

Frequency Response Analysis of Earphones

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Zhao, Yuxiao

I. Introduction

Earphones (popularly called "earbuds" in recent years) are very small headphones that are fitted directly in the outer ear, facing but not inserted in the ear canal. Earphones are portable and convenient. For those who seek the perfect sound, the world of headphones can be confusing. It is difficult to pick the best headphones. There are so many makes and models out there, from the no-frill, no excitement, little \$10 budget ones that can be thrown out within a couple of months, to these which cost hundreds of bucks. So, where do you put your money? That is a real question. After all you don't want to waste your money on headphones which don't work for you in terms of sound, build quality and as an admired music gadget.

Frequency response is the quantitative measure of the output spectrum of a system or device in response to a stimulus, and is used to characterise the dynamics of the system. It is a measure of magnitude and phase of the output as a function of frequency, in comparison to the input. Therefore frequency response is an important measurement of quality of earphones.

II. Materials and Apparatus



Figure 1

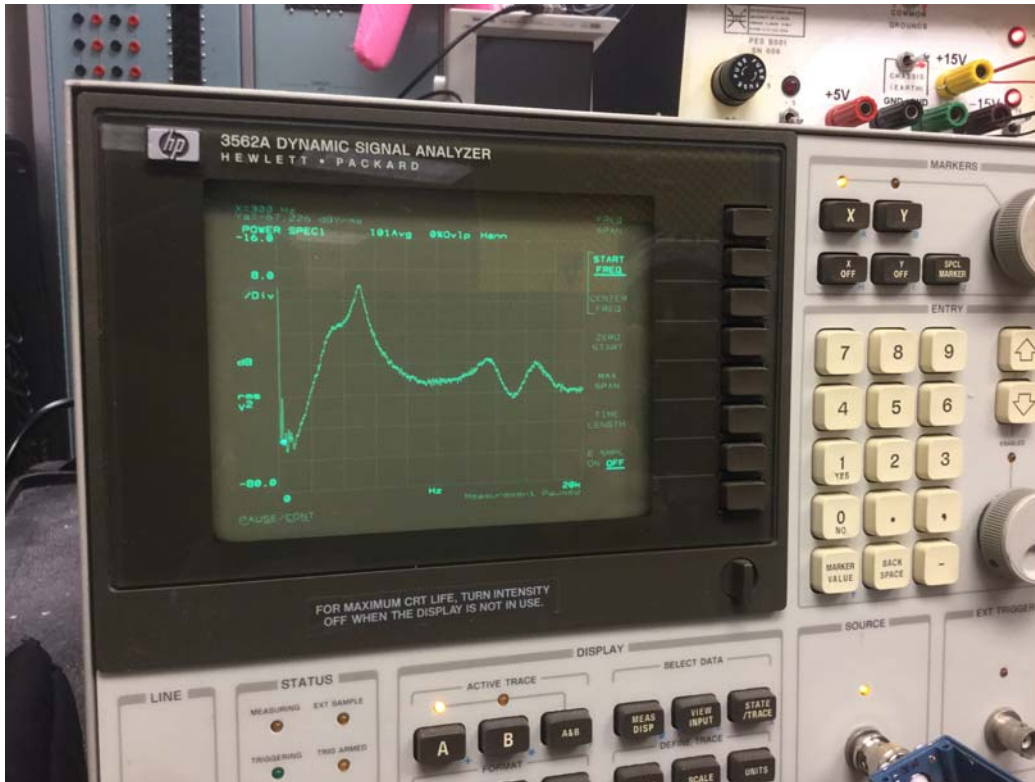


Figure 2
HP-3562A Dynamic Signal Analyzer



Figure 3
SHURE 535
\$500



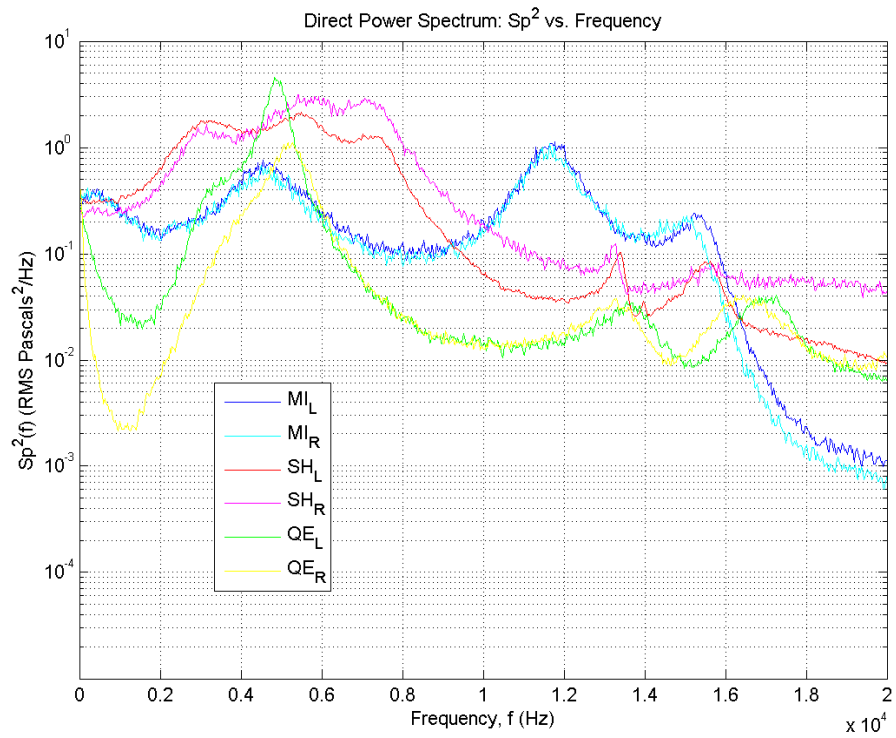
Figure 4
Monster Inspiration
\$100

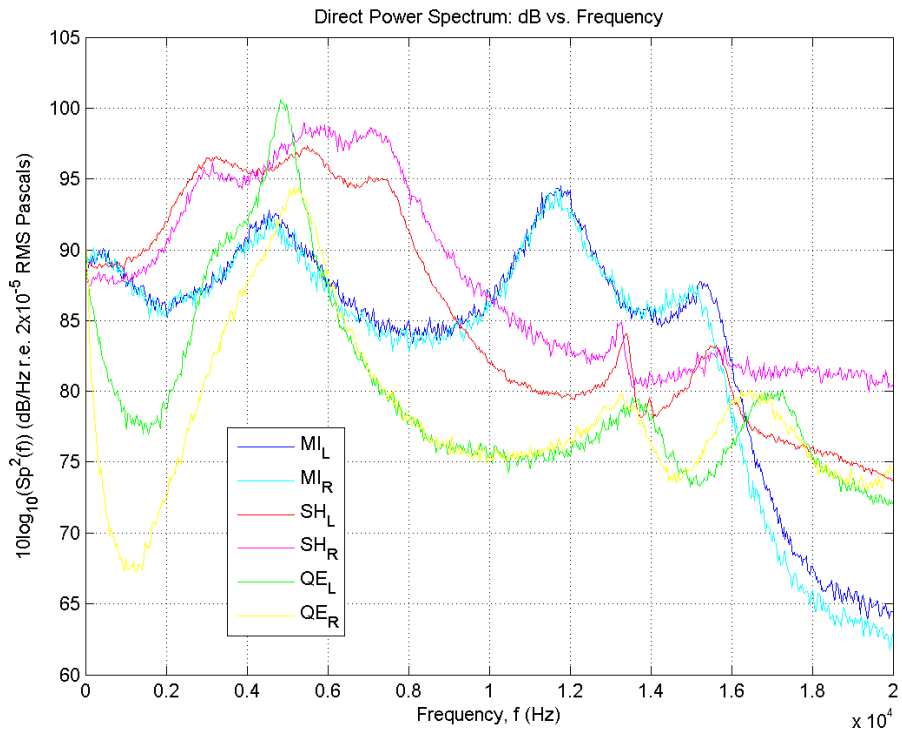
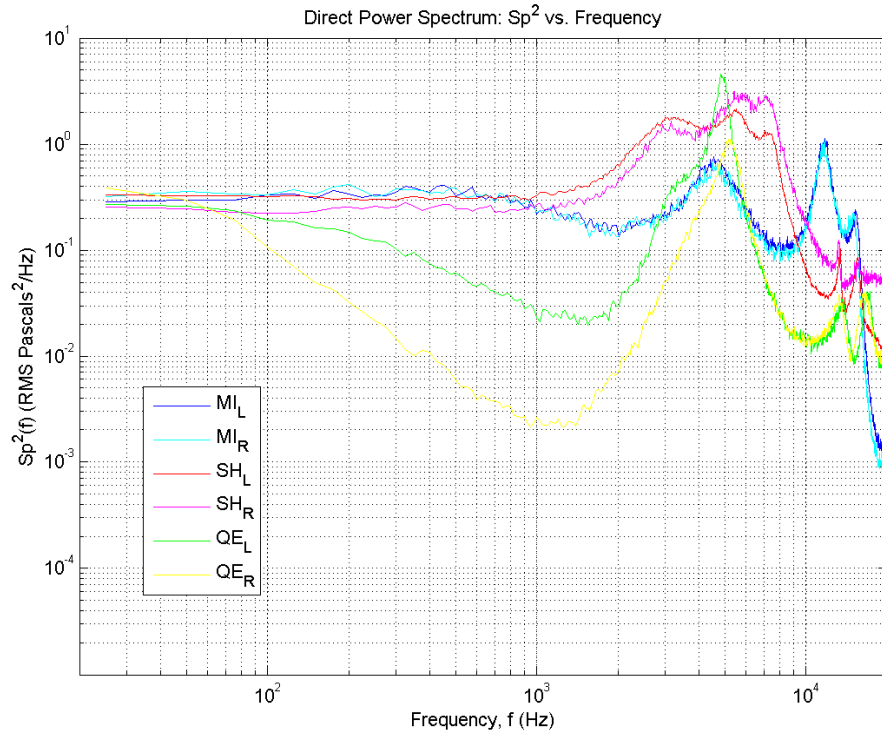


