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open questions and explores the future of  
Part I concerns the problem of enhancing  
an array of microphones. For a variety of  
computer interaction and hands-free telephony  
roam unfettered in diverse environments  
speech signal and robustness against background  
and reverberation effects. The use of microphone  
tunity to exploit the fact that the source of  
noise sources are physically separated in space  
ing techniques, typically developed for array  
were initially applied to the hands-free system  
the environment in which microphone arrays  
from that of conventional array applications  
has an extremely wide bandwidth relative to  
that conventional narrowband techniques

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and track one or more speech sources is an essential requirement of microphone array systems. For speech enhancement applications, an accurate fix on the primary talker, as well as knowledge of any interfering talkers or coherent noise sources, is necessary to effectively steer the array, enhancing a given source while simultaneously attenuating those deemed undesirable. Location data may be used as a guide for discriminating individual speakers in a multi-source scenario. With this information available, it would then be possible to automatically focus upon and follow a given source on an extended basis. Of particular interest lately, is the application of the speaker location estimates for aiming a camera or series of cameras in a video-conferencing system. In this regard, the automated localization information eliminates the need for a human or number of human camera operators. Several existing commercial products apply microphone-array technology in small-room environments to steer a robotic camera and frame active talkers. Chapter 8 summarizes the various approaches which have been explored to accurately locate an individ-

beamforming methods to reduce background noise. These methods are shown to dramatically improve the speech quality and are compared and paired and to increase their overall satisfaction. This chapter focuses on the case of a simple two-element array and how to achieve noise and echo reduction. The chapter is analyzed under realistic acoustic conditions for desktop conferencing and intercom applications with the problem of acoustic feedback in mind. Various techniques involving loudspeakers and microphone arrays and cancellation methods are integrated within the chapter to enhance echo suppression. These results are applied to channel conferencing scenarios. Chapter 9 discusses microphone arrays for sound capture in automobiles. The chapter also discusses echo cancellation specifically within the context of a particularly effective approach is detailed.

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2.1 Introduction.....

2.2 Evaluation of Beamformers.....

2.2.1 Array-Gain .....

2.2.2 Beampattern.....

2.2.3 Directivity.....

2.2.4 Front-to-Back Ratio .....

2.2.5 White Noise Gain .....

2.3 Design of Superdirective Beamformers.....

2.3.1 Delay-and-Sum Beamformer .....

2.3.2 Design for spherical isotropic .....

2.3.3 Design for Cylindrical Isotropic .....

2.3.4 Design for an Optimal Front-to-Back Ratio .....

2.3.5 Design for Measured Noise Field .....

2.4 Extensions and Details .....

2.4.1 Alternative Form .....

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helped us in a big way. In the early days  
nal processing complexity were possible.  
high cost DSP computations, where com  
widespread use of the technology. Today  
us to implement all but the most comple  
processing technology in real-time. But t  
from breaking through the computing bo  
problems at hand has significantly progres  
of the results presented are from recent y  
the potential and the limitations of micr  
too often the same problems that were  
years ago are still set apart for 'future  
proposed solutions are similar to the ones  
for a long time. Generally speaking we r  
tions add to our understanding but lack r  
future for themselves.

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