CHAPTER 6

Homomorphic Signal Processing

6.1 Introduction

Signals that are added together and have disjoint spectral content can be separated by linear filtering. Often, however, signals are not additively combined. In particular, the source and system in the linear speech model are *convolutionally* combined and, consequently, these components cannot be separated by linear filtering. The speech signal itself may also be convolved with a system response such as when distorted by the impulse response of a transmission channel or by a flawed recording device. In addition, the speech signal may be *multiplied* by another signal as occurs, for example, with a time-varying fading channel or with an unwanted expansion of its dynamic range. In these cases, it is desired to separate the nonlinearly combined signals to extract the speech signal or its source and system components.

The linear prediction analysis methods of the previous chapter can be viewed as a process of *deconvolution* where the convolutionally combined source and system speech production components are separated. Linear prediction analysis first extracts the system component and by inverse filtering then extracts the source component. This chapter describes an alternative means of deconvolution of the source and system components referred to as *homomorphic filtering*. In this approach, convolutionally combined signals are mapped to additively combined signals on which linear filtering is applied for signal separation. Unlike linear prediction analysis, which is a "parametric" (all-pole) approach to deconvolution, homomorphic filtering is "nonparametric" in that a specific model need not be imposed on the system transfer function in analysis.