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The Mathematics behind Playing Hindustani Classical Stringed Musical Instruments

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The Hindustani classical stringed musical instruments are not only melodious but also designed scientifically along with its playing methods. Here we will study only the mathematical significance of plying a particular *raaga* in any Indian classical stringed instrument like Veena, Sitar, Sarod, Santoor, Violin (Indian style), Sarengi, Esraj etc. All these instruments are structurally different indeed but the very fundamental way and technique of playing a particular *raga* in each of them are similar. So without losing any interest let's see what's inside.

We know that any Indian classical stringed instrument has just two very basic strokes and they are '*Da'* and '*Ra'*.
(Somebody says '*De'* and '*Reh'* also)

For example in Sarod or Sitar hitting a particular string by *'Jawa'* or *'Mizrab'* from up to downwards is called '*Da'* where as the opposite that is from down to upward stroke is called '*Ra'*. So every single sound which has been produced by these instruments are basically the composition of these two fundamental strokes *Da* and *Ra*.

Let's denote the basic set of these two strokes as {0,1}

[0 as *Da* and 1 as *Ra*]. Now let X is the ordered set of all nodes or *Swars* of a particular raga.(Irrespective of *Aroho* and *Abroho* swar). For Example let's take the very popular raga *'Malkuns'* or '*Malkosh'*. This is a raga consists of five swar i.e of *Aurava Jati*. So in this case
X = {Sa, ga,Ma,dha,ni}
(Capital signify *Suddha* and small letters signify *Komal* swar)

We know that *Mir* is a very important thing involved in the playing methods of any Indian classical stringed instrument. It's basically producing a continuous sound melody by hitting a single stroke from a swar to it's neighbour *swar(s)*. So for X in the case of *raag Malkuns* the basic *Mirs* are <u>*ga-Ma*</u> , <u>*dha-ni*</u> & <u>*ni-Sa*</u> . So mathematically we are presenting them as the close intervals in the real line as [*ga,Ma*] , [*dha,ni*] & [*ni,Sa*]. Any other long *Mirs* are just the compositions i.e the unions of these intervals. Actually it's the skill of the musician who plays a long *Mir* as <u>*ga-ni*</u> which produce a sound continuously without touching the middle node of '*Pa'*.
But actually it is [*ga,Ma*]∪[*dha,ni*]

Here I'm not mentioning about *'Gomak'* because that's also frequent repeatation of *Mirs*. Now for easy demarcation let I= [*ga,Ma*] , J= [*dha,ni*] and K = [*ni,Sa*]. Afterwards let's define a set Ω, generally in the language of Indian music this set is called *'Chalan'* of a particular raga. Ω is nothing but the collection of all the basic nodes of the raga along with the unions of its basic *Mirs*. In this present case of raag Malkuns

$\Omega = X \cup < I, J, K >$;where
$< I, J, K > = \{I, J, K, I \cup J, J \cup K, I \cup K, I \cup J \cup K\}$

Without loss of generality Ω should also be an ordered set like X.

Now any function $f : \{0,1\} \rightarrow \Omega$

is called *'play'* or '*Baz'*. Now the definition of ***playing a raga*** is nothing but the set of all such play functions that is $\mathscr{L} = \{ f_i \mid f_i : \{0,1\} \rightarrow \Omega \}$.

Watch that playing a raga means $\mathscr{L}$ can be an *alap, jor, jhala* or *gaath* anything of a particular raga also notice that in such different modes the application of *Chikari* is nothing but a '*Da'* stroke of a particular string producing sound of *Sa* or *sa* sound individually. So that's everything is included in the $\mathscr{L}$.Any subset of $\mathscr{L}$ is called '*piece'* or '*tukra'*. Another important thing is that in $\mathscr{L}$ the time span between every $f_i(0)$ and $f_i(1)$ should be constant, which is called the ' *Laya'* or *rhythm*.

Now for any *tukra* of $\mathscr{L}$ say $\mathscr{L}_x$ if the *Laya'* of $\mathscr{L}_x$ is 1/x th of $\mathscr{L}$

then $\mathscr{L}_x$ is called a '*taan'* of x th speed over $\mathscr{L}$. For example if x=2 then we called $\mathscr{L}_2$ is a *Duni taan* where as x=4 means $\mathscr{L}_4$ *chowduni taan* etc.

There's a lot of themes and topics in Indian classical music even I don't know that all these things can be mathematisized or not. Here I just tried to introduce the very simple mathematical analysis behind the basic playing technique of the stringed musical instruments of Indian classical music. So in this pandemic situation stay happy and tuned on Hindustani classical music.

Author Profile

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