

Partial Realization Theory and System Identification Revisited

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Abstract: In the beginning of the 1970s R.E. Kalman posed a question related to the connection between subspace identification for time series and partial realization theory. In this partially tutorial talk we review these connections and show that the answer to Kalman's question is negative. The appropriate realization problem for system identification is the rational covariance extension problem. However, most basic subspace algorithms actually solve a deterministic partial realization problem where the basic condition of positive realness has been removed. This may lead to failure for theoretical rather than numerical reasons. In fact, a sequence of estimated covariance lags has both an algebraic and a positive degree, and failure will occur when the degrees do not coincide. Kalman asked whether there is a matrix criterion for the positive degree similar to the Hankel condition for the algebraic degree. Today we understand that this is not possible. The closest matrix condition is related to the rank of a nonstandard matrix Riccati equation, where the rank has to be minimized over a manifold.