

# Harmony Space

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## Overview

Harmony Space is an interface for exploring harmony and learning to compose music based on two recent cognitive theories of harmony. It exploits artificial intelligence and human computer interaction methodologies to help beginners learn about and make use of tonal harmony rapidly and without previous training. Harmony Space employs modified forms of Longuet Higgins' and Balzano's theories of tonal harmony via direct manipulation and visualisation techniques to make a wide range of musical tasks simple and clear for musical novices to perform. Design decisions give the interface particularly useful human-machine-interface characteristics for many harmonic tasks, even compared with three of the most long-live 'interfaces' for harmony, namely; common music notation, the guitar fretboard and the piano keyboard. Harmony Space exhibits a high degree of uniformity and consistency in the way that the phenomena it deals with (pitch, interval, scales, chords, inversions, chord sequences, voicing, keys, tone centres, modulation, key-relationships are controlled and represented. A simple version of Harmony Space for the Macintosh is presented here.

# Comparison of properties of Harmony Space interface with common music notation, the guitar fretboard and the piano keyboard for various common musical tasks.

1 Chord progressions fundamental to western tonal harmony (such as cycles of fifths and scalar progressions) are translated into simple straight line movements along different axes. This renders fundamental chord progressions easy to recognise and control in any key using very simple gestures. (These progressions can be hard for novices to control and recognise by conventional means.)

2 The same property enables particularly important progressions (such as cycles of fifths) to be manipulated and recognised as unitary "chunks". A common problem for novice musicians is that they only treat chord progressions chord by chord (Cork, 1988).

3 Chords that are harmonically close are made visually and haptically close. This renders other fundamental chord progressions (such as IV V I and progression in thirds) easy to recognise and play. (On a piano, for example, these progressions require gestural 'leaps' to be made that can be particularly hard to judge in 'remote' keys. All keys are rendered equally accessible in Harmony Space.)

4 Similarly, keys that are harmonically close are made visually and haptically close. This makes common modulations easy to recognise and play. (In common music notation, or on either traditional instrument, considerable experience or knowledge can be required to work out key relationships.)

5 The basic materials of tonal harmony (triads) are made visually recognisable as maximally compact objects with three distinguishable elements. (In other representations mentioned above, the selection of triads as basic materials may seem arbitrary.)

6 Major and minor chords are made easy to distinguish visually. (This is not the case, for example, in common music notation or on a piano keyboard)

7 Scale-tone chord construction is made such that it can be seen to obey a consistent and relatively simple graphic rule in any key. (On a piano keyboard, for example, this is not the case in remote keys, where semitone counting or memorisation of the diatonic pattern for the key is necessary.)

8 Consistent chord qualities are translated into consistent shapes, irrespective of key context. (Again, this is not the case, for example, on a piano)

9 The tonic chords of the major and minor keys are spatially central within the set of diatonic notes, whatever the key context. (This relationship is not explicit in common music notation, guitar or piano keyboard)

10 Scale-tone chords appropriate to each degree of the scale can be played (even when there is frequent transient modulation) with no cognitive or manipulative load required to select appropriate chord qualities (This does not hold with guitar or piano).

11 The rule determining the correspondence of chord quality with degree of scale makes sense in terms of a simple, consistent physical containment metaphor.

12 A single consistent spatial metaphor is sufficient to render interval, chord progression, degree of the scale, and modulation. (Not so in the other three points of comparison)

# Exploitation of 'universal' skills in Harmony Space

Harmony Space exploits skills that most people already have, such as being able to;

- recognise straight lines
- make straight line gestures,
- keep within a marked territory,
- distinguish points of the compass,
- recognise and find objects that are close to each other,

and so forth. The design of the interface maps complex, unfamiliar skills, normally requiring extensive training, into commonplace abilities that most people already have.

## Reduction of cognitive load in Harmony Space

Cognitive load is reduced by Harmony Space because relationships that have to be learned or calculated in other representations (such as common music notation, or notations based on the guitar or piano keyboard) are represented explicitly or uniformly in Harmony Space. Examples include;

- the location of the notes of the diatonic scale in different keys,
- the shapes of different chord qualities in different keys,
- the internal intervallic structure of chords on different degrees of the scale,
- the degree of note overlap between sharp and flat keys,
- the structure of the cycle of keys.

When inspecting chord progressions by conventional means, a considerable amount of implicit knowledge and processing or memorisation is required to recognise regular chord progressions. In Harmony Space, such progressions are trivially recognisable in a single mental 'chunk' (e.g. often as straight lines).

# Providing a vocabulary to analyse and articulate experience

Articulating intuitions about chord sequences requires a vocabulary of some sort. The traditional vocabulary is difficult to learn. Novices may have strong intuitions about chord sequences, but may have no vocabulary for articulating and discussing the structure of chord sequences. Harmony Space gives novices a simple, uniform spatial vocabulary and notation for articulating and discussing such matters. This vocabulary and notation are consistent and uniform across all relevant levels, from the chord constituent level, through the chord progressions level, up to the level of inter-relationships between modulations. Harmony Space can be used as a complement and means of access to more traditional vocabularies.

