Optimal Stack Filtering and the Estimation and Structural Approaches to Image Processing [1]

E.J. Coyle, J.-H. Lin and M. Gabbouj

School of Electrical Engineering
Purdue University
West Lafayette, Indiana 47907

Abstract

Rank-order based filters such as stack filters, multistage median filters, morphological filters, and order statistic filters, have all proven to be very effective at enhancing and restoring images. Perhaps the primary reason for their success is that they can suppress noise without destroying important image details such as edges and lines.

Two approaches have been used in the past to design rank-order based nonlinear filters to enhance or restore images. They may be called the **structural approach** and the **estimation approach.** The first approach requires structural descriptions of the image and the process which has altered it, while the second requires statistical descriptions. The many different classes of rank-order based filters that have been developed over the last few decades are reviewed in the context of these two approaches.

One of these filter classes, stack filters, then becomes the focus of the rest of the paper. These filters, which are defined by a weak superposition property and an ordering property, contain all compositions of 2-D rank-order operations.

The recently developed theory of minimum mean absolute error (MMAE) stack filtering is reviewed and extended to two dimensions. Then, a theory of optimal stack filtering under structural constraints and goals is developed for the structural approach to image processing.

These two optimal stack filtering theories are then combined into a single design theory for rank-order based filters.

[1] This work was supported by the National Science Foundation under grant EET87-21333.