WAHBA, G. (1990). *Spline Models for Observational Data*. SIAM, Philadelphia.

ANDREAS BUJA
DIANE DUFFY
BELLCORE
445 SOUTH STREET
BOX 1910
MORRISTOWN, NEW JERSEY 07962-1910

TREVOR HASTIE
AT & T BELL LABORATORIES
600 MOUNTAIN AVENUE
MURRAY HILL, NEW JERSEY 07974-2070

ROBERT TIBSHIRANI
DEPARTMENT OF STATISTICS
UNIVERSITY OF TORONTO
TORONTO, ONTARIO
CANADA M5S1A8

FINBARR O'SULLIVAN[1]

University of Washington

This article reviews a set of key developments in nonparametric function estimation, many of them due in part or in large to Professor Friedman, which have radically changed the scope of modern statistics. MARS is an impressive addition to this set. There is a growing practical interest in innovative adaptive function estimation techniques. For example, I am aware of the need for sophisticated covariate adjustment in connection with survival analysis of a large clinical trail, where $N = 27{,}000$ and $n \geq 200$; the thought of sending these data to MARS for analysis will have undoubted appeal!

1. General comments. With any adaptive regression technique, it is of interest to know the kinds of functions which cause greatest difficulty. MARS is coordinate-sensitive. A rotation of the coordinate axes in the examples in Sections 4.2 and 4.3 will destroy the simple additive and low-order interactive structure. Will this substantially degrade the performance (ISE) of MARS? Perhaps the effect could be ameliorated by allowing linear combination splits in the algorithm. A natural set of split coordinates would be those obtained by successive orthogonally restricted regression of residuals r at the Mth order model on the covariates: The linear combination c_1 determining the first split coordinate solves the least-squares regression of r on covariates, the linear combination c_2 determining the second split coordinate solves the least-squares regression of r on covariates but subject to the orthogonality constraint $c_2'c_1 = 0$ and so on. The relevant formulas are available in Seber ([4], pages 84–85). Algorithm 2 only requires a minor change to incorporate consideration of linear combination splits. Obviously it would no longer make sense to have a

[1]Research supported in part by Dept. of Energy Grant FG0685-ER2500 and by National Cancer Institute Grant 2P01-CA-42045.