Sound Propagation Analysis
Wave Equations and Transmission Loss

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November 24, 2025

Abstract

Analysis of sound wave propagation through various media, including acoustic impedance, transmission coefficients, and transmission loss calculations.

1 Introduction

Sound propagation is governed by the acoustic wave equation and boundary conditions at material interfaces.

2 Acoustic Impedance

$Z = \rho c$

Figure 1: Acoustic impedance comparison.

3 Reflection and Transmission

$R = \frac{Z_2 - Z_1}{Z_2 + Z_1}$

Figure 2: Reflection and transmission coefficients.

4 Mass Law Transmission Loss

$TL = 20 \log_{10}(\pi f m / \rho c)$

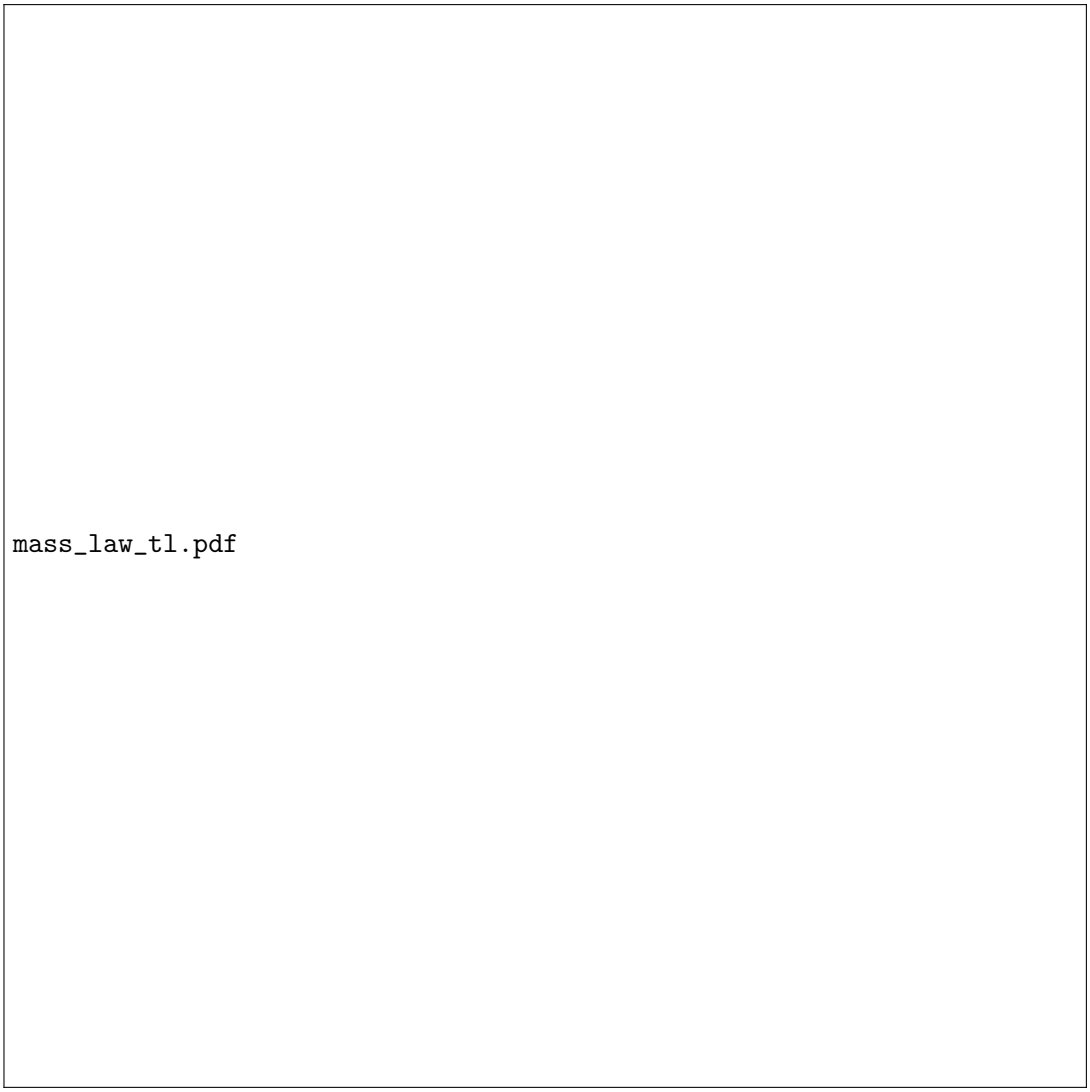

Figure 3: Mass law transmission loss predictions.

