Noise Engineering & Aeroacoustics **Class 2019_Spring**

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HomeWork #2 (Due 04/08)

1. Explain briefly the followings, (5pts each)

   a) Compact and Non-compact source

   b) Near-field and Far-field

   c) Causality condition

2. Survey the following items via the internet, (10pts each)

   a) The types of the microphone and their characteristics

   b) The microphone calibration methods

3. A boundary vibrates in water at the frequency of 10Hz with a displacement amplitude 10^{-5}m. Determine the SPL generated by that vibration at a distance 1km from the boundary when

   a) the boundary is a plane surface with uniform normal displacement. (5pts)

   b) the boundary is a circular cylinder of radius 50cm with axially uniform displacement. (10pts)

   c) the boundary is a sphere of radius 50cm with symmetric radial displacement. (10pts)

4. The following duct is filled with air. Plane wave is propagated from the flat type speaker which is installed on the left side of the duct. Frequency of plane wave is 250Hz. Inner radius of duct is 5cm. And, one point's SPL (sound pressure level), 5m away from speaker's vibrating surface, is 80dB. Determine the followings. (5pts each)

a) p'_{rms}

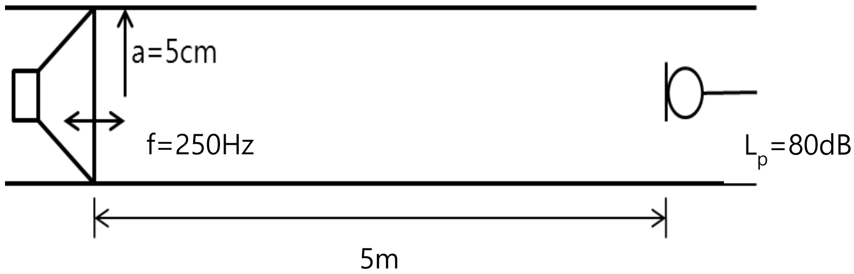
b) intensity (W/m^2)

c) acoustic power (W) passing through the vertical plane of the duct

d) speaker diaphragm's vibrating amplitude (peak value of deflection)

(hint: using the value from a))

※ Note: Dissipation in a medium is negligible.



5. In the water, when the pressure rapidly drops so the local pressure becomes below the water vapor pressure, bubbles are generated. This phenomenon is called "cavitation". Volumes of each bubble vibrates until they disappear. Neglecting its movement, the vibration of each bubble can be modeled as "pulsating sphere." The pressure field by the pulsating spherical boundary can be represented as: $\hat{p}(\mathrm{r}) = \frac{a}{r}\frac{\frac{j\omega a}{c}}{1+\frac{j\omega a}{c}}\rho_0 c\hat{u}_a e^{-j\omega(r-a)/c}$.

When we assumed that the bubble size is very small (much smaller than the wavelength), the vibrating frequency to the radial direction is 'f', and the surface velocity is 'V,' the predicted acoustic power was P_0.

1) Acoustic power predicted by this model is 4 times larger than experimental data. It seems that the assumed vibrating frequency is incorrect. In order to get the correct acoustic power, what should be the vibrating frequency of the bubble? (10pts)
2) Due to the pressure increment, the volume of the bubble became half. (the shape remains sphere) Determine the acoustic power P_1 radiated from the smaller bubble in terms of P_0. (10pts)