

Re: A new paradigm?(On pitch and periodicity (was "correction to post"))

- To: AUDITORY@xxxxxxxxxxxxxxxx
 - Subject: Re: A new paradigm?(On pitch and periodicity (was "correction to post"))
 - From: Willem Christiaan Heerens <heerens1@xxxxxxxx>
 - Date: Fri, 9 Sep 2011 18:39:17 -0400
 - Approved-by: heerens1@xxxxxxxx
 - Comments: To: Ranjit Randhawa <rsran@xxxxxxxx>
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 - Reply-to: Willem Christiaan Heerens <heerens1@xxxxxxxx>
 - Sender: AUDITORY - Research in Auditory Perception <AUDITORY@xxxxxxxxxxxxxxxx>
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Dear List,

In this thread: "A new paradigm?(On pitch and periodicity ..)" the original start of all this was the question of Nedra Floyd-Pautler about auditory illusions in relation to hearing aids. But it was the comment of Randy Randhawa addressed to her with the following content:

In my opinion the most enduring (over 200 years) of all auditory "illusions" is what has been called the "missing fundamental". The fact that this has not been satisfactorily resolved by the tortured use of existing signal processing techniques leads some, including yours truly, to believe that the auditory system has figured out a unique way to do frequency analysis and to meet the dictum in biology that "form follows function". Taking into account where we are and the discussions that take place, e.g. this forum, it is interesting that there has been no discussion as to why the cochlear has the shape it does. Therefore some experimental phenomenon that we may call as an illusion, could have a very natural consequence of how frequency analysis is done. One is lead to believe that we are truly very far from understanding how the auditory system works and therefore hearing aid designs are a bit of a hoax foisted on the "proletariat". Sorry if I sound a bit harsh, but I think it is time people recognized that the emperor has not clothes.

And sorry for those who have other ideas, I completely agree with Randy's remarks here above. And I have reasons for this opinion.

Although not being an auditory expert, but having an academic applied physics background I have studied already for more than ten years the functionality of the mammalian hearing sense. Together with ENT MD J. Alexander de Ru I have recently published a booklet with the following title:

Applying Physics Makes Auditory Sense

With subtitle:

A new paradigm in hearing

This booklet describes in the first chapter – Introduction – the objections we have against a number of existing hypotheses, simply because they are at variance with general laws of physics.

In the second chapter – The new hypothesis – we describe how based on our findings the mammalian hearing sense can function in such a way that it is on the one hand in full agreement with the rules and laws of general physics and mechanics and that on the other hand it explains clearly all the salient mysteries and anomalies, has the potential to explain even much more yet unclear details in our auditory system and predicts other verifiable hearing phenomena.

The third chapter – Methods and experiments for verification – deals with perception experiments in which the 'missing fundamental' and the 'strike note of bells' are found to be normal hearing phenomena, so no illusions, while the 'shift in pitch', described in literature as result of a uniform frequency shift in higher 'incomplete harmonic' sound complexes, is found as an illusion, based on subjective perception of musically trained experimenters.

The other four chapters describe details about the functioning of the cochlea.

If you combine this with the formulation of Richard Lyon in his comment to Ita Katz:

It would be much more robust to say that "The pitch is determined based on an approximately common periodicity of outputs of the cochlea," which I believe is consistent with your intent.

Why is this better?

First, it doesn't say the periodicity is determined; what is determined is the pitch (even that is a bit of stretch, but let's go with it).

Second, it doesn't depend on whether the signal is periodic, that is, whether harmonics exist.

Third, it doesn't depend on being able to isolate and separately characterize components, harmonic or otherwise.

Fourth, it doesn't need "multiples" (or divisors), but relies on the property of periodicity that a signal with a given period is also periodic at multiples of that period, so it only needs to look for "common" periodicities--which doesn't require any arithmetic, just simple neural circuits. Fifth, it admits approximation, so that things like "the strike note of a chime" and noise-based pitch can be accommodated.

Sixth, it recognizes that the cochlea has a role in pitch perception. It's still not complete or perfect, but I think presents a better picture of how it actually works, in a form that can be realistically modeled.

You will observe that all these six aspects are forming parts of the concept we have named a new paradigm in hearing.

You can download the e-book version of our booklet from the website of the University of Utrecht:

<http://igitur-archive.library.uu.nl/med/2011-0204-200555/UUindex.html>

But for your convenience I have attached the PDF version of the booklet to this message

Regards

Pim Heerens

Attachment: [Book Heerens de Ru EN.pdf](#)

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