Science Of Music Study Guide

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Contents

Instruments

Categories of Instruments

- Chordophone - A chordophone is a string instrument such as a harp or banjo.
- Aerophone - An aerophone is a wind instrument such as a trombone or saxophone.
- Idiophone - An idiophone is an instrument you strike such as chimes, marimbas, or crotales.
- Membranophone - A membranophone is an instrument that uses a membrane such as a snare drum or timpani.
- Electrophone - An electrophone is an electronic instrument such as a moog synthesizer.

Three Components of an Instruments

1. Energy Source

    - The energy source for an instrument provides an input for vibration to occurr. Some sort of energy input from a player must create the mechanical energy required to vibrate the primary oscillator.

2. Primary Oscillator

    - The primary oscillator is the main vibrating body in an instrument; which the rest of the instrument acts as a resonator for. This could be strings on a chordophone or lips for a brass player.

3. Secondary Oscillator/Resonator

    - The secondary oscillator/resonator is often the body of the instrument. The resonator helps to create sustain and transform the sound from the primary oscillator.

Transposition

Transposition is the act of transforming pitches to different notes on the scale. For example, I can play an alto and tenor sax with the same key fingerings for the same notes on sheet music, but if I play the same fingering for both instruments it will not be the same note. This is what transposition is. Often we denote an instrument based off its key. For example an E flat clarinet.

Brass Instruments

Instrument Concept

Instrument Examples

Woodwind Instruments

Instrument Concept
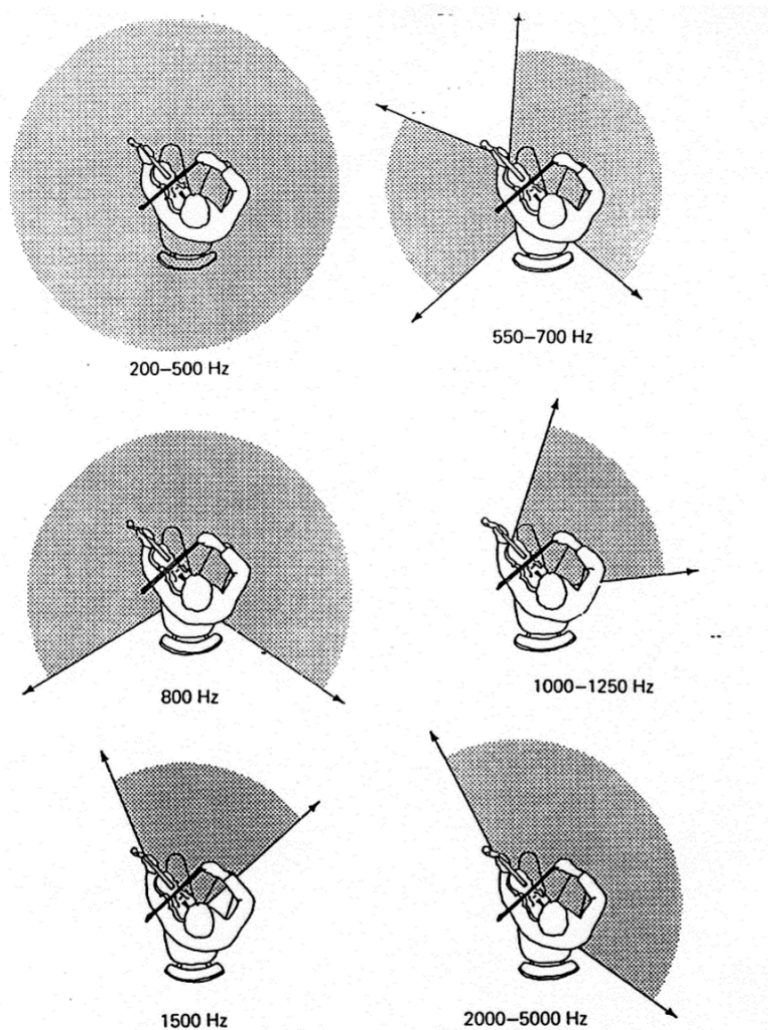
Instrument Examples

Vocal Instruments

String Instruments

Parts of a Violin

Instruments also have directionality. For example the violin:

FIGURE 11.22 Directional radiation from a violin, as measured by Meyer. Shaded regions have sound level within 3 dB of maximum. Outside the shaded regions the intensity is merely weaker, not zero. (By permission of *JASA*)

Percussion Instruments

Room Acoustics

Absorption Coefficient

The absoption coefficient of materials determines how effective a certain material is at aborbing the pressure waves of sound at certain frequency. Often softer materials are better at absorbing and better at absorbing at higher frequencies. An example table of these coefficients is located below.

