Basics of Noise and Its Measurement

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What is Sound?

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Breaking a wine glass using resonance

http://www.youtube.com/watch?v=17tqXgvCN0E
Vibration versus Waves
Wave Propagation
Wave Propagation in Time & Space

Wave function

$$\psi(x, t) = A \sin(\omega t \pm kx)$$

$A =$ wave amplitude  
$\omega =$ angular frequency  
$k =$ wave number

Animation courtesy of Dr. Dan Russell, Kettering University
Is particle velocity in a wave same as velocity of wave?
Longitudinal Waves

Particles and wave move in the same direction.

Animation courtesy of Dr. Dan Russell, Kettering University
Transverse Waves

Particles and wave move in mutually perpendicular directions.

Animation courtesy of Dr. Dan Russell, Kettering University
Where do you see such waves?

Particles move in longitudinal and transverse directions. Wave travels in longitudinal direction. Particle motion is more on top than at bottom. Here, blue-dots move in clockwise direction.
Rayleigh Waves

Particles move in longitudinal and transverse directions.
Particle motion is anti-clockwise on top.
Particle motion is clockwise below.

Animation courtesy of Dr. Dan Russell, Kettering University
Nature of Sound Wave

A small disturbance in fluid (acoustical) medium
  • Pressure, density, displacement, velocity, temperature

Longitudinal waves
  • velocity \( (c) = 343.2 \text{ m/s} \) at 20 °C in air

Sound pressure is measured by microphones or pressure transducers

Nature of Sound

\[ P_{total} = P_0 + \rho \]

\[ P_0 = 1,013,250 \text{ Pa} \]
Acoustic Waves (Sound)

- Pressure wave

- Speeds in various media

<table>
<thead>
<tr>
<th>Medium</th>
<th>Speed (m/s)</th>
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<tbody>
<tr>
<td>Air @ 21 C</td>
<td>344</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1213</td>
</tr>
<tr>
<td>Hydrogen @ 0 C</td>
<td>2169</td>
</tr>
<tr>
<td>Water (fresh)</td>
<td>1480</td>
</tr>
<tr>
<td>Water (saline - 3.5%)</td>
<td>1520</td>
</tr>
<tr>
<td>Human body</td>
<td>1558</td>
</tr>
<tr>
<td>Wood</td>
<td>3350</td>
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<tr>
<td>Concrete</td>
<td>3400</td>
</tr>
<tr>
<td>Mild steel</td>
<td>5150</td>
</tr>
<tr>
<td>Glass</td>
<td>5200</td>
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</tbody>
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References


