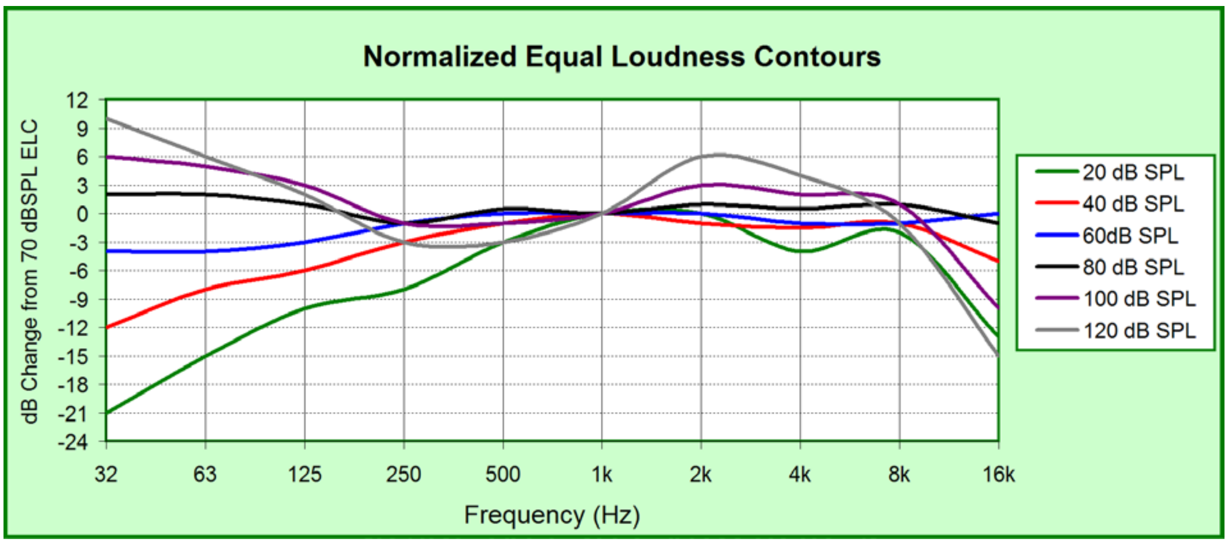
Lecture Summary – Reception

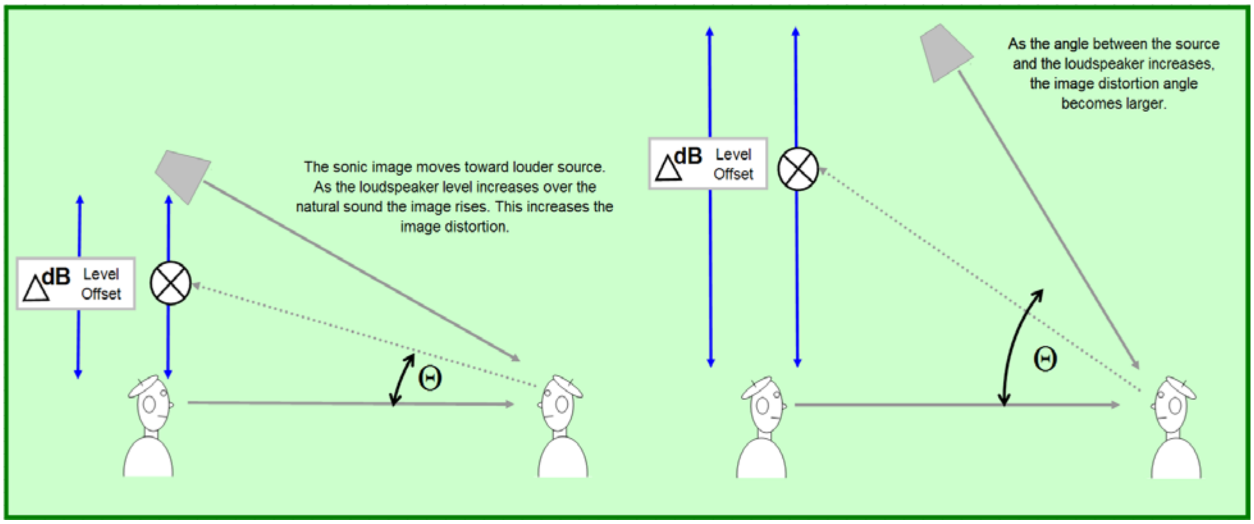
Chapter 5

- **loudness and dB SPL**
  - **perception of loudness comes from combination of sound pressure and duration**
  - **ear integrates level over approx. 100 ms**
  - **noise floor in typical venue 50 dB or more above lower limit of hearing threshold**
  - **actual dynamic range of program material up to mix engineer**
- **crest factor = difference between peak and continuous level**
  - **pure sine wave: 3 dB**
  - **pink noise: 12 dB**
  - **speech – variable (high for consonants, low for vowels)**
  - **must be able to faithfully reproduce speech transients to distinguish between consonants (%ALCONS)**
- **equal loudness contours**

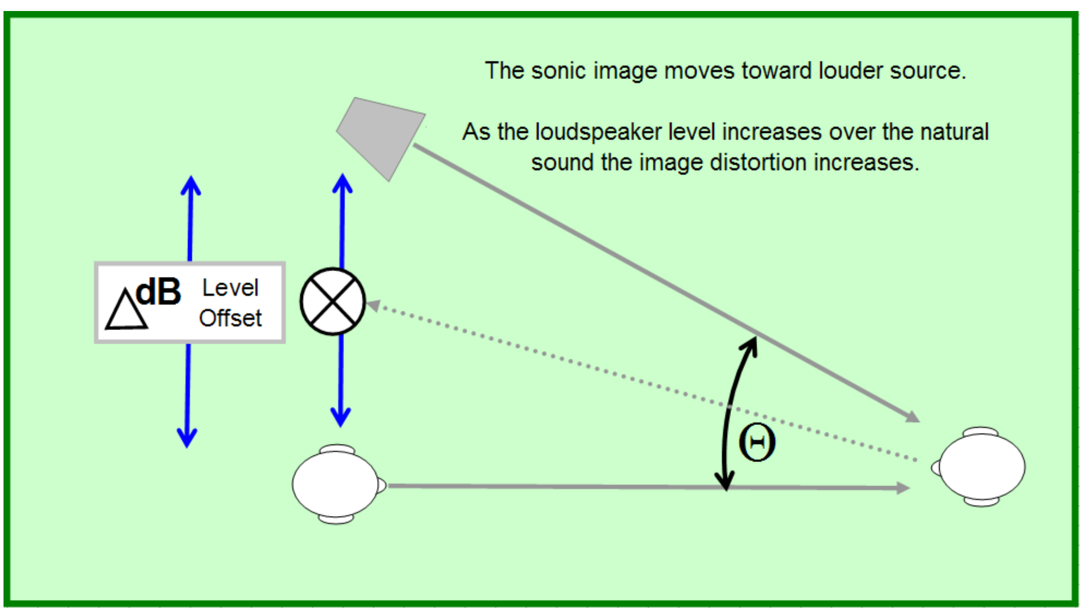


- **localization**
  - **ability to steer sound image**
  - **difference in perceived sound image from that of source is sonic image distortion**
  - **want to link perceived sound location to the visually perceived source (“localization”)**
- **vertical localization**
  - **contours of the outer ear (pinna) create a series of reflections that steer sound into inner ear, which cause coloration**
  - **tonal signature of these reflections is encoded in brain as a vertical map called the head-related transfer function (HRTF)**
  - **HRTF operates independently for each ear**
  - **isolated sources can be easily localized**
  - **multiple arrivals make localization more difficult (spatial spread)**
  - **if levels offset, louder source will be perceived as source of sonic image**
  - **level dominates over arrival time**