TABLE 23.1 Absorption coefficients for various materials

| Material | Frequency (Hz) | | | | | |
	125	250	500	1000	2000	4000
Concrete block, unpainted	0.36	0.44	0.31	0.29	0.39	0.25
Concrete block, painted	0.10	0.05	0.06	0.07	0.09	0.08
Glass, window	0.35	0.25	0.18	0.12	0.07	0.04
Plaster on lath	0.14	0.10	0.06	0.05	0.04	0.03
Plywood paneling	0.28	0.22	0.17	0.09	0.10	0.11
Drapery, lightweight	0.03	0.04	0.11	0.17	0.24	0.35
Drapery, heavyweight	0.14	0.35	0.55	0.72	0.70	0.65
Terrazzo floor	0.01	0.01	0.02	0.02	0.02	0.02
Wood floor	0.15	0.11	0.10	0.07	0.06	0.07
Carpet, on concrete	0.02	0.06	0.14	0.37	0.60	0.65
Carpet, on pad	0.08	0.24	0.57	0.69	0.71	0.73
Acoustical tile, suspended	0.76	0.93	0.83	0.99	0.99	0.94
Acoustical tile, on concrete	0.14	0.20	0.76	0.79	0.58	0.37
Gypsum board, one-half inch	0.29	0.10	0.05	0.04	0.07	0.09

TABLE 23.2 Sound absorption by people and seats, and air absorption

Material	125	250	500	1000	2000	4000	8000	Frequency (Hz) Unit*
Wood or metal seats, unoccupied	0.014	0.018	0.020	0.036	0.035	0.028		m^2
Upholstered seats, unoccupied	0.13	0.26	0.39	0.46	0.43	0.41		m^2
Audience in upholstered seats	0.27	0.40	0.56	0.65	0.64	0.56		m^2
Air absorption (per m^3):								
20°C, 30%	—	—	—	—	0.012	0.038	0.136	
20°C, 50%	—	—	—	—	0.010	0.024	0.086	

Room Modes

Rooms have resonances just like any other cavity. Our rule of thumb to determine the resonant frequency is to use the longest dimension as 1/2 the wavelength of the resonant frequency. D here is the longest dimension:

$$f = \frac{344}{2 * D}$$

Reverb Time

Reverb time is a measurement of how long the sound pressure level in a room takes to decrease by 60 dB or by a factor of 1 million. The equation to calculation RT (Reverb Time) is lcoated below:

$$\text{RT} = 0.161 \frac{V}{\Sigma_{i=1}^{n} a_i S_i}$$

$$\text{V = Volume}$$

$$\text{a = absorption coefficient}$$

$$\text{S = Surface Area}$$

Tuning Temperaments

An instrument can be tuned so each note sounds as made to specification. A piano or chordophone has a lot of room for tuning. Each string on a chordophone can be changed while tuning, but a brass or woodwind instrument can merely slide a tuning slide or mouthpiece to adjust on the fly. These aerophone are often produced with a certain tuning system in mind. Also keep in mind that different cultures have different scales.

Microtones

A microtone is a pitch that is in between pitches on a scale. For example, even with the same tuning system a 12 note scale will have microtones of a 5 note scale, because some of the pitches come in between the notes on that scale.

Pythagorean Temperament

The pythagorean tuning system is perhaps one of the oldest. The tuning in this sytem follows one simple rule. In order to find the pitch of each note you start on a base note. From that base note you go up a perfect fifth interval and assign that frequency to the given pitch. This is done until all 12 notes in our modern scale are fileld in.

Just Intonation

Just Intonation is a tuning system that focuses on tuning to intervals. Given a certain base note the rest of the scale has the pitches filled in based off the proper ratio of intervals. The good part of this system is that in the base key all notes are beatless given the perfect intervals, but it is essentially tuned to a specific key, since if you try to play in another key it will sound pretty bad.

Equal Temperament

Equal temperament is a tuning system that attempts to solve the issue of being able to play in more than one key. The idea behind equal temperament is that each half note step in our 12 note scale will have the same distance from each other. Since we want to keep the octave as a doubling in frequency we use the twelfth root of 2 as a the distance between each half note. We then based everything off a certain pitch in the scale. Today it is often A=440.

Electrophones

Compressor

A compressor enables you to shape a sound. You can suppress louder sounds and increase the level of quieter sounds. There are also options for attack, decay, sustain, and release, where anything in the threshold will be affected.