5 Coincidence Effect

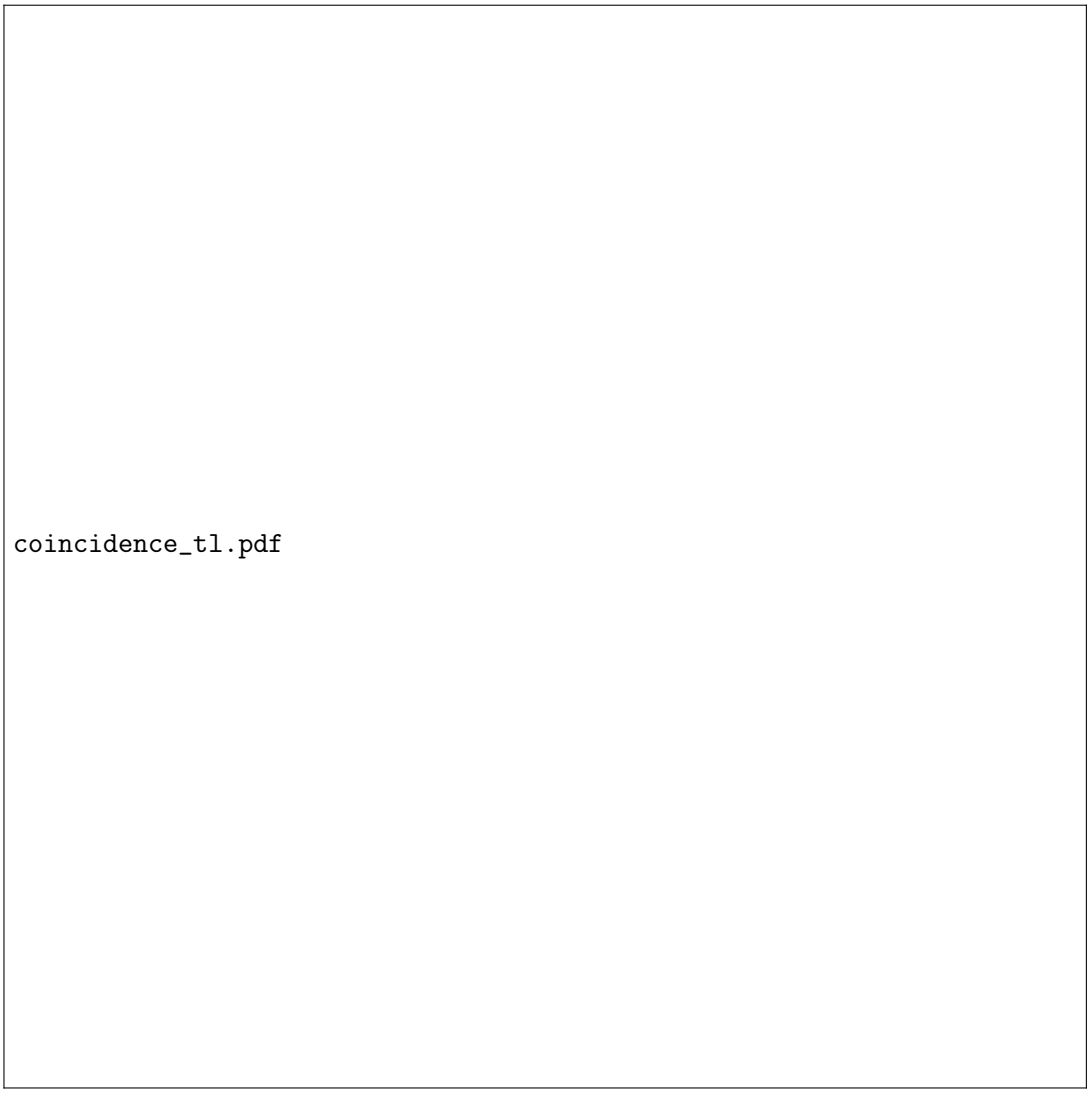

Figure 4: Transmission loss with coincidence dips.