Figure 5
Ear Drops
\$ 10

III. Result

We used two ways to measure the frequency response of these three earphones. The first way is measure it by putting probe directly into the earphone sleeves. The frequency response of three earphones are shown in Fig6, 7, 8, 9.





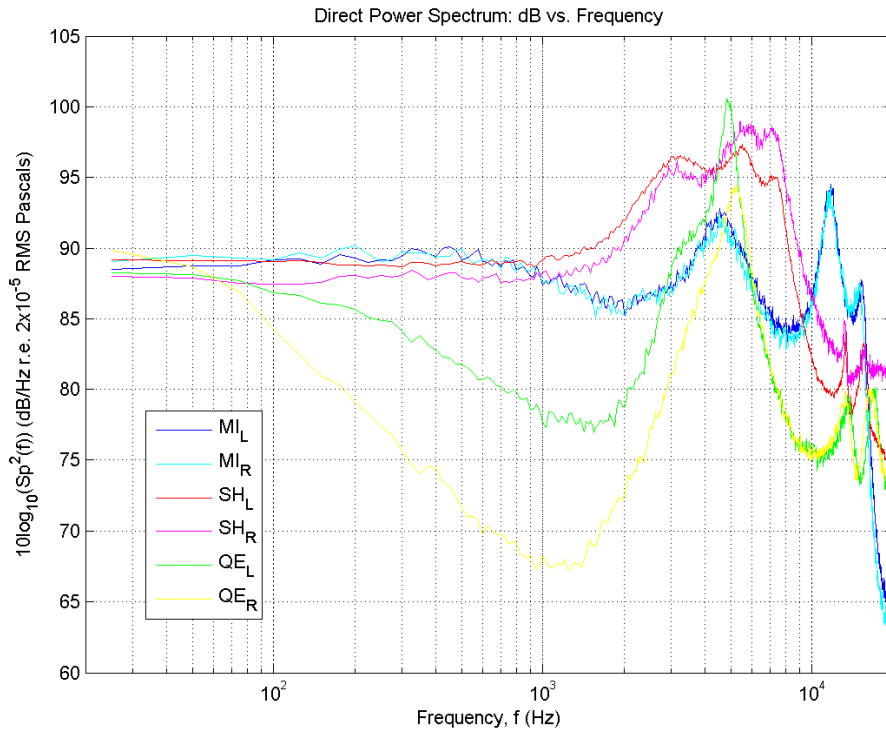


Figure 6, 7, 8, 9

Then we cut off a 5cm long plastic tube simulating human ear canal. And do the measurements again, see Figure 10, 11.



