The Tritonet Approach to Music Theory

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I thank

my wife Cecilia who keeps my faith steady,

my brother Hakan who keeps my curiosity fresh,

my Mother Bilgekan and Father Bülent who keep my roots secure,

Kemal Yücel and Ertan Keser who keep my inspiration high,

all my students who keep my mind sharp,

and my son Luka who keeps me alive.

for the future generations,

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“Everything you can imagine is real.”

Pablo PICASSO
1881 – 1973

Getting Started

Preface

I lost count of how many times I started this book over and over again. Each time, I found a better explanation which once more took me back to the starting point. In this sense, I consider this book to be a milestone from my encounter with an ancient tablet[1] up to this day where what you are holding sums up my first ten years of hassle with the Circle of Fifths.

I tried to be extra careful not to follow any aesthetic rules, but rather to explain everything through the physics of vibration. As a musician who has been trained to follow the path of certain aesthetics, this was not an easy task and sometimes I needed to refer to the current harmonic approach. In that sense, I would consider myself to be just beginning this particular harmonic thinking. My hope is that somebody will internalize this method one day and take it beyond the limits that we currently have.

I also hope that one day I will see Tritonet being used not only for music, but for understanding any kind of harmonic vibration.

In general, I prefer to write short and concise sentences, which are hopefully sufficient to describe my enthusiasm.

May it give inspiration.

August 2016

1 See Ancient Fifths.

A Brief History of Music Theory

Music has always occupied an important place in human life. It has been one of the best tools for carrying knowledge and understanding throughout generations, and is thus one of the prime values constituting a culture. It can articulate our feelings and allow us to express ourselves.

"Harmony" is a word which has existed since the invention of writing. It can be interpreted in music as meaning "the marriage between music and mathematics".

Music in the Ancient Middle East was regarded as being a dialogue between the Gods. Each note would correspond to a deity, and the lowest pitched sound would represent the supreme God.[2] Music was taught as a lesson in temples so as to understand the dialogue between them and thus gain information concerning life.

When we move on to Ancient Greece, we can see that this understanding did not change very much. Music was still used as an essential tool to understand the universe. In the fifth century BC, the characteristics of the fundamental link between mathematics and music were defined by Pythagoras.

We can see that philosophers living in the early centuries of Christianity were thinking along the same lines. For example, Boëthius[3] from Rome, who lived in the fifth century AD, classifies music into three main categories:

1) **Musica Mundana**: Cosmic Music, harmony of celestial bodies in space.
2) **Musica Humana**: Harmony of the body and the soul.
3) **Musica Instrumentalis**: Audible music perceived by the ear. Produced by instruments and voice, it reveals the basic principles of numerical ratios of harmony.

Martianus Capella, who lived during the same era, classified the scientific disciplines of the earliest European universities under two main categories:

1) **Trivium**: Rhetoric, Grammar, Logic.
2) **Quadrivium**: Arithmetic, Geometry, Astronomy, Music.

If education in one of these branches were desired, it was also necessary to receive

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2 In most of the folk music from the Eastern Mediterranean region, the melodic line still starts at high pitches and goes down to low ones.

3 Anicius Manlius Severinus Boëthius (480 – 524), De Institutione musica.

training in the others from the same group; for example, somebody who was interested in astronomy was also expected to learn music.

We can also see that important philosophers of the early periods of Islam followed a similar path for music. For example, Farabi[4] classified the applied sciences like this:

1) **Sayı İlmi**: Arithmetic
2) **Hendese**: Geometry
3) **Menâzır ilmi**: Optics
4) **Yıldızlar ilmi**: Astronomy
5) **Musiki**: Music
6) **Cerr-i Eskal**: The Science of Weights
7) **Hilyeler ilmi**: Mechanics

One of the important breaking points for music in history was the French Revolution (1789). *Musica Instrumentalis* was taken under the protection of the government as a policy, and the first conservatory was founded.[5] Over time, such models of music schools became more widespread as they were adopted by other countries with similar government policies.

