XIII. DIGITAL SIGNAL PROCESSING

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A. TWO-DIMENSIONAL DIGITAL FILTER STRUCTURES

National Science Foundation (Grant ENG71-02319-A02)

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The study of the realization of two-dimensional digital filters has traditionally proceeded by formal generalizations from one dimension. Such generalizations do not make clear the issues involved in using a finite-state machine to process 2-D signals. Therefore we have initiated work on formulating basic issues that arise when the finite-state machine is a basic component of a signal-processing scheme. Two examples of issues that thereby become clear are as follows. First, since a finite-state machine necessarily operates in sequence upon a finite amount of data at a time, 2-D signals must be ordered in some manner to be processed. Second, although a 2-D filter may be shift-invariant (i.e., its characteristics at each point in 2-D space depend in a constant way upon some fixed neighborhood of that point, regardless of the absolute location of the point), the amount of memory required by a machine to realize the filter may grow without bound. Intuitively, the reason for this is that a fixed neighborhood in 2-D space may translate to a growing neighborhood in "time." Thus the problem of realizing 2-D filters must not only include the traditional issues of coefficient sensitivity, roundoff errors, and number of multiplies, etc. but also such issues as efficient ways of ordering computations and minimizing memory requirements. Understanding these issues and incorporating them in the problem definition phase is a first step toward a general filter synthesis procedure.