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Stochastic filtering theory, by G. Kallianpur, Springer-Verlag, New York, Heidelberg, Berlin, 1980, xvi + 316 pp.,$29.80.

An important problem in statistical communication theory is the separation of random signals from random noise. These phenomena are modelled by stochastic processes s_t, n_t called respectively the signal and noise processes. The signal cannot be observed directly; instead, at time t the sum

$$z_t = s_t + n_t \tag{1}$$

is observed. Roughly speaking, the filtering problem is to make a "best" estimate for s_t given observations z_τ for times $\tau \leqslant t$. Closely related problems are to best estimate s_T when $t < T$ (the prediction problem) and for $T < t$ (the data smoothing problem). By "best" estimate $\hat{s}_t$ let us mean an estimate minimizing the mean squared error $E(s_t - \hat{s}_t)^2$, with $E(-)$ denoting expected value. Pioneering work on the filtering problem was done by Wiener and Kolmogorov during the 1940s. In that work, the filtering problem was considered in the frequency domain, by taking Fourier transforms of z_t, s_t, n_t. The problem was reduced to solving an integral equation of Wiener-Hopf type.

Linear filtering theory took a distinctive new direction around 1960, stimulated by two key papers by Kalman [**9**] and Kalman and Bucy [**10**]. In their approach the filtering problem is considered in the time domain (rather than the frequency domain), and state space representations are introduced. The signal is expressed as a linear function of an N-dimensional state vector X_t,