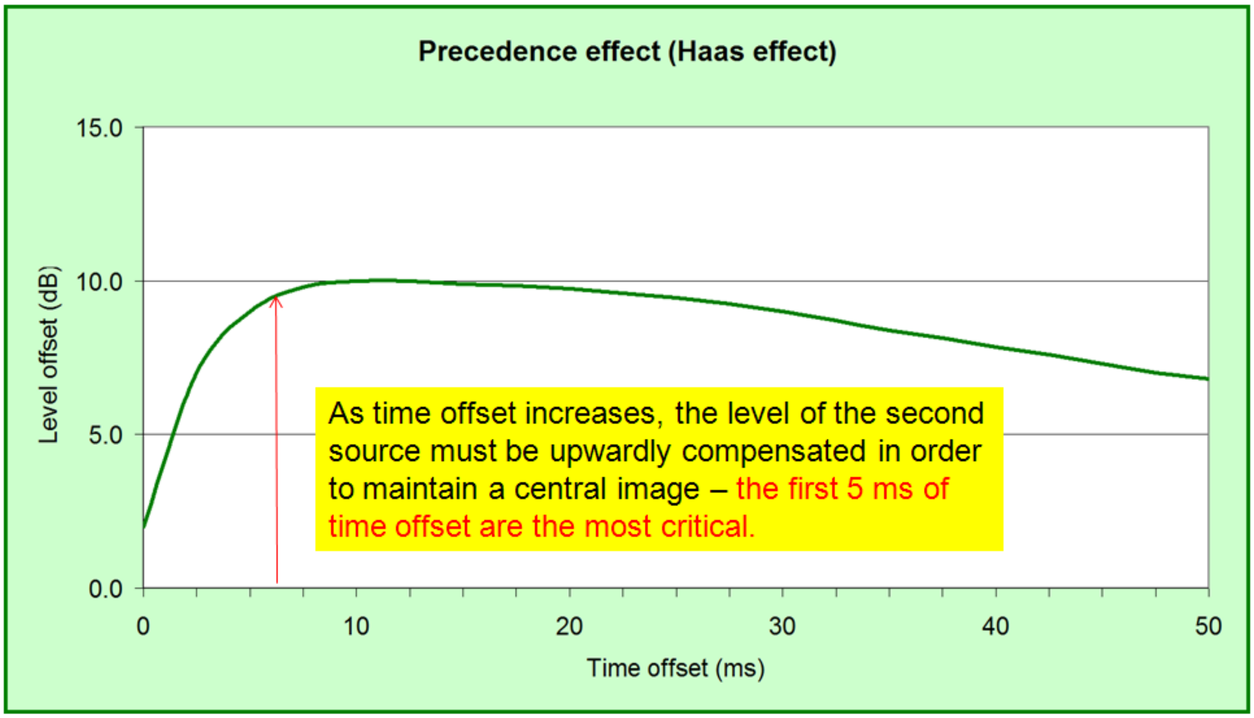
- **sonic image moves toward louder source, spreading out image**

