実施報告

2種類の直交多項式による合わせ込みの比較研究

A Comparative Study of Tuning by Two Types of Orthogonal Polynomials

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In the two step optimization procedure advocated by quality engineering, first a robust set of design conditions with high noise tolerance is found; then, if necessary, the conditions are tuned toward the target characteristic. When the target characteristic is expressed as a curve, orthogonal polynomials are useful in the tuning process. Two types of orthogonal polynomials are available: Chebyshev general orthogonal polynomials, which have constant terms; and proportional orthogonal polynomials, which lack constant terms. Criteria for choosing between these two types have been unclear. In the present study, this issue was addressed with respect to the operating force curve of a switch by using theoretically derived orthogonal polynomials of both types and comparing the tuning processes. Both types were applied to the same materials, making possible a concrete comparison between them. Both types of orthogonal polynomials led to nearly the same final tuning accuracy and yielded nearly identical design specifications, but the proportional orthogonal polynomials were found to be advantageous because they were easier to work with and were more generally applicable.

Key words : two step optimization, Chebyshev general orthogonal polynomial, proportional orthogonal polynomial, switch, operating force curve, theoretical formula, S/N ratio, Taguchi methods, quality engineering

1. はじめに

　品質工学が提唱する「2段階設計」は，まず初めにノイズ因子に強いロバストな設計条件を探り，その後に必要に応じて目標に合わせ込むという考え方である。その合わせ込みの方法にはさまざまあるが，目標特性が曲線の場合は，直交多項式が有用である。

　直交多項式は，最小2乗法などに対し，各次数の係数を独立に決められること，ある次数まで展開式を取ったときの誤差分散が分かることなどのメリットがある。

　直交多項式の中で品質工学の合わせ込みに登場するのは，「チェビシェフの一般直交多項式」[1][2]と「比例直交多項式」[3]〜[5]である。しかし，両者の使い分けの指針は必ずしも明確でなく，共通の題材に適用して比較ができるような事例もほとんど見られない。そこで今回，当社のスイッチにおける作動力理論式をベースに，両方の直交多項式を使って，操

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