Numerical Acoustics – Exercise 2

1. Analytical solution of 1D sound field in a pipe ....

One-dimensional sound field is analysed in a straight pipe with length 1 m. The pipe is closed at both ends.

(a) Determine the lowest five eigenfrequencies of the pipe.

(b) Determine the distribution of sound pressure amplitude (eigenmodes) inside the pipe at the five eigenfrequencies.

2. Calculation of 1D sound field in a pipe using FDM ....

Solve the problem described above numerically using Finite Difference Method (FDM):

(a) Calculate the eigenfrequencies and the sound pressure amplitude distribution with 2nd-order accuracy (except perhaps at the ends of the pipe).

(b) Calculate the eigenfrequencies and the sound pressure amplitude distribution with 4th-order accuracy (except perhaps at the ends of the pipe).

(c) Compare the eigenfrequencies calculated with both orders of accuracy for 10, 100, and 500 nodal points.

Note: the speed of sound is $c_0 = 343$ m/s.