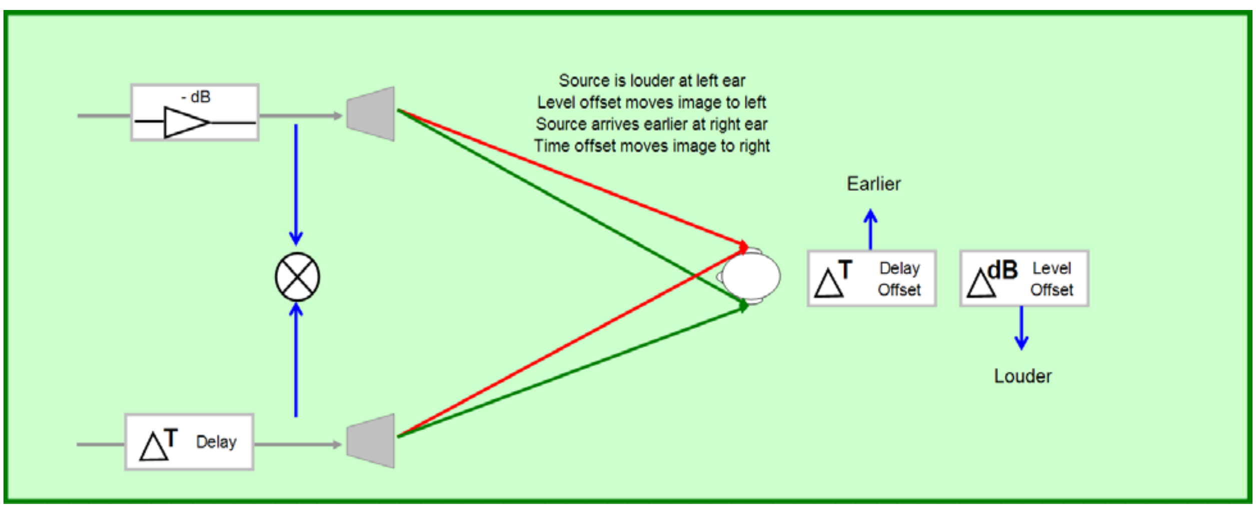


- **horizontal localization**
  - **more sensitive than vertical**
  - **spaced placement of ears allows any position on horizon to be found by triangulation (binaural localization)**
  - **perceived sonic image depends on both time and level differences**
  - **relative time called the inter-aural time difference (ITD) – dominant factor in low-frequency localization**
  - **relative level called the inter-aural level difference (ILD) – dominant factor in high-frequency localization**
  - **when listening to a single source, ITD and ILD track together**
  - **if multiple (independent, uncorrelated) sources, localization can be done for each source (since each will have distinct ITD/ILD)**
  - **if sources correlated (reflections), becomes more complex – source becomes general area rather than a pinpoint)**

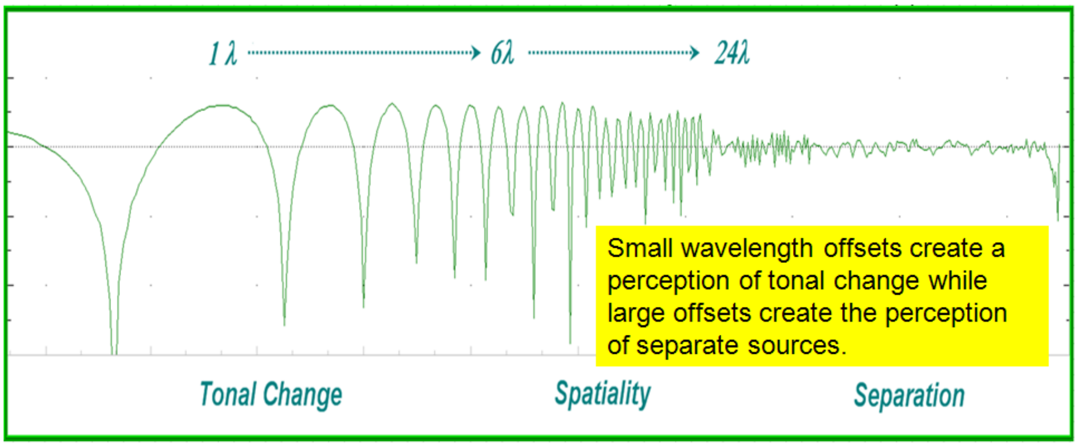


- **panoramic perception**
  - **horizontal image ("pan") can be moved by offsetting either level or delay (level panning vs. delay panning)**
  - **relationship between arrivals and our perception of sound image is known as the precedence ("Haas") effect**
  - **image control can be maintained over a limited range of time (5 ms) and level (10 dB) between horizontally displaced sources**
  - **if level offset > 10 dB, *no amount of delay can move the image***

