SPATIAL SOUND PERCEPTION BY SANTA CLAUS AND HIS REINDEER

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This paper presents an overview of the studies carried out in the cold weather of Northern Finland in order to understand how Santa Claus and his reindeers manage to find the way to all children during Christmas Eve, sometimes based on just minor cues of directional hearing from distant sound events. It is shown that while Rudolf the Red Nose Reindeer helps to throw light to darkness of the night, Edward the Long Ear Reindeer is the best helper of Santa Claus in auditory navigation. Edward's exceptional accuracy in directional and spatial sound perception is due to the long time training when listening to the newest multi-channel and 3-D sound systems that Santa Claus has purchased.

INTRODUCTION

The following chapters specify the instructions for the authors of the 16th AES International Conference "Spatial Sound Reproduction", to be held in Rovaniemi, Finland, April 10-12, 1999. This is a template to simplify writing a manuscript that fits to the style and layout of the conference proceedings. Please read carefully the instructions below to see if your manuscript prints as desired. It is recommended that you compare your print-out also with the example paper PostScript version, especially if you find any problems using this template. Don't forget to check the official AES 16 website for submission details!
(`http://www.acoustics.hut.fi/aes16/`)

Figure 1: Santa and his team.

1. PAPER LAYOUT

The final paper layout is a *one-sided, two-column* format with the font size of **10pt**. However, in order to final papers print correctly on both A4 and US Letter size paper, it is important that the text **must not exceed height of 23 cm and width of 17 cm**. The top margin should be exactly **2.5 cm** and the left margin **2 cm**. The size between columns should be exactly **1 cm**.

1.1. Subsections

Subsections and subsection titles should look like this.

1.2. First page

The first page must contain a **predefined area** for basic paper and author related information. The height of this are is **exactly 10 cm** from the top margin. The information inside this area will be reformatted for the paper proceedings!

The information for the first page should include:

- Paper title
- Authors
- Affiliation and contact information
- Abstract

These items should be formatted in a one-column layout and they must not exceed the predefined area!

2. FIGURES

To illustrate topics, numbered figures can and should be included within the text (Fig 1) [1]. Figure labels should be centered and placed immediately after the figure (Fig 2). Remember that figures will be printed in greyscale

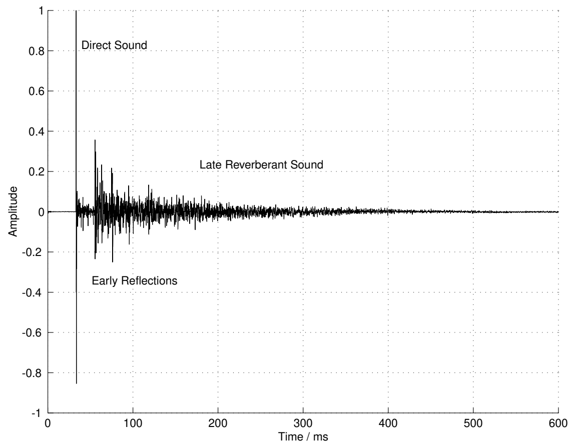

Figure 2: The impulse response of a reindeer shed.

and that they should be clear enough even after being printed and copied.

3. EQUATIONS

Equations should be placed on separate lines and numbered:

$$x(t) = s(f_\omega(t)) \tag{1}$$

where $f_\omega(t)$ is Santa warping function

$$f_\omega(t) = \frac{1}{2\pi j} \oint_C \frac{\nu^{-1k} d\nu}{(1-\beta\nu^{-1})(\nu^{-1}-\beta)} \tag{2}$$

Santa's residue theorem states that

$$\oint_C F(z)dz = 2\pi j \sum_k Res[F(z), p_k], \tag{3}$$

where

$$Res[F(z), p_k] = \lim_{z \to p_k} \frac{d^{q-1}}{dz^{q-1}} (z-p_k)^q F(z) \tag{4}$$

Applying theorem 3 to 1, it is quite straightforward to see that

$$1 + 1 = \pi \tag{5}$$

4. CONCLUSIONS

Our studies clearly prove that Edward the Long Ear Reindeer is the key to Santa's outstanding accuracy with his Christmas present delivery system. Without a doubt, only long time training [2] could have been the reason for achieving such remarkable directional hearing properties although there are indicators showing that Edward might have a so called "Golden Ear" [3] as well. However, Edward's ability to distinguish between good and bad people, which allows Santa to choose the right items, is left for future research.

REFERENCES

[1] Audio A.C., Speaker S.J. 1998. The Effects of Long White Beard on Directional Hearing. Journal of Santa Audio, 24, 12, pp. 1–1998.

[2] Speaker S.J. 1998. Introduction to Santa Audio - Theory of Multichannel HRTF Systems. Santa Press. Finland. 1999 p.

[3] Audio A.C., Does Edward the Long Ear Reindeer have a "Golden Ear"? In Proc. 1998 Int. Conf. Acoustics, Audio and Christmas, Korvatunturi, Finland, December 24-25, 1998. pp. 1–4.