6 Double Wall TL

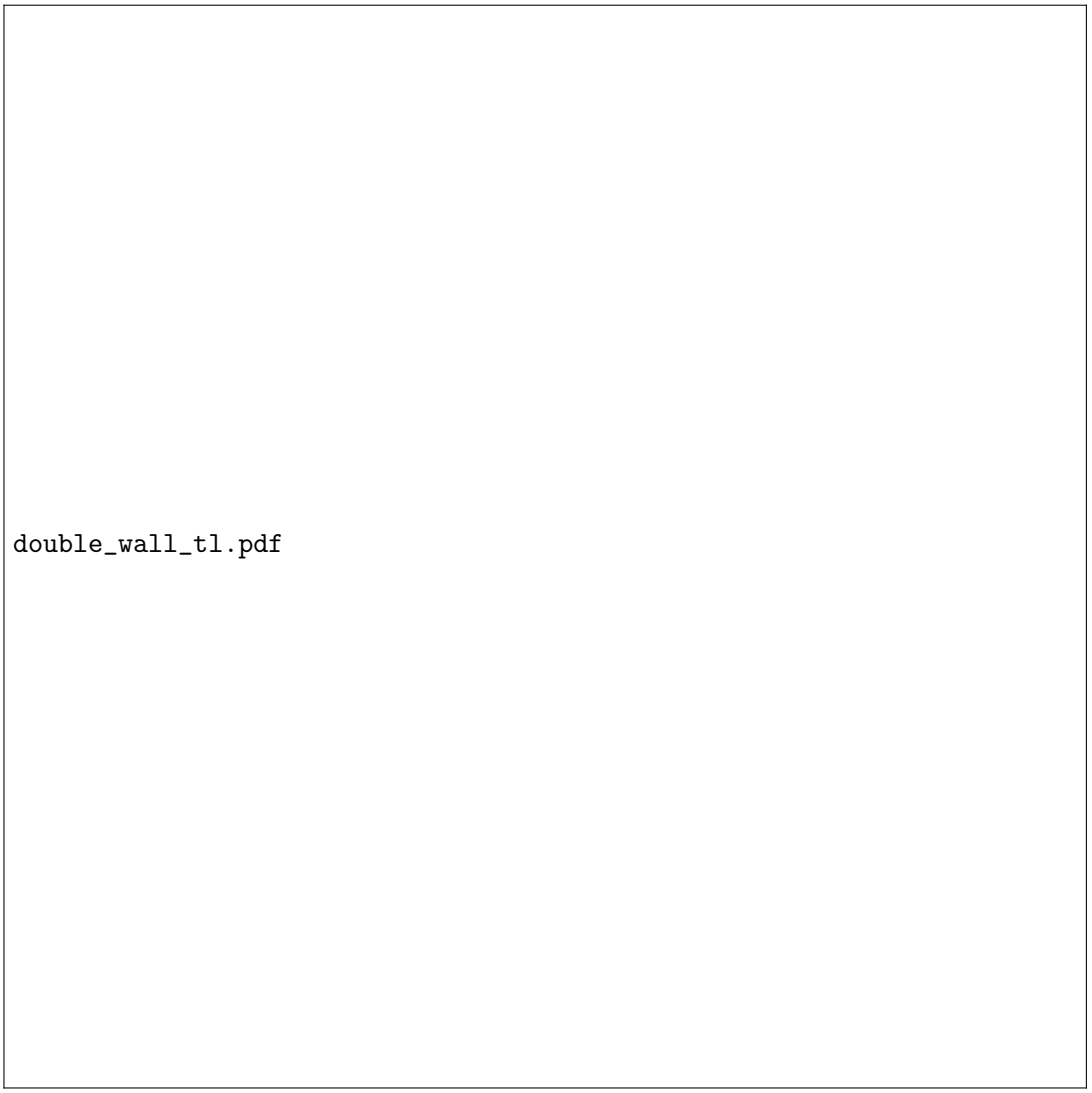

Figure 5: Double wall transmission loss.