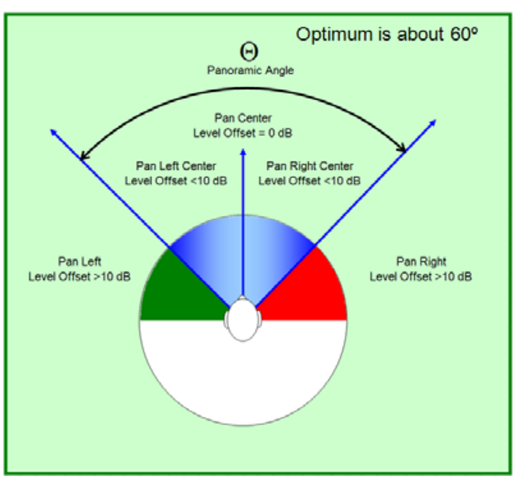


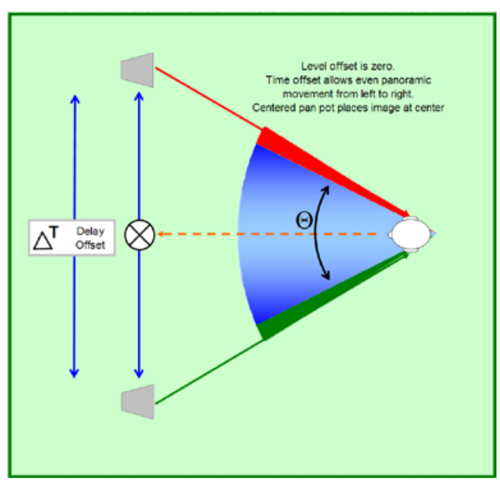


- **tonal, spatial, and echo perception**
  - **tonal quality combination of direct sound plus arrivals within duration period of direct sound**
  - **tonal character modified by comb filtering (as summation ripple increases, distortion of tonal quality becomes increasingly perceptible)**
  - **time offset determines frequency range where tonal disturbance most perceptible (greater time offset → lower frequency range)**
  - **filters narrower than λ/6 generally not perceptible**
  - **pattern of "bright spots" in spectrum is the envelope (audible shape of spectrum, tonal character)**
  - **frequency resolution to which tonal character is audible known as the critical bandwidth**
  - **tonal change comes from early arrival summation**
  - **spatial perception comes from middle arrival summation**
  - **discrete echoes come from late arrival summation**

