層破壞 ; 輕量化 ; 勁度 ; 最佳化 ; 粒子群最佳化演算法

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