Another breaking point was the Second World War. During this time, new technology emerged for use in warfare. The devastation of the war created a void in musical traditions. This was subsequently filled by musicians with a background in mathematics and engineering. These pioneers turned technological advances towards new musical understandings, and thus "Musica Humana" and "Musica Mundana" resurfaced.

4 Ebu Nasr Muhammed el-Farabi (870 – 951), İhsa'ül-Ulüm.

5 Paris Conservatoire National de Musique et d'Art Dramatique (1795).

Why?

I decided to write this book when questions from my students could not be answered any longer using the current method of training.

Theory is a compulsory course at musical institutions which requires a number of years. Music schools today frequently use derivations of the music theory book written by Rameau[6] in 1722, based on functions.

Because of the heavy burden that accompanies it, this class does not usually start before the age of 14 to 15. During the education, the intricacies of tonal harmony aesthetics are taught. However, this particular aesthetic was only prevalent in Western Europe between 1650 and 1900, the Common Practice Period, where functional harmony was strong. With the second half of the nineteenth century, the rules began to be extended beyond the conventions of the time by the composers, so that usage of harmony from the twentieth century onwards would be unrecognisable to the exponents of Rameau's time.

The idea of Tritonet however, is to give a new approach to music harmony based on physical properties of sound. Suggesting no aesthetics, providing a visual helper, the idea intends to teach fundamental harmony to everyone in a shorter time and more individual way.

6 Jean-Philippe Rameau (1683 – 1764), Traité de l'harmonie réduite à ses principes naturels.

To the Reader

- Even though there is a brief introduction in the Musical Alphabet chapter, it is advised to already be familiar with music hearing and writing.
- Exercises accompany the topics throughout the book. Answers are provided in the back to check and compare.
- Download the Tritonet app for your smart device and scan QR Codes to listen examples, check answers, practice and explore.

As an instructor:

If you are already teaching Tonal harmony: The method in this book has many conceptual overlaps with tonal theory. Contrast of Major and Minor is placed between Ionian and Aeolian. The rest of the modes are tuned in order to enhance the tonal gravitation. To have a proper voice leading, please refer to 'ResTens in Tonal Harmony' in the 'Notes' chapter. For the cross terminology, please refer to 'Dictionary'.

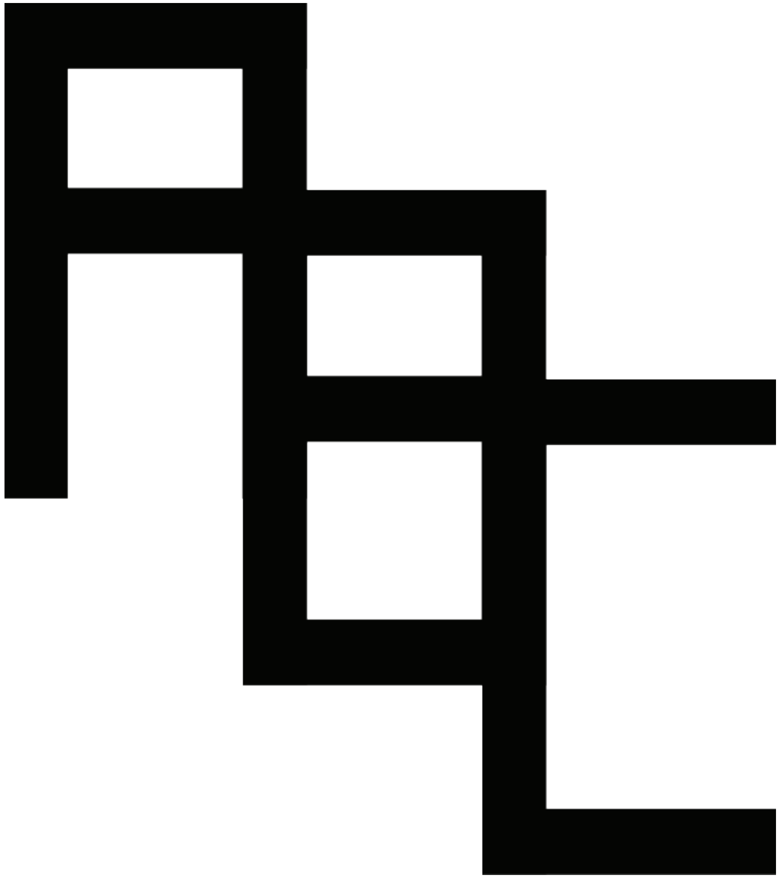
If you are going to teach Tritonet: The book is laid out from beginner to advanced level. A course could be designed to be as short as 12 weeks, from 'Structure' to 'Notes'. Referring back to 'Structure' makes the class more scientific, using different 12-member sets for Table makes it more intuitive. The teacher should find the balance in between. It is desired for students to get familiar with cross terminology in order to communicate musically with tonal-harmony-oriented musicians.

