ACTIVE NOISE CONTROL

APPLIED TO CONFINED FLOWS

Part I: Anti-Sound

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1. Introduction

Anti-sound has moved from science fiction to commercial products, facilitated by advances in rapid and cheap digital signal processing. In this brief introduction we begin in section 1 by discussing the basic consequences of the superposition of sound waves. This is developed in sections 2 and 3 to consider anti-sound for plane waves in ducts and for more complex acoustic fields in enclosures.

2. Concepts of Anti-Sound

Anti-sound aims to reduce the effects of unwanted noise by introducing a secondary ‘control’ signal which is designed to be 180º out-of-phase with the sound from the primary source (see Figure 1). It exploits the fact that sound waves are linear, the superposition of two sound signals resulting in the sum of their pressure fields.

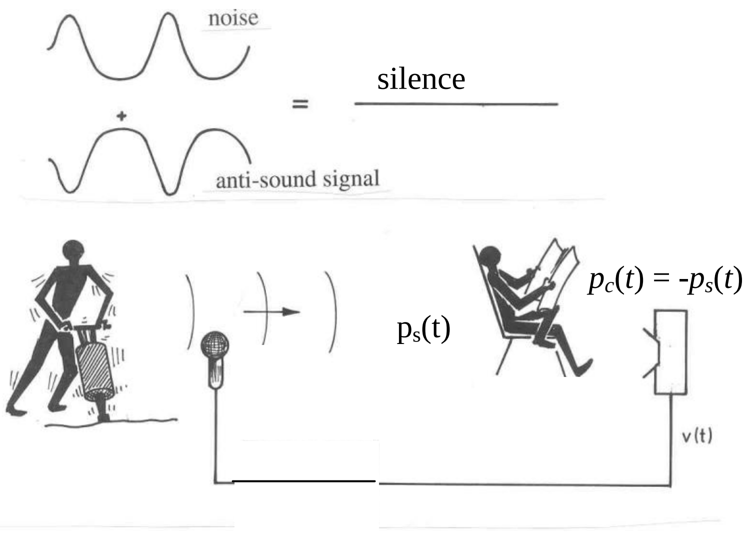

Figure 1 Sound and Anti-sound

If $p_s(t)$ represents the sound pressure at a listener due to the primary source, and $p_c(t)$ the signal produced by the controller then the resultant pressure is

$$p(t) = p_s(t) + p_c(t) \tag{2.1}$$

Ideally $p_c(t)$ is chosen to be $-p_s(t)$, resulting in silence. However, errors inevitably occur. Since the human response to noise is on a logarithmic scale, it turns out that $p_c(t)$ must mimic