Manual on the Code of the Book "Acoustic Waves Generated by Parametric Array Loudspeakers"

Jiaxin Zhong

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1 Introduction

This document introduces the usage of the code package, which is a supplementary material for the book "Acoustic Waves Generated by Parametric Array Loudspeakers". All demos and functions were tested by MATLAB R2022b installed on a personal computer with an AMD Ryzen Threadripper 3960X central processing unit (CPU) with 256 GB of random access memory (RAM).

1.1 Installation

Steps:

1. Download all codes from GitHub: JiaxinZhong/AWPAL
2. Run the script AWPAL.m at first to add subfolders to the path.

2 Demo Scripts and Core Functions

2.1 Direct Integration Method (DIM)

2.1.1 Audio Sound Field

2.1.1.1 On-Axis

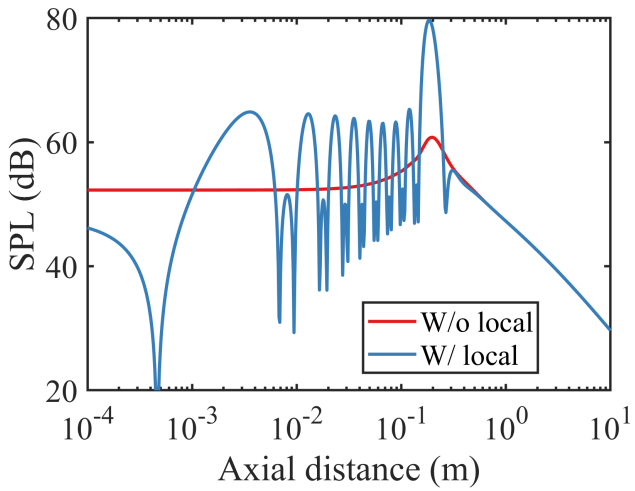

Figure 1: On-axial SPL (dB) as a function of the axial distance (z, m) [1, Fig. 2(e)].

Demo: PalDIM3D_CircSrc_Axis_Demo.m

Function: PalDIM3D_CircSrc_Axis.m Calculate the audio sound field on the axis $\rho = 0$ using the DIM. The source profile is assumed to be

axisymmetric in the azimuthal direction, i.e., $v_{i,z}(\mathbf{r}_\mathrm{s})$ is independent of φ_s. The formula used in this function is

$$p_\mathrm{a}(\rho=0,\varphi,z)=-\frac{\beta\omega_\mathrm{a}^2}{2\rho_0 c_0^4}\int_{-\infty}^{\infty}\int_0^{\infty}\frac{p_1^*(\mathbf{r}_\mathrm{v})p_2(\mathbf{r}_\mathrm{v})}{\sqrt{\rho_\mathrm{v}^2+(z-z_\mathrm{v})^2}}\mathrm{e}^{\mathrm{i}k_\mathrm{a}\sqrt{\rho_\mathrm{v}^2+(z-z_\mathrm{v})^2}}\rho_\mathrm{v}\mathrm{d}\rho_\mathrm{v}\mathrm{d}z_\mathrm{v} \tag{1}$$

3 Known Issues

References

[1] Jiaxin Zhong, Tao Zhuang, Ray Kirby, Mahmoud Karimi, Xiaojun Qiu, Haishan Zou, and Jing Lu. Low frequency audio sound field generated by a focusing parametric array loudspeaker. *IEEE/ACM Trans. Audio Speech Lang. Process.*, 30:3098–3109, 2022.