If you are teaching to children: The book is not originally written for children, although it can be used by a teacher who can translate the information via stories. Seven modes can be personified as the seven dwarfs in Snow White. Compass can be explained as a vehicle which has six engines on the back. Reading table and writing musical notation can be introduced at later ages. The main priority is to make mindful decisions with a sense of direction for the students.

“I would teach children music, physics, and philosophy; but most importantly music, for the patterns in music and all the arts are the keys to learning.”

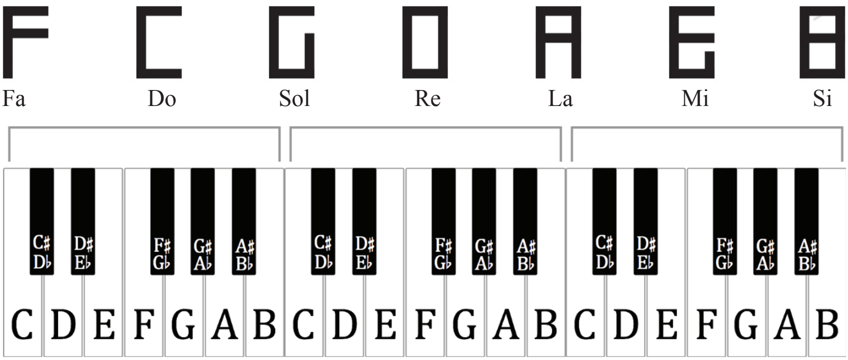
PLATO
From the book *Republic*
427– 347 BC

Musical Alphabet



The Notes

To be able to understand the contents of this book, we first need to agree on a language. For this reason, it becomes essential for beginners to internalize some core knowledge regarding music. First of all, let's recognize the alphabet we use. The alphabet used in music consists of seven letters in total.

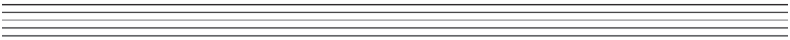


If we look at the placement of the keys on a piano, we can easily see that the same pattern repeats consistently. As the keys go towards the left side, the sound gets lower, and as they go towards the right side it gets higher.

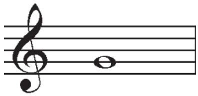
Distance between the same notes only a pattern apart is called **'Octave'**. An octave contains all the note material of the sonic environment. This book is based on 12 divisions of an octave.

Notation

To write music, five parallel lines are used, called a **'Staff'.** The vertical plane indicates the pitch while the horizontal one the time.

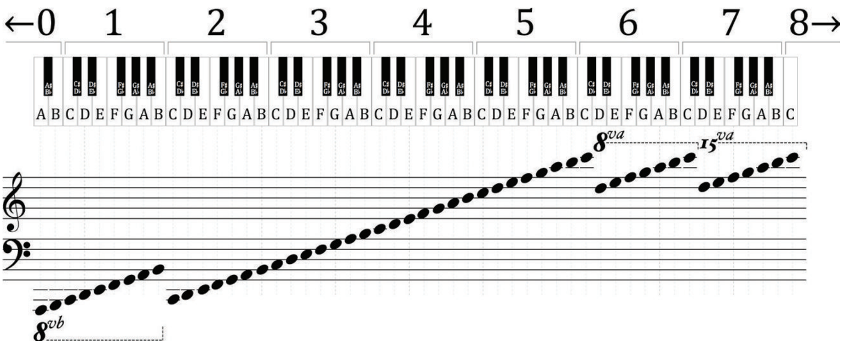


Since the tone range we use for music is broad (nine octaves), we use a **'Clef'** on the staff to determine the location of the notes. The G clef is used to indicate high notes while the F clef is for low notes.[7] The line where the clef symbol starts shows the name of the clef.