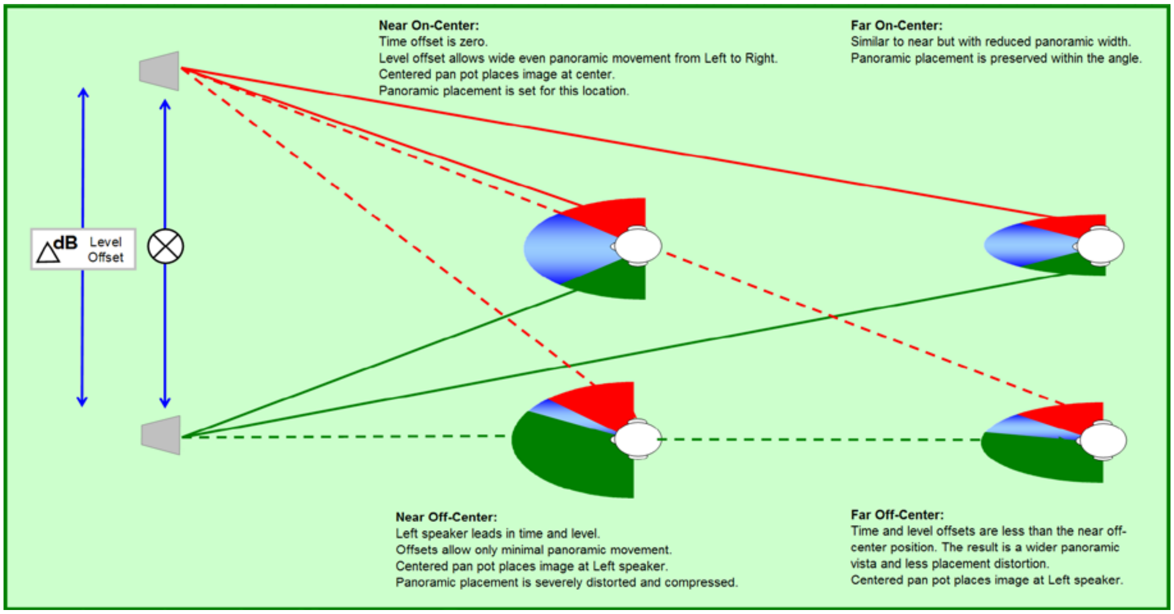


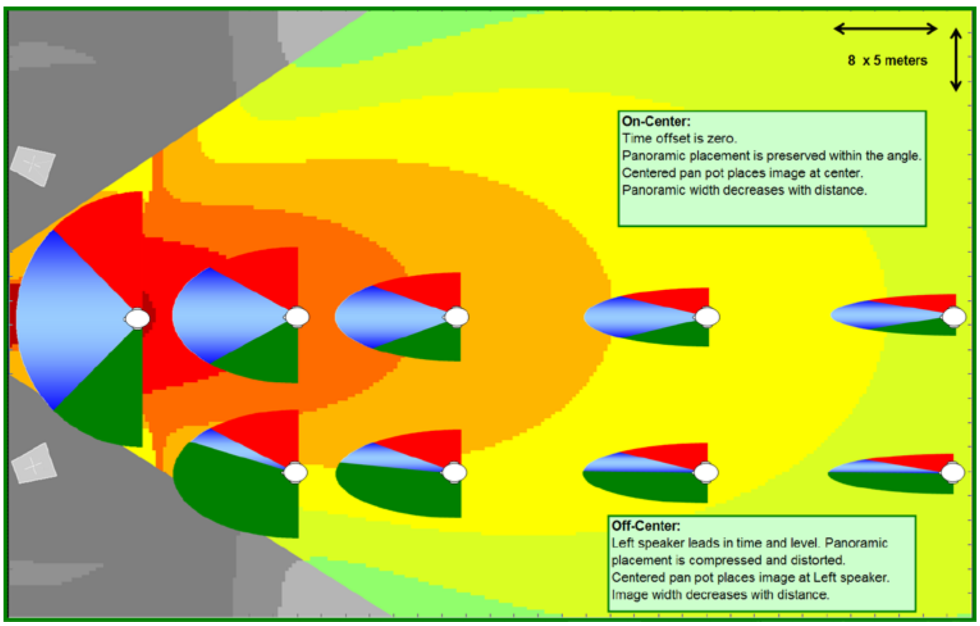
- **stereo scaling**
  - **"stereo" does not scale well to large spaces – after leaving central zone (Δ 5 ms), the system becomes to mono channels**
  - **basic choices:**
    - **wide panoramic stereo for tiny majority of seats**
    - **narrow panoramic stereo for a minority of seats**
  - **every "off-center seat" will be affected differently due to changing time/level offsets**
  - **panoramic angle**

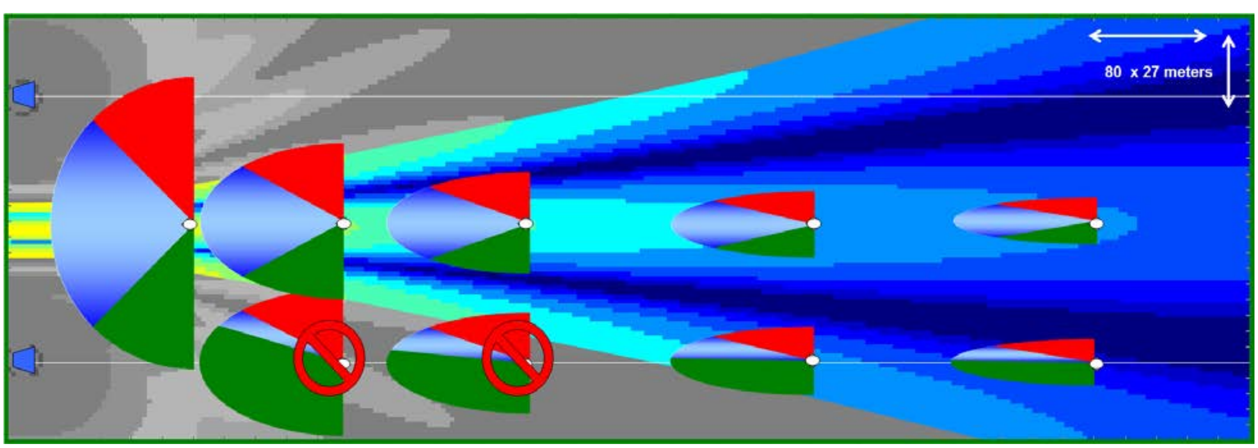




- **stereo image at different seating locations**







- **discussion – how does the following reconcile with what we just learned (can there really be "stereo everywhere")?**