7 Atmospheric Absorption

Figure 6: Atmospheric sound absorption.

8 Spreading Loss

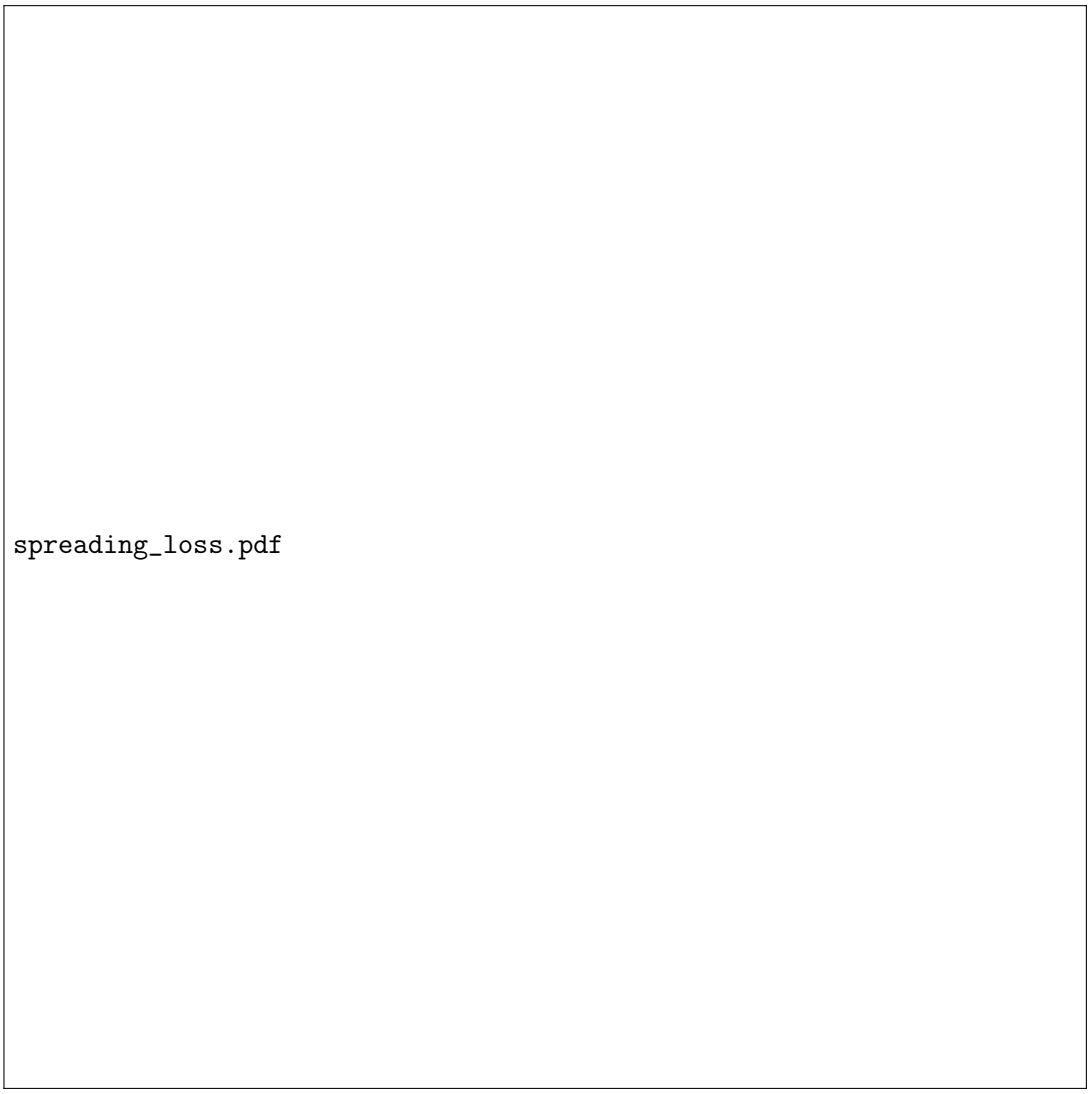

Figure 7: Sound level decay with distance.

9 Results

10 Conclusions

This analysis demonstrates key principles of sound propagation and transmission loss including mass law, coincidence effects, and atmospheric absorption.