Some Correlation Properties of and Entropy Calculations in 2-D Lattice Filters

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The theory of one-dimensional (1-D) lattice filters are well developed and well known. In recent years, two dimensional (2-D) lattice filters are being investigated intensively and their theories are being developed. 2-D lattice filters with quarter plane support have many similarities with the causal 1-D lattice filters. Making use of these similarities, the correlation relations between the forward and the backward prediction errors are derived. However, there are some differences between the 2-D and the 1-D lattice filters due to the differences in the growth of data support. Even though the data support of a 1-D lattice filter grows linearly with the order of the filter, the growth is not linear in a 2-D case since the support grows in both directions. Thus a lattice filter with fixed number of coefficients is not sufficient to model a 2-D autoregressive (AR) data field. The information is lost while modeling a data field with fixed number of reflection coefficients. An expression is derived to express the autocorrelation matrix of the backward prediction errors in terms of the reflection coefficients and the residual error power at each stage. The entropy of the backward prediction errors is calculated in terms of its autocorrelation matrix and it is compared with that of the data field. The entropy lost is calculated quantitatively by computer simulations and the theory is confirmed.