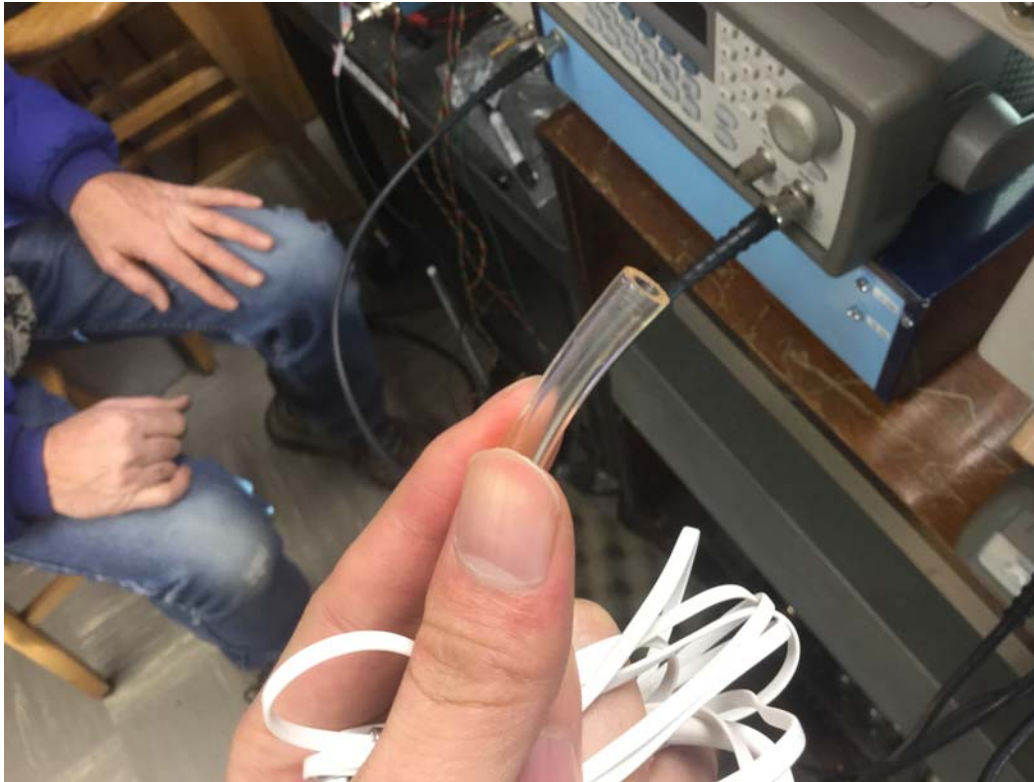
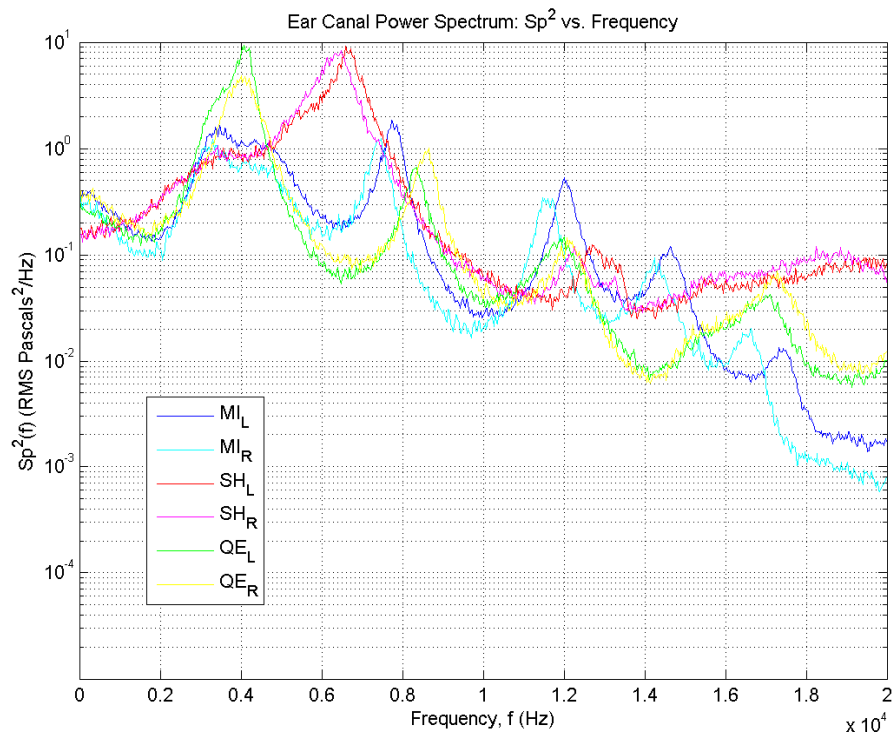
