

*Abstract*—The water-filling solution for the quadratic rate-distortion function  $R(D)$  of a stationary Gaussian source is given in terms of the spectrum of the source. Similarly, the capacity  $C$  of a power-constrained inter-symbol interference channel with Gaussian noise is given by a water-filling solution relative to the effective noise spectrum. Both these formulas amount to mutual-information between vectors in the frequency domain. In contrast, linear prediction along the time domain can translate these vector mutual-information quantities into scalar ones. Indeed, for capacity it is known that  $C$  is equal to the scalar mutual-information over a slicer embedded in a decision-feedback noise-prediction loop. We show that a parallel result holds for the rate-distortion function:  $R(D)$  is equal to the scalar mutual-information over an AWGN channel embedded in a source prediction loop.