# Reducing cognitive load in particular tasks

Examples abound of the way in which the interface can reduce cognitive load in particular tasks. To pick two more or less at random: when modulating between two keys, the number of notes in common does not have to be calculated using previously memorised knowledge: it can be grasped visually. Again, when inspecting chord progressions in roman numeral notation by conventional means, a considerable amount of implicit knowledge and processing or memorisation is required to recognise regular chord progressions. In Harmony Space, such progressions are trivially recognisable in a single mental 'chunk' (e.g. as a straight line).

# Sample generic tasks that are relatively easy to carry out using Harmony Space

- Accompany songs with a range of contrasting harmonic constructions, playing the correct chords, on the basis of simple verbal instructions or demonstrations.
- Compose chord sequences making use of simple musical plans, such as: return home, cautious exploration, modal harmonic ostinato and return home with a modulation.
- Carry out harmonic analyses of the chord functions and modulations of specific pieces (easier on fully featured Sparc prototype).
- Analyse pieces at a higher level in terms of compositional ideas.
- Modify existing chord sequences in musically 'sensible' ways: for example carrying out tritone substitutions on jazz chord sequences.
- Play and recognise examples of various abstract musical concepts (e.g. circles of fifths, tonal centres).
- Understand and discuss of music theory.  
Some intermediate and advanced examples.
  - Explore natural harmonic resources of pentatonic scale.
  - Does the pentatonic scale have a natural harmonic centre?
  - What chord construction is appropriate to the Harmonic scale?
  - What tonal centres are inherent in the diatonic scale and why?
  - Why aren't extended plagal cadences common?
  - What modal harmonic ostinati work best?

# Sample generic tasks that are easy to carry out using Harmony Space

- play the chord sequences of a variety of existing pieces,
- compose new chord sequences in a purposive manner,
- modify chord sequences in 'musically intelligent' ways,
- play accompaniment for a singer,
- harmonically analyse modulatory chord sequences (better supported on Sparc versions)
- understand and discuss of music theory.  
(some intermediate and advanced examples).
  - minor chord construction problems,
  - the two tonal centres built into the diatonic scale,
  - the problem with extended plagal cadences,
  - chord construction in the pentatonic scale.

# Recommended fun tasks to try with Harmony Space

- Ask the demonstrator to show you how to play a chosen piece of music.
- Learn the 2,3 and 4 chord tricks.
- Make up your own 4 chord trick.
- Learn the *minor* 3 chord trick.
- Learn to invent your own modal harmonic ostinati: learn *Phil Collins* ' chord sequence trick; reinvent the mixolydian modal shuttle with *Michael Jackson*.
- Learn the 'dominant-powered' classical chord progression as used by Bach, Vivaldi, Mozart, and others.
- Learn how to modulate intelligently.
- Play and analyse jazz chord sequences.
- Compose a variant on John Coltrane's 'Giant Steps'.

## Some suggested pieces to look at

Pachelbel's canon, anything by Bach, Mozart, Vivaldi.

Berry, Chuck (1958) "Johnny B. Goode". Jewel Music, London (Chappell). Chess 1691.

Collins, Phil (1981) "In the Air Tonight". Hit and Run Music, London.  
Collins, Phil (1984) "Easy Lover", (Phil Collins, Phil Bailey and Mason East) MCA, Warner-Chappell, Hit and Run, London. First released 1985.

Coltrane, John (1959) "Giant Steps". Atlantic 1311.

Crawford, Randy (1978) "Street Life". Performed by Randy Crawford and The Crusaders, MCA 513. Written by Joe Sample and Will Jennings. Published by Rondor and Warner-Chappell, London.

Davis, Miles (1959) "So What" on LP "Kinda Blue". Columbia, CL 1355

Dylan, Bob (1968) "All along the Watchtower". Feldman, EMI, London.

Gershwin, George and Ira (1930) "I Got Rhythm". New World Music Corporation, New York.

Jobim, C.A. and Moraes, V. (1963) "Girl from Ipanema". MCA Music, London. On Getz, S. and Gilberto, A. (1963) Verve 68545.

Hendrix, Jimi (1980 re-issue) "Hey Joe" (popular arr. Jimi Hendrix). Polydor 2608001.

Jackson, Michael (1982) "Billie Jean", on "Thriller". CBS Inc/Epic.

Kern-Hammerstein "All The Things You are". Chappell & Co. and T.B. Harms.

Miller, Steve (1984) "Abracadabra", Warner-Chappell (music publishers), London.

Police (1979) "Message in a Bottle" (Sting). Virgin Music. Issued on LP "Regatta de Blanc".

Rogers, R. and Hart, L.(~1934) "The lady is a tramp". Chappell, London. First Frank Sinatra recording, 1956.

Steely Dan (1974) "Pretzel Logic" on LP "Pretzel Logic". ABC, ABCL 5045



Taj Mahal (~1968) "Six Days on The Road" on "Fill Your Head with Rock" (various artists) CBS records.

Youmans, Harbach, Caesar (1924) "Tea for Two". Harms, Inc.

Wonder, Stevie (1973) "Living for the City" on LP "Inner Visions".  
Tamla Motown STMA 8011.

Wonder, Stevie (1976) "Isn't she lovely" Jobete Music Co. Inc. and  
Black Bull Music Inc. On LP 'Songs in the Key of Life', Motown STML  
60022.

Mozart's "Ave Verum", Transvision Vamp's "Baby I don't care", The  
Archies' "Sugar Sugar", The Kingsmen's "Louie, Louie", The Beatles'  
"Birthday", The "Banana Splits Show" theme song.