NEW UNIQUE TECHNIQUE TO MEASURE SIGNAL DEGRADATION

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(Part III)

To explain more about what type of distortions are well audible and why another one, even strong, are inaudible lets look well known article "Re great debate: Subjetive evaluation" [5]. In the test described in this article crossover distortion of different levels where especially added to signal by two diodes.
It was found in audio tests on musical signals that the level of noticeability is ~1% !

So the level of distortion is quit high and any known signal test will decide that 1% THD amplifier is low-level design but two pass reverse test will be in agreement with LIPSHITZ, S.P. & VANDERKOOY, J.
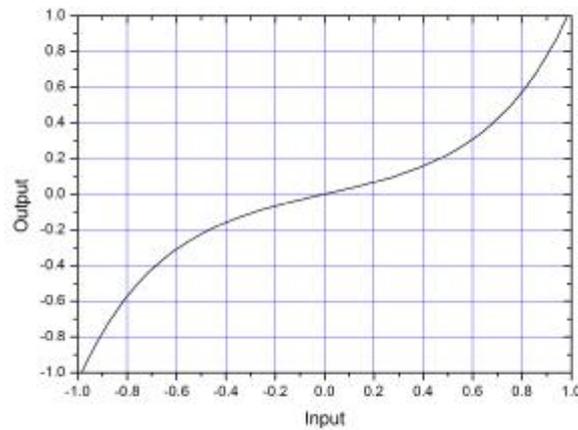

Fig. 8

Suppose the amplifier is strong nonlinear like on Fig. 8. Signal going thought amplifier in two pass reverse test will be distorted twice by nonlinearity but left 'wing' and right 'wing' will be still equal like it shown on Fig. 9.
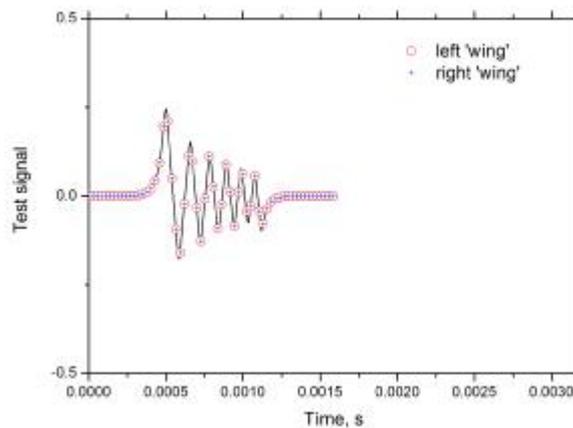

Fig. 9

Nonlinear function do not destroy the symmetry of the signal 'wings' and two pass reverse test will show zero distortion level. Same will be with soft clipping of the signal in amplifier. The level of nonlinearity may be high but in reasonable range.

But if input/output function in real amplifier exhibits variation due to influence of signal on the elements of amplifier then the signal symmetry will be destroyed and it is same time is the indication of the signal degradation which is quit well noticeable even if degradation is ~0.001%.
Low level of degradation is not even covered by the 1% of nonlinearity or common linear distortions in C, L, R circuits.

The result for capacitor in Part II was to show the ability of capacitors to degrade signals and also it shows why hearing so sensitive to the quality of capacitors.

If to present a signal in vector form in polar coordinates one single frequency tone is one vector S on left diagram. Fist pass through test circuit will produce output as rotated in phase and modified by amplitude main tone S' and distortions shown as D'.
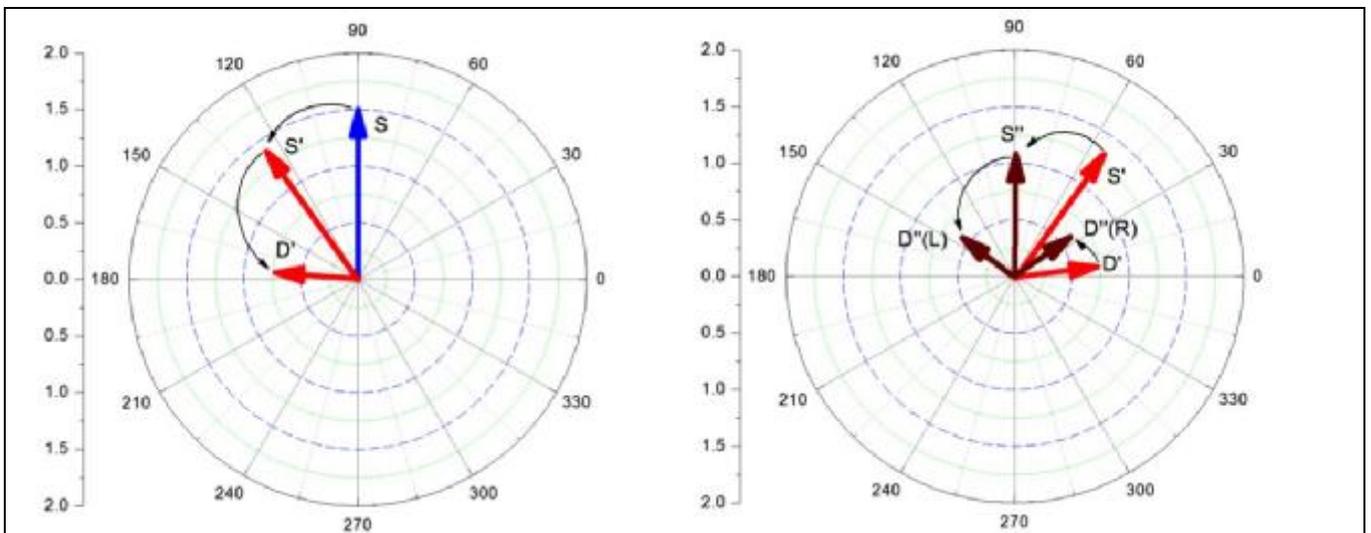

Fig. 10

On the right diagram S' and D' are shown in right semi plane after procedure of time reversing transform $U1(t)=U(-t)$.
In the second pass through test circuit same transformation will be as in first pass. S' maine tone will produce the output main tone S'' and distortion D''(Left). The distortion D' will be transformed into D''(Right).
In circuit is without degradation of signal distortion then D''(Left) and D''(Right) equals and symmetrical along vertical axis. Comparing the 'wings' of a signal is just procedure of comparing of symmetry of vectors D''(Left) and D''(Right) which is quit sensitive to nonreversible signal degradation and very good correlate with audibility impression.

To summarize about the technique:

- Double reverse test (let say DRT) is based on the human sound recognition abilities
- The main idea is that the same sound (musical) fragment exist in two forms with time reversed in one, and if this forms are different (what is quit important) then the reproduction of one fragment produced output different from reversed one output.
- As example – words "abcd" and "dcba" will produce different set of distortion in amplifier with listenable distortions and will be the same in amplifier with inaudible distortions
- The asymmetric behavior appear due to amplifiers 'memory' distortions, commonly appear in thermal form or capacitors absorption or other
- DRT include test sound fragment in digital form, DAC connected to tested circuit and ADC connected to output of to tested circuit as in all classic tests
- The unique resolution and possibility to resolve audible signal degradation is connected with time reversing procedure
- The small value of signal degradation is selected by DRT even from the sum with high-level but inaudible distortions
- Set of psychoacoustics audio tests show that it is possible that human hearing use the same procedures in processing of sound chunks of some parts of second duration

(More about and some application results will be later)

Literature (preliminary):

[5] -- LIPSHITZ, S.P. & VANDERKOOY, J. (1981) "Re great debate: Subjetive evaluation", JAES, 29, 7/8, Pp.482-490.