G Clef and the location of G on the fourth octave.

F Clef and the location of F on the third octave.



As shown here, a staff can cover only a certain range of notes with the help of the clefs. If notes start to extend beyond a staff, ledger lines are used to write notes as if the lines continue, or octave replacement signs to shift back into the staff.

7 There are many more clefs in use; however, two clefs will be sufficient for this book.

Degrees

We use degrees to alter the pitch of notes. Each note can take five different degrees.

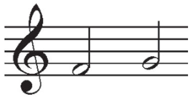
Double flat	Flat	Natural	Sharp	Double Sharp

The **‘Flat’** sign lowers the tone by a half step and the **‘Sharp’** sign raises it by a half step. While the **‘Double flat’** flattens it by two half steps (a full step), a **‘Double sharp’** sharpens it by a full step. **‘Natural’** sign neutralizes the effect of other degrees.

In this way, we get a total of 35 different notes. When we classify the ones that sound the same, we get a total of 12 tones. In order to achieve the micro-tones, derivations of the degree signs are used.

Two neighbouring tones can have three different positions:

Diatonic: Different in sound and name



Chromatic: Different in sound but sharing same letter name

Enharmonic: Same in sound but different in name

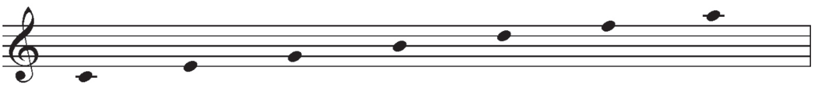
Note Series

For ease of understanding here, it may be useful to name the hierarchical sequences of notes which frequently used in to book.

1. **Series of Fifths:** A scale where consecutive notes are at a range of a perfect fifth (seven semitones) above. The notes at the two ends of the sequence are dual tones.[8]

2. **Melodic Series**: A scale where notes are written in consecutive steps.[9] These are sounds which, when played on the horizontal plane -meaning melodically- are able to tie in harmoniously.

3. **Modal Series:** The notes are at intervals of thirds and are aligned vertically. They are used to make up chords.



8 It is also known as the order of sharps from left to right, and as the order of flats from the opposite side.

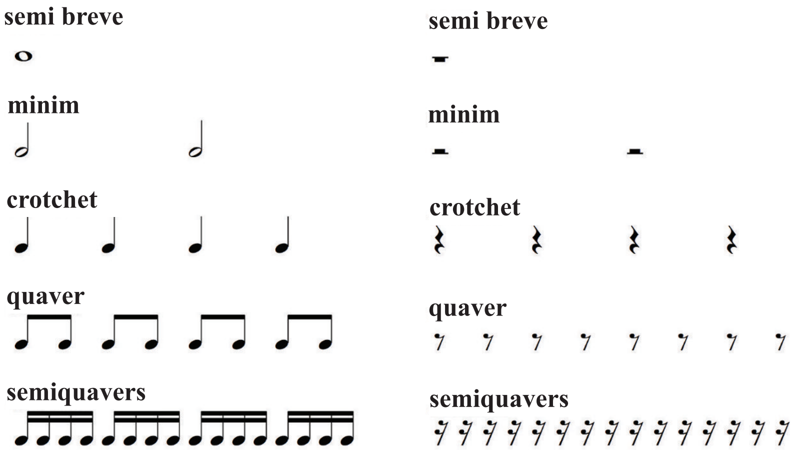
9 Also called the diatonic scale in some sources.

Time

What we have seen so far is how to notate the pitch differences of sounds. While describing music, we also need to see how we organize time.

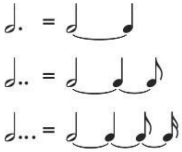
First variable for is the **'Tempo'** which is the speed of time. In daily life, we divide time in seconds. This gives us one beat per second and a tempo of 60 beats per minute. To be able to create different perceptions of time in music, tempo sign is indicated to show how many beats there are per minute.

