

Confident Exploratory Visualization Techniques for Improvement in High Dimensional Response Surfaces*

ROBERT J. PARODY[†] and DON EDWARDS[‡]

Abstract

Quadratic response surface methodology often focuses on finding the levels of some (coded) predictor variables $\mathbf{x}' = (x_1, \dots, x_n)$ that optimize the expected value of a response variable y . Often the experimenter starts from some best guess or "control" combination of the predictor variables (usually coded to $\mathbf{x} = \mathbf{0}$) and performs an experiment varying them in a region around this center point. The question of interest addressed here is whether any \mathbf{x} in the experimental region provides an improvement in long-run mean response $E(y)$ over that of the control, and if so, by what amount? Sa and Edwards (1993) addressed this question via simultaneous confidence intervals for $\delta(\mathbf{x}) = E(y|\mathbf{x}) - E(y|\mathbf{0})$ for all \mathbf{x} within a specified distance of $\mathbf{0}$. Here, we discuss methods for visualization of the improvement contours $\delta(\mathbf{x})$ and simultaneous confidence bounds when $k \geq 2$ using canonical and ridge analysis, with examples. The canonical profile bounds are useful in adding much needed confidence to the elucidation of ridge systems, whereas the ridge trace bounds are useful in adding confidence to the identification of the optimal coordinate settings, even when the stationary point is inside the experimental region. These methods allow for blocks and covariates in the design, and are useful for all types of second order surfaces.

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[†]*Mailing Address:* Center for Quality and Applied Statistics, Rochester Institute of Technology, 98 Lomb Memorial Drive, Rochester, NY 14623–5604, USA. *E-mail:* rjpeqa@rit.edu.

[‡]*Mailing Address:* Department of Statistics, 216 LeConte College, University of South Carolina, Columbia, SC 29208, USA. *E-mail:* edwards@stat.sc.edu.