

Subjective Sound Quality evaluation of SACD compared to CD

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Abstract: Using a high quality sound reproduction system and listening to SACD recordings compared to the same CD recordings, show significant quality differences between these two digital formats. In short: the high segment of the frequency range is much more fluent and open and natural sounding in SACD. Also the dynamic loudness range is larger in SACD. The profoundness and deepness of the bass-region is stronger and larger with SACD. Overall, the sound character of SACD is more natural, more real life, than the CD.

All these subjective noticeable qualities come clearly to the foreground, although, as always, heavy discussions could be held about the reliability of this subjective evaluation. In spite of these possible discussions, I consider it to be important that we do not set our subjective observations aside, because for this moment scientific objective proves might be absent.

This paper will discuss the findings and also deliver a scientific philosophical approach how to deal with subjective findings in an objective environment, leading to a better validation and use of subjective evaluation in general.

1: Introduction

What are we talking about? The CD has a dynamic range of 96 dB and a frequency range from almost DC to 22 kHz. That is a much wider range than our ears can hear, assuming that we do listen in a healthy average loudness environment around 80 to 90 dB_{SPL}. So, the CD is good enough, no further improvement is needed for, except maybe improvements in linearity and jitter.

However, the SACD came to birth with a much wider frequency range and a much wider dynamic range. This better performance exceeds the qualities of our ears and compared to CD we should not be able to hear any improvement.

How strange it may sound, at least I can hear that SACD sounds better than CD. This observation points to the facts that the threshold of audibility and the equal loudness curves plus the noticeable frequency range of our ears do not abundantly describe what we are able to observe. There is more going on, we can hear more and this "more" is not quantified in the scientific measured qualities of the ear, as mentioned above.

The qualities of our ears are measured with continues sinusoidal signals, using Fourier series (de-) construction. The results give us partly understanding and insight in how we observe Loudness, Timbre and Pitch, while being unable to explain how we hear and understand speech, let alone how we listen to and enjoy music.

As examples, Plomp¹ states in chapter 6: "*Sounds have a meaning, implying that their significance is much greater than the physical content of the signal*" and "*vision and audition are biased senses*". Based on many more observations and thoughts, Plomp strongly advises to include phenomenological observations to get a better picture of the capabilities of our hearing. Oliver Sacks² is a very good example of how the phenomenological approach could function.

Richard Heiser³ states: "*The existence of bimodality of response is a direct clue that the perception of quality is a nonlinear process. It should also be a clue that any objective measurements which are based on linear theory will not be worth a hill of beans when we try to*

correlate those measurements with subjective value judgments".

When we perform measurements on our ear and hearing, mostly we use sinusoidal tones, based on the concepts of Fourier analyses. However, his impressive theories are only valid in a linear environment and for ever lasting tones. But, our ear is certainly not linear, our hearing is not linear, and our perception certainly is far away from linear. When we listen to music or speech, we listen to a stream of discontinue signal bursts.

For above given reasons it becomes clear that linear measurements with continues sinusoidal signals do not have the final power of proof. We should go into the direction of measuring and observing with discontinues signals, while taking non linear qualities into account. In this workshop Hans van Maanen gives examples how CD and SACD behave differently with discontinues signals.

I will focus, like Oliver Sacks, on a phenomenological description of my observations when I compare SACD and CD.

At the end of this paper I formulate more precise a scientific validation of the phenomenological approach as applied in this research.

2: Listening Conditions

The subjective listening tests were performed in the listening room of Temporal Coherence, in Bleiswijk, the Netherlands. The sound system comprised a Denon DCD-2000AE combined SACD-CD player, driving a TC-ST4 pre amplifier and active TC-Diamond loudspeakers (see photo-1). These loudspeakers radiate equal in the 2π horizontal plane, therefore the direct and reflected sound have equal spectral content. The loudspeakers are a three speakers minimal phase design (no all pass transfer), and the closed box bass section has an extra active correction down to 16 Hz to extend the -3dB frequency range to this frequency. The transfer of this speaker is not only optimized in the frequency domain, but also in the time domain, which is a specific goal in the work and products of Temporal Coherence⁵.



Photo-1: The TC-Diamond Loudspeaker

Large sections (minimal 2 minutes) of CD and equal SACD recordings were compared and evaluated on several listening items, which will be discussed following. There was only one person, me⁴, making the judgments and comparisons. The duration of the test was one quiet relaxed day, followed by a good diner.

3: Test Results

In 1970, CBS made an analog recording of Santana, called "Abraxas" and I listened to the CD and SACD version of the song "Singing Winds, Crying Beasts". The tonal character of the recording is a little dark warm colored, however this is more noticeable on CD than on SACD. The high section of the frequency range sounds a little dull on CD, while more open and detailed on SACD. The depth of the soundstage is wider on SACD and the deep bass is more present and fluent on the SACD. The differences are clearly noticeable and certainly not on the edge of notification.