Second variable is the '**Duration**' of each note. The semi breve has four beats, and is the note with the longest duration used in today's notation. The note with half its duration is the minim and has two beats. The next one is called a crotchet. As the note durations get smaller, flags are added to the crotchet. A flag divides the time into two unless any other number of division has been marked on top of the notes.



Rest creates a silence in music. It is as important as a tone in music like a window or a door in a sound wall. The rests corresponding to the durations use the right column symbols.

'Dots' and **'Ties'** are used to show the unequal time units. The dot extends the duration of a rest or tone by half as much. The tie mark joins the notes that are tied, so they are played as a single note with a duration of the sum of the durations of each note.



In music, beats are enclosed in a **'Measure'** which is like a little time cell with an organization of the beats. The **'Time signature'** consists of two numbers where the top digit indicates how many beats there are in a measure and the bottom one shows the reference unit for the beat.

Each measure consists of four beats

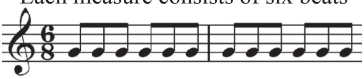
Each beat is a crochet

Each measure consists of three beats

Each beat is a minim

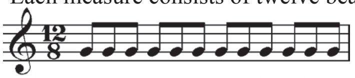
The division of the beat is not only in multiples of two, but also three. Flags of the notes are linked to indicate which beat they belong to.

Each measure consists of six beats



Each beat is a dotted crochet

Each measure consists of twelve beats



Each beat is a dotted crochet

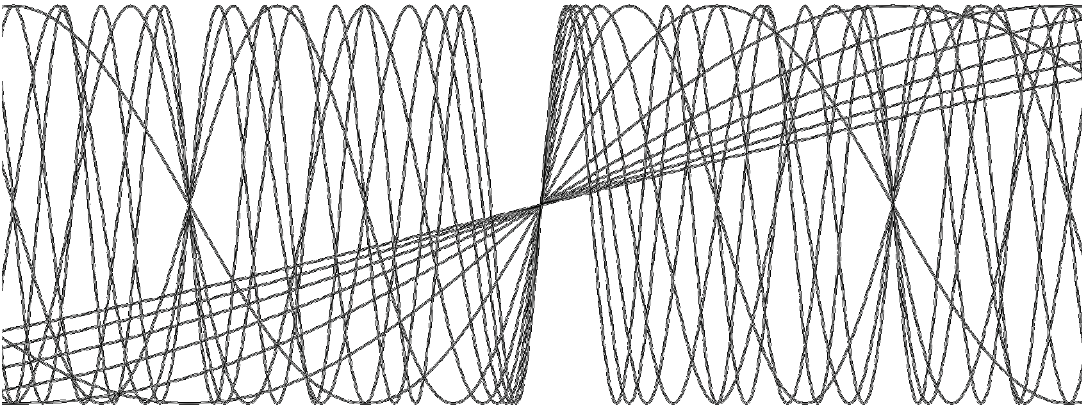
We can also group the beats as mixed clusters of two and three notes, which are called **'Compound meters.'**

“Heavenly bodies are nothing but a continuous song for several voices perceived by the intellect, not by the ear; a music which sets landmarks in the immeasurable flow of time. ”

Johannes KEPLER
(1571–1630)
From the book *Harmonices Mundi* [10]
Book V, Ch. 7

[10] Music of the Spheres.

Structure



Vibration

First of all, we need a proposition as a reference point to mutually agree on. We can start by accepting that "Everything in the Universe vibrates." We can even go a little further[11] along this route and state that "Energy is All."

'Vibration' is the transfer of energy from one point to another in pulses. If there is Energy, there is vibration. We can think about vibration as a removal of imbalance from the system by wave transference, returning to its original immobile state.

It is hard for us to imagine waves in a single dimension because we need a second dimension as an accepted reference point to detect the movement.

Thinking in terms of a two-dimensional plane, you can imagine throwing a stone into a pool of calm water. Ripples, or waves, will form around this stone, expanding outwards in circles with peaks and troughs in between.

