An Application of the Principle of Maximum Information Preservation to Linear System

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Abstract: This paper addresses the problem of determining the weights for a set of linear filters (model "cells") so as to maximize the ensemble-averaged information that the cells' output values jointly convey about their input values, given the statistical properties of the ensemble of input vectors. The quantity that is maximized is the Shannon information rate, or equivalently the average mutual information between input and output. Several models for the role of processing noise are analyzed, and the biological motivation for considering them is described. For simple models in which nearby input signal values (in space or time) are correlated, the cells resulting from this optimization process include center-surround cells and cells sensitive to temporal variations in input signal.