On Musical Pitch and Music Theory



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Pitch?

- A perceptual attribute of sound relating to frequency
- A defining attribute of tone
- Fundamental and spontaneous and not exclusively related to music. Language - the meaning of words determined by pitch in some languages...
- Physics, Physiology & Perception, Cognition & Culture

Pitch in music

Pitch is a <u>perceptual</u> property of <u>sounds</u> that allows their ordering on a <u>frequency</u>related scale.^[1] or more commonly, pitch is the quality that makes it possible to judge sounds as "higher" and "lower" in the sense associated with musical melodies.^[2] Pitch can be determined only in sounds that have a frequency that is clear and stable enough to distinguish from noise.^[3] Pitch is a major auditory attribute of musical tones, along with duration, loudness, and timbre (Wikipedia)

Pitch is our perceptual interpretation of *frequency*. In general, we perceive pitch logarithmically in relation to frequency (http:// www.indiana.edu/~emusic/

Tone one ghe or the found according to Pitch in music, pos Dimensionality ple Cultural or it natural? higher and lower according to the frequency of sounds producing them (Brittannica-com) (CT African music cultures)? to high (ANSI)

Pitch (in music) is the particular quality of sound that fixes its position in the gale. Centain location of tone in relation to othere, thus giving it a sense of being high or low, the relative sounds in music that occupy no particular scale position, such as these produced by cymbals or the side drum, can be said to be of indefinite Stor. Picture termined by (Melody vocabulary) what the ear judges to be the most fundamental wave frequency of the sound . Pitch is expressed by combining a frequency of the sound is a source of the sound is the source of the source of the sound is the source of the sou Haynes, 2001) **Pitch.** In listening to music one may experience pitches that are sounded

Tone - stability

Pitch. In The word "tone" in this study refers to a physical entity: a periodic acoustica departed of the period of the play a tone. Notes belong to the world of information. The attributes of a note compared by the physical attributes of the tone to be played but to its perceptual attributes, expressed by means a labelled categories. Pitch categories in Western music are normally specified relative to each other and to tonally important pitch categories by means of interval categories expressed in semitones. (Parncutt; Harmony: A psychoacoustical approach, 1988)

height or depth of a sound. Pitch are changed by adjusting their frequency of vibrations.

successively or simultaneously as forming coherent patterns which unfold as the piece progresses, one may hear both melody and harmony. Many aspects of these heard patterns - such as the sense that particular pitches seem more 'stable' than others, or that simultaneously sounding pitches fit more (or less) well together, or the that the occurrence of certain pitches is highly predictable - appear to conform to the theoretical precepts of tonality or part-writing. Research, however, indicates that several factors that are not reducible to a single principle play a role in our experience of pitch. (Ian Cross, Grove, 2001)

Listening to music, we hear the sounds not as isolated, disconnected units, but integrated into patterns. Our perceptual experience goes beyond sensory registration of single musical events. Sound elements are heard in context, organised in pitch and time, and are understood in terms of their function within that context. The absolute pitch of a particular tone is less important to the listener than the intervals it forms with surrounding pattern. (Krumhansl: Cognitive foundations of musical pitch (1990))

Modelling pitch dimensionality

ratios<->intervals PITAGORAS solmization - melodic pitch categories NACOVE E ABITO fa sol la la sol fa un ve ut Guido of Arezzo (1020) Pythagoras (ca 500 BC) Circle of 5ths Riemann (1877) Key profiles มาราช เกมา์ช เมคมอันได้เลยาเม Diletsky (1679) (a) C maio (b) C minor 10.00 Virtual pitch Shepard (1981) hroma

Revesz (1913)

Chroma helix - two-component

G

G#

Chroma/5ths double helix

LISTARENTAL 5.475Vistual Pitc.

Terhardt (1970)

Tonnetz - harmonic relations





Krumhansl (1979)

My own doctoral project: From tonality in older swedish folk music to modelling music structure:

How **similarly** do we experience basic music structure?

Can music structure be **modeled** based on capacities that we all share?



An embryo to automatic transcription from performance MIDI input



Figure 6-69. Output from computer model analysis including local phrase boundary analysis performed on Raag Suddha Danyasi

User need -> A practical MIR task: Transcribe a sung melody into a musical score



ScoreCloud





Input



What I really sang

Let's listen painfully slowly

What the pitch tracker finds?

Pitch discrimination:

- Just Noticeable Difference (JND)
- successive notes (> 6-10 cents)
- intervals (> 20 cents)
- at best 200 2000 Hz (Rakowski 1971, Sundberg 1978, etc....)

I don't want to hear this!

Pitch scale (10 cent resolution)



Let's assume chromatic pitch categories and quantise the pitch to the closes chromatic MIDI-note



How is pitch perceived in relation to music structure?

instruments

Tone system

What pitch categorisation exist in a culture on instruments?

- Tone system
- Tuning system
- Temperature
- Instrument pitch sets

Piano Mbira

Scale system

What pitch categorisation is used in a piece, style etc.?

- Pitch sets/ "Scales"
- Instrument scales
- Number of pitches: Tritonic, Pentatonic, Heptatonic,
 Octatonic, Dodecatonic etc.
 "scales"
- Interval structure: Diatonic / Anhemitonic etc.

Pentatonic Diatonic

Tonality

Hierarchical & Functional Relationships between pitches

- Hierarchical systems: Tonality, Modality, Polytonality, Free Tonality, Atonality
- Musical modes: Major, Minor, Rasd, Bayati etc.
- Orders of pitches in modes: Musical Scales: Harmonic & Melodic minor, Gypsy scale, Dim scale etc.
- Hiearchical relationships: Scale degrees
- Hierarchical relationships: Tonic, central reference pitch, dominant, subtonic, leading notes...
- Harmonic tonality harmonic implications
- Intonation patterns, Ascending/ Descending, sub-scales, leading tones

Tonic Melodic Minor Scale

Conceptual abundance Interrelation

Melody

temporal gestalt relationships between pitches

music

- Melodic interval, steps, leaps, fifth
- Melodic motion, up-down, triads, intervallic relationships etc.
- Phrases, motifs, themes, figures
- Hierarchic levels of melodu: Alterations, chromaticism, embellishments, grace notes, passing-notes, appogiaturas etc.
- Ending notes, Finalis, pickup-notes
- Tonality in form, polyphonic structure

Leading tone Finalis

Harmony

relationships between combination of pitches

- Simultaneities chords, broken chords, arpeggios, Drone, pedal tone
- Harmonic systems, functional harmony, modal harmony, overtone harmony etc.
- Chord functions, Dominant, subdominant etc.
- voice-leading chord progressions...

Dm7-G7-Cmaj7 Chord progression

Pitch organisation in a Swedish folk song

"Falska klaffare" sung by Susanne Rosenberg

Solo singing No accompaniment Melodic Lyrical song



rec. 1996, after Lisa Boudré, b 1866

F0 Transcription



Pitch set (30 cent resolution)





Symbols for deviation

Five pitch categories per semitone (ca 25 cents)







Pitch set (30 cent resolution)



Is this the scale?



Musical scale - melody structure

- A musical scale in melody displays the pitch categories that are perceived as structurally significant in the melody, making up the melodic contour/shape of the melody.
- steps scale degrees melodic pitch categories
- The scale degrees are the "building blocks" of melody, reflected in independency of melodic motion can be reached "step-wise"
- The shape of the melody, hence the identity the melody *gestalt* remains even if intervals between scale degrees are altered (cf. Dowling & Harwood 1986)
- Alternative, variants of the same scale degree: intonation / alterations



Melodic contour - Scale degrees?





Scale degrees in "Falska klaffare"





Tonality - Perceived relationships between scale degrees: Finding the tonal center ("tonic")

- How does it sound? Can you sing it?
- Tonal center (tonic) central referential pitch The tone (or tones/interval) to which the melody tones are conceived in relation to, the main referential pitch for the melodic structure



Which properties of melody determines the tonic?

Western common-practice shortcut method:

1.Match the pitch set with major and minor modes and keys

2.Check the last note of the song to determine which one it was

PITCH SET STRUCTURE

MELODY STRUCTURE

Which properties of melody determines Tonality?

Cognitive psychology (Krumhansl et al): shortcut method: Tonicity reflects hierarchical stability Points of attraction Matching with culturally learned schemata based on statistical distribution of pitch

2.Check the lattow are they learned in song to determine which one it was **The first place?** MELODY STRUCTURE

Ethnomusicological method (e.g. Nettl 1964) Analysis of tonal center ("tonic") within a given pitch set

- 1.Frequency of appearance (+ cognitive psychology)
- 2. Duration of notes (+ cognitive psychology)
- 3.Appearance at the end of a composition or of its subdivisions or initial position
- 4. Appearance at the low end or center of a scale
- 5.Intervallic relationships to other tones (two octave positions or a fifth below a frequently used tone)
- 6.Rhythmically (and metrically) stressed position

7. Combinations of the above

Tonal center can be determined by pitch set structure and melody structure

Psychophysical method (e.g. Parncutt 1989)

Spontaneous matching of the pitch set with properties of an "ideal" harmonic partial tone series (virtual pitch) series, such as

- Interval relationships between salient pitches
- The position of different pitches in the partial tone series
- Pitch salience in relation to the perception of complex tones
- Acoustically related dissonance -> consonance influence tonality perception

Tonicity reflects intervallic stability - mirrors virtual pitch perception

Falska klaffare - converging indications



Fourth-Fifth frame

Tonality - Perceived relationships between scale degrees: Degree distance to the tonal center



Functional 'Scale degrees' - melodic pitch categories representing relationship to the tonal center

What is the key and mode? C with variable third



In the context of a music culture: The "herding tune" mode



- variable 3rd , 4th and -2, often all three
- ca 57% of vocal folk music in a large collection "Svenska låtar, Dalarna" and 64% of recorded herding music from the region (Ahlbäck 1986, 1995, 2018)
- When a sixth is added it is usually high or variable
- When a seventh is added it is usually variable, in-between or low
- Recognized in historical sources (e.g. Haeffner 1818, Moberg 1950 etc.)

Is the variation of intonation arbitrary? Is there a systematic variation of intonation?



- When is the quarter tone third used?

the "23b1" - pattern

Conceptualizing intonation pattern The "43#1" pattern

 A falling second plus third is tuned towards minor 2nd - major 3rd, even if the intonation of variable scale degrees has to be altered in relation to stepwise motion



Tonality system - How does this music work with regards to pitch?

Tonality in the context of melody Perceived hierarchical/functional relationships between pitches - two systems

Modal

The sequence of tones in the melody becomes meaningful through the different relationships the individual tones have with one (or several) reference tone(s).

The central reference tone in the melodies movement is called the tonal centre, or tonic.

- Linearity
- Monophony
- Non-hierarchical form
- Drone
- Bagpipes, hurdy-gurdy, jaw harp, Shruti box etc. often have built-in modal function
- Resonance strings can emphasise drone experience
- continuity unity
- significance of detail, pitch nuance
- "monotonous"/"suggestive"

Harmonic

The sequence of tones in the melody becomes meaningful through the different relationships to chords in a chord progression, which in itself creates a meaningful sequence of events. Apart from the central reference tone, each chord also has a reference tone, root or tonic.

- Verticality
- Homophony
- Hierarchical form
- Chord accompaniment
- Mouth organ, accordion, chord zither etc. often have built-in harmonic functions
- Resonance strings can emphasise drone experience
- coherence hierarchy
- significance of process/form, pitch clustering
- "monotonous"/"suggestive"

Modal vs Harmonic music around...

Drone's included...

(Hurdy-gurdy Hungary, Northindian Alap, Norwegian mouth harp)

Chords included...

Western art music from Rameau: From in-love-with triad chord progressions to voicings, tonal spheres

Galante style music 18th century, Schubert quintet, Brahms Lieder)

Imply the tonic...

(Gregorian chant France, Abdel Halim Hafez Egypt, Kulning Sweden)

"Falska Klaffare"Western popular music

Modal polyphony...

Finally we don't need melody? (Accordion group Sweden, American 20th century popular song, Latin jazz: One note samba, Jobim)

(Notredame school XII century France, Bulgarian folk

singing, Early blues, USA, Gamelan music Java

20th century Western music: modal revival...

Western art music,:Cage, Jazz: Coltrane, Rock: Stones

Implications for MIR

- Are chords a relevant concept for the music in question?
- Are we living in a world of equal tempered MIDI?
- Is pitch detection and interpretation an already solved problem (not included in MIREX)? Reactions on ScoreCloud Express
- Challenges for MIR
- Did anyone watch Madonnas performance on the Eurovision Song Contest?

https://www.youtube.com/watch?v=wG4th7yEojY

https://www.svtplay.se/video/21980070/eurovision-song-contest-2019/ eurovision-song-contest-2019-final-18-maj-21-00

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