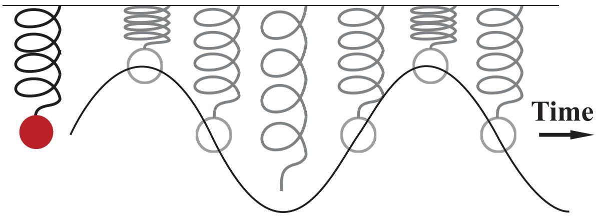
When we start thinking in terms of a three-dimensional plane, we need to switch our mental picture to a sphere; interwoven spheres which dissolve as they expand.

Depth, as the third dimension, can also be considered as time. When you look at the sphere, light waves coming from the equator of the sphere reach your eyes earlier than from the poles, so the view you get from the poles will be slightly 'older.'

[11] The famous equation $E=mc^2$ by Albert Einstein acknowledges the energy and mass being equal within a ratio related to velocity.

Cycles

Now, I would like you to close your eyes and imagine a weight hanging from a spring. Pull the spring vertically and let it go. What kind of movement do you observe?



The weight vibrates with a perpetual oscillation until it reaches balance. This movement by the spring is called the **'Simple Harmonic Motion'** and the trajectory shape through the time line is called the **'Sine'** curve.

We can see that the oscillation of the weight comes to a stop after a while due to the environment being filled with interacting vibrations.[12] If it was totally empty, the vibration would keep going with the energy infinitely.[13] However, no environment is an empty void; sooner or later, the spring's energy will be absorbed as heat by the other present vibrations.[14]

Seeing an immobile spring, can we really talk about motionlessness? This would contradict our primary proposition of "Everything vibrates." The oscillation of the spring is now tuned into the bigger system to which it is connected, and if you look at that particular system from outside you will see that the spring is still moving. However, if you are also inside the same system with the spring it will now seem stationary to you. This is similar to reading a book while travelling inside a vehicle, or trying to read the same book while the vehicle is passing right by you. Thus, the spring oscillates harmoniously with the Earth, to which you also are connected.

12 "As energy is being transferred, it is inevitable for it to have an effect other than just the transference" Rudolf Clausius (1822 – 1888).

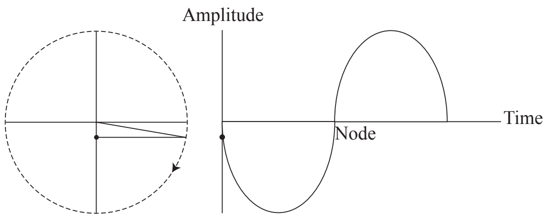
13 "A system tends to continue its behaviour as long as there are no interventions from outside. This is called vis viva, living force" G.W. Leibniz (1616 – 1689).

14 The second law of thermodynamics: All closed systems tend to achieve balance and at that point of balance, randomness is at its highest, and the amount of energy for action is zero.

So, is the Earth still? Earth continues to rotate around its own axis with a speed of 1,670 km/h and orbits the sun at 108,000 km/h. Moreover, the Sun continues to orbit around a much bigger system at a speed of 828,000 km/h. You have travelled thousands of kilometres plotting spirals while just reading this sentence.

Regardless of whether the spring is making a simple, two-dimensional harmonic motion or plotting spirals inside the three-dimensional space-time, the spring's trace on the time line will present the same sine curve.

For example, if we were watching our position on Earth from the poles, it would take 24 hours for a sine curve to complete. If we watched the Earth's orbit around the Sun, it would take 365 days and 6 hours. It takes 25,800 years to orbit the Sun, and 225 million years to orbit the Milky Way. As the wavelength of a newly discovered celestial body converges to infinity (or the boundaries of the universe!), the perception of the oscillation converges to zero.



The vertical distance between the peaks and troughs of the sine wave is called its **'Amplitude'**, in other words, how much energy the oscillation is loaded with.

The point at the centre of the sine curve, where it intersects the time coordinate, is called a **'Node'**. The movement decreases as we get closer to the node. We perceive it as completely still when it is on the node.

We have stated that no matter how complex the movement of the spring is, it will give out the same sine curve. However, it is impossible to perceive a sine curve from a pure shape in nature using only our senses. There are always other elements which affect the balance inside the system.