

Technical representation and analysis of music

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10/4/12

An ETIC framework for thinking about music – including terms common deployed in ethnomusicology (e.g. in Cantometrics), elaborated in logical detail by M.F.

A. Instruments; sound sources; timbral classes; sounds

Instrument: single object classified under the Hornbostel-Sachs taxonomy (or voice).
Comprises: *energy source*: (usually human powered) transmitted to a *sound generator*: medium (air column, string, membrane) developing standing waves, often transmitted to a *resonating chamber* (air, walls) which also develops standing waves, amplifying and filtering the sound

Sound source: a single vibrating medium (capable of developing standing waves producing sound). Note that with this definition an instrument may comprise more than one sound source. Sound source may produce a variety of different sounds; we want to get a sense of the range. Musical sound comprises several variables, including: timbre; pitch; loudness; duration. These may vary continuously, or discretely.

Each sound source comprises one or more *timbral classes*.

Each timbral class might produce more than one *pitch*.

The following chart really needs to be continuous, but we can approximate the foregoing ideas for a particular instrument as follows. Note that pitch is ordered and often continuous, whereas timbral classes are basically unordered (or roughly ordered according to high and low) and often conceived of as discrete.

	unpitched	pitch 1	pitch 2	pitch 3
timbral class 1				
timbral class 2				

Then percussion sound sources (membranophone, idiophone) tend to be represented in the first column, while aerophones and chordophones tend to be represented in the first row. (Some stringed instruments can actually produce two quite distinctive timbral classes: sound via bowing, and sound via plucking.)

Loudness and duration: tend to be continuous quantities even more than pitch; for a given sound source one can only give ranges. Some sound sources produce only short sounds for instance (especially percussion).

B. Lines

A line is psychoacoustically cohesive: you hear it as a linear unit. Not everyone will always hear the same lines, or hear them consistently, or may not be able to tell what s/he is hearing.

Lines also occur at different levels; like the weave of a rope: there are thin lines, which combine to form fatter lines. Again this is a matter of hearing.

Each sound source might produce a line, or each instrument might produce a line, with all the sound sources combining. Or sometimes a single instrument or sound source produces more than one line. Or sometimes several instruments combine to form a single line (as in hocket, or homophonic blending described below).

Each line consists of a sequence of sounds and silence which the ear links as a continuum due to one or more of the following: (1) emanation from one sound source or instrument; (2) similarity in timbre; (3) similarity in pitch, loudness.

Each sound in each line has a timbral class, start/stop points (duration), loudness, and possibly pitch [four main variables].

Each sound may or may not have a definite pitch. Indefinite pitch may result either from inharmonic sound (as in much percussion) or harmony/chords (multiple pitches which blend together into a single “vertical” sonic structure, but not so much as to become a timbre). That is the sounds may be (1) pitches; (2) unpitched sound; (3) chords.

Start point for each sound is more important than end point (perceptually); I’ll call this the “attack” (or more precisely the “attack point” or “beat point”). (Recall that the “envelope” of a sound comprises the attack, sustain, and decay; in practice some sounds don’t have definite starts or stops (the attack is very gradual), and have to be described in other ways. But percussion tends to be very well localized on the attack side.)

C. Temporal aspect (for each line)

Both acoustic and perceptual aspects.

Rhythm of a line: position of attack points in time.

Provided that the time distances between successive attack points are all multiples of some fundamental temporal unit, a simple graph notation is possible, called TUBS (time unit box system) and attributed to ethnomusicologists James Koetting. Each box gets an equal duration; x marks attack point = start point of the sound. The following rhythm is common in Arab music:

x	x		x	x		x	
---	---	--	---	---	--	---	--

Pulse or beat of a line (psychological; periodic; usually shared with other lines). Line may be pulsed (many possible tempi) or unpulsed. This is a subjective perceptual issue; different people might perceive different pulses. Lines representable using TUBS are

typically (but not necessarily) felt as pulsed. Unpulsed lines are difficult to perform using TUBS notation, even when they could be represented by TUBS (e.g., the ‘fundamental time unit’ mentioned above might be too short to be counted effectively).

line	x	x		x	x		x	
pulse	x	x	x	x	x	x	x	x

Meter of a line (psychological; periodic; usually shared with other lines): hierarchy of accents is superimposed on the pulse in a periodic pattern (repeats). A line may be metric (many possible meters) or non-metric.

line	x	x		x	x		x		acoustic signal
pulse	x	x	x	x	x	x	x	x	psychological
meter	X		x		X		x		psychological

Here an accent is indicated by a big x: X.

(Note: you may not hear it this way! The pulse and meter are a result of individual perception, and only implied by the acoustic signal.)

Tempo of a line: frequency or period of the perceived pulse (number of pulses per second (frequency), or seconds per pulse (period)).

D. Timbral aspect (for each line)

Set of timbral classes used. Thus Arabic music on the riqq uses the set of timbral classes called “dum” and “tek” (two classes).

Timbral classes tend to be discrete and no quantitative linear relation must be expressed among them; hence they can just be named (e.g. dum and tek of Arab music), and are easier to notate than pitch: just pick any symbol (or the name) for each one.

Timbral sequence (sequence of timbral classes at attack points): e.g. dum, tek, tek, dum tek.

E. Timbral-temporal aspect

Reduce line to rhythm plus timbral classes, which can be indicated in place of ‘x’ in the boxes.

E.g.:

dum	tek		tek	dum		tek	
-----	-----	--	-----	-----	--	-----	--

Note possibility of a “drum language” in which timbral classes are represented by nonsense words. Such languages are quite common in the world; we’ll discuss them later in the course.

F. Tonal (pitch) aspect (for each line)

You don't need to analyze tonal aspects for this course. We don't want to get into this because pitch is more complex to notate and understand than rhythm.

For those who are curious, here are some of the analytical concepts used:

pitch sequence (independent of timbral class): sequence of pitches of a line (e.g. do do sol sol la la sol).

melody (pitch-temporal aspect): sequence of pitches matched to attack points: the ABC song is:

do	do	sol	sol	la	la	sol	
----	----	-----	-----	----	----	-----	--

Chord (harmony): group of pitches sounding simultaneously which blend into a single sound (not as blended as a timbre, but not separated into different lines either). Chord sequence (sequence of chords used); Chord rhythm: sequence of chords matched to attack points.

Aggregate properties of pitches used in a line: Pitch set (unordered set of pitches used in the line); scale (ordered set of pitches, usually ascending from the most important pitch (the "tonic")), mode (intervallic structure of pitches, with pitch functions), key (a particular scale mapped to a particular mode).

Size of pitch set: Pentatonic = 5 pitches in system; heptatonic = 7 pitches in system (most western music is heptatonic).

G. Texture (how two or more lines relate to each other): terms used

So far we've been talking primarily about a single line.

Now consider multiple lines and how they relate to one another.

A set of lines all sounding simultaneously is called *a* texture; the ways in which they relate to each other is called *the* texture; there are several types of texture which we'll now try to classify (though it isn't possible to be absolutely precise here or elsewhere in this system of analysis).

Note that these terms may be used to describe the whole texture or only part of the texture (e.g. 3 lines out of 10 may be heterophonic; 1 line may be drone). So there is more than one way to analyze a texture depending on which lines you hear, what level you're looking at (thin rope strands, or fat strands) and which ones you are considering together. Each of these types represents a particular relation among lines.

1. Monophony:

one line only.

2. Unison:

all lines are the same, tonally and rhythmically.

Variation in timbre only.

3. Heterophony:

all lines perform slight variations on the same thing.

Variations arise due to ornamentation, or time-lag (delay): one line may slightly lag another.

4. Call/response or antiphony

two lines (or sets of lines, whole sub-textures maybe) alternate with one another.

each set fills the others' gaps (with possible small amount of overlap).

call and response implies a question (usually solo) which produces an answer (often group) – while the two groups can be more balanced, the idea of alternation persists.

5. Hocket:

when the units of c/r get very short, to the point that a single line is perceived arising out of two parts (which however can still be identified as two contributing sublines – but perhaps only by watching the performers play!).

Hocketing: set of lines mesh rhythmically and melodically, to appear as one line.

6. Polyphony:

significant differences in time/tone among simultaneously sounding lines. Various (overlapping) types are included in this category:

a) Drone: two lines: one of constant pitch, the other varying.

b) Homophony or blended:

contrast in pitch only, little or now contrast in rhythm, little contrast in timbre.

creates sequence of harmonies or chords, in which the ear tends not to pick out individual lines.

think of a chorus in which everyone sings harmony in the same rhythm. If individual lines do not stand out at all (due to timbral homogeneity) this homophony might even be classed as monophonic sequence of chords.

c) Layered

strong contrasts (in timbre, rhythm, melodic character) among lines, which play continuously (heterogeneous group) cause the texture to be perceived as a set of distinct layers.

Some special cases of layering:

(1) Ostinato: two lines, one repeats a fixed rhythmic pattern

(2) Stratification: strongly contrasting tempos

(term used primarily for music of southeast Asia, e.g. Java and Bali in Indonesia) – a kind of layering produced by strongly contrasting tempos in the different lines (one line might be 64 times per minute, the next line 32 times, the next 16 times, etc.).

d) Interlock:

set of lines meshing rhythmically, each filling the others’ gaps (but denser than mere call and response)

different sound sources may join together to form a single line, but there may also be more than one line resultant.

May or may not be a hocketing (could also be polyphony, when the resultant interlock sounds like more than one line).

e) Polyrhythm, polymeter:

more than one line.

at least one line’s rhythm strongly contrasts with the meter implied by another line (or group of lines)

strongly contrasting simultaneous rhythms, suggesting different ways of subdividing time.

if the contrasting line suggests a second meter, then we call this polymeter

example:

line 1	x			x			x			x		
line 2	x		x		x		x		x		x	
meter implied by line 1	X			x			X			x		
meter implied by line 2	X		x		x		X		x		x	

f) Counterpoint:

Complete melodic and rhythmic independence of lines.

Baroque music provides classic example.

But we’ll see others from “world music” as well.

7. Other attributes of lines

Relation of line to words. In melismatic singing, each syllable gets more than one sound; in syllabic singing each syllable gets exactly one sound. One could also look at the song text as providing a timbral component (depending on which vowels and consonants are sung).

Relation of lines to dance (kinesthetic lines and rhythms also); can be audible via foot stamps or jingles worn as clothing.

H. Other musical parameters for analysis

Volume: overall energy level

Accent: energy in one particular sound (or attack point)

Form: larger organization of piece into sections demarcated by repetition, sudden contrast, or separating pauses. (e.g. movements in western classical)