I guess we all know the famous analog Allen Parson recording from 1972-1973 in Abby Road, where Pink Floyd performed the "Dark Side of the Moon" album. I listened to the track "Time", with clocks and bells and many more pulse like sounds. With the CD I had the feeling that the high frequencies were limited in their dynamics and also a little distorted. All this was absent in the SACD where I found the highs to sound clean. The SACD depth of the soundstage was deeper and opener. The instruments were easier to distinguish in position and dimension.

In 1959, Sony made an analog recording of the work of Respighi, "Fontaine de la Villa Medici Altramonto". This recording was remastered on SACD and I compared it to a 1994 CD recording, also of Sony. Although the recordings were made at different moments in time and with different orchestra, I thought it to be valid for the use of comparison. SACD used old analog technique from 1959 and the CD-recoding was made with ultra modern high quality CD-stuff. Who would win? Clearly the SACD version was the great winner. Firstly because the old guys from 1959 knew acoustically exactly what they were doing, they created a great sound and a great space. The musicality of the performance also was far more better than the CD-version. A good example to discuss here is the sound of the triangle. This small tiny instrument sounded buried and not lively on the CD, while the SACD showed the full extend of the special sound character of this little instrument. Again the highs sounded far more clearer and cleaner on the SACD.

Lets go now to the more modern stuff. Phonogram recorded in 1985 the "Brothers in Arms" album of Dire Straights. I listened to the track "Your Latest Trick". Here we deal with an original digital recording, mastered to CD and later mastered to SACD. This comparison is tricky, because I know nothing about the original digital recording format. Was it 16 or 18 or 24 bits and was the sampling frequency 44.1 or 196 kHz? All is unknown by me, and the only tool I have is to listen to the final results and to compare those. The results are: again SACD excels in the highs which are more open and natural sounding. Again the depth of the soundstage is larger with SACD, while the bass region sounds more natural and deeper, compared to the CD-version.

It is of no further use to extend the description of the many other trials I did, because they all gave the same results. The high segment of the frequency range is much more fluent and open and natural sounding on SACD. Also the dynamic loudness range is larger on SACD. The profoundness and deepness of the bass-region is stronger and larger with SACD. Overall, the sound character

of SACD is more natural, more real life, more musical than the CD.

In summary: the differences between SACD and CD are clearly and easily noticeable and can be described and worded very precise and repeatedly.

4: Phenomenological approach and science

Let us play Newton for a while: I am absolutely sure that he did not start with the formula " $F=m \cdot a$ ", but started with observing and playing with falling objects. Following he made measurements, finally resulting in his famous formula. That really is science!

What am I doing in this research? I make observations, and have my formulae and explanations not available yet. I believe my observations to be true, maybe not optimal described and worded yet, but that will come in due course. This also is science, you bet!

To be more precise: at the university they taught me to observe, and to write down my observations carefully in thick blank paper books, combined with data and time and temperature and humidity information.

They also taught me that nothing is sure in science, once one might find that specific example that does not follow the rules. And it is just that example, which might open doors to new theories and inventions.

So, just observing, just this phenomenological approach is a totally valid tool in science.

I invite you to visit my "TubeSociety" school, where I discuss observations and findings with my students and where I train them to listen and to design and construct valve amplifiers. In the listening sessions I ask them to word their observations and often I hear: "I might not be right, but I think I hear". My answer has become a standard to such 'humble' behavior: "Please, believe your own observations. If you don't, you remove yourself away from a basic quality of a human being. Which is: your senses and what they tell you".

Some might argue against all of this: "Menno, you were listening to differences in DA-converters inside the Denon player". Might be, but I happened to

have listened under many other conditions, with the same set of findings. There always will be "the other explanation" and in this stage I am not explaining, I observe.

5: Conclusions

The research has shown that sound quality differences between SACD and CD are clearly noticeable, in favor of the SACD. The nature of the observations of this test are placed in a scientific context. Further work is to search for and to test new theories about the capabilities of our hearing that explain the observations.

References:

- 1: Reinier Plomp: "The Intelligent Ear: on the nature of sound perception"; Lawrence Associates, Inc., ISBN 0-8058-3867-8; chapter 6.
- 2: Oliver Sacks: "Musicophilia, Tales of Music and the Brain".
- 3: Richard C. Heiser: "Catastrophe Theory and its Effect on Audio"; Part III; Audio, vol. 63, no 5, pp. 42-55, 1979 May.
- 4: www.mennovanderveen.nl
- 5: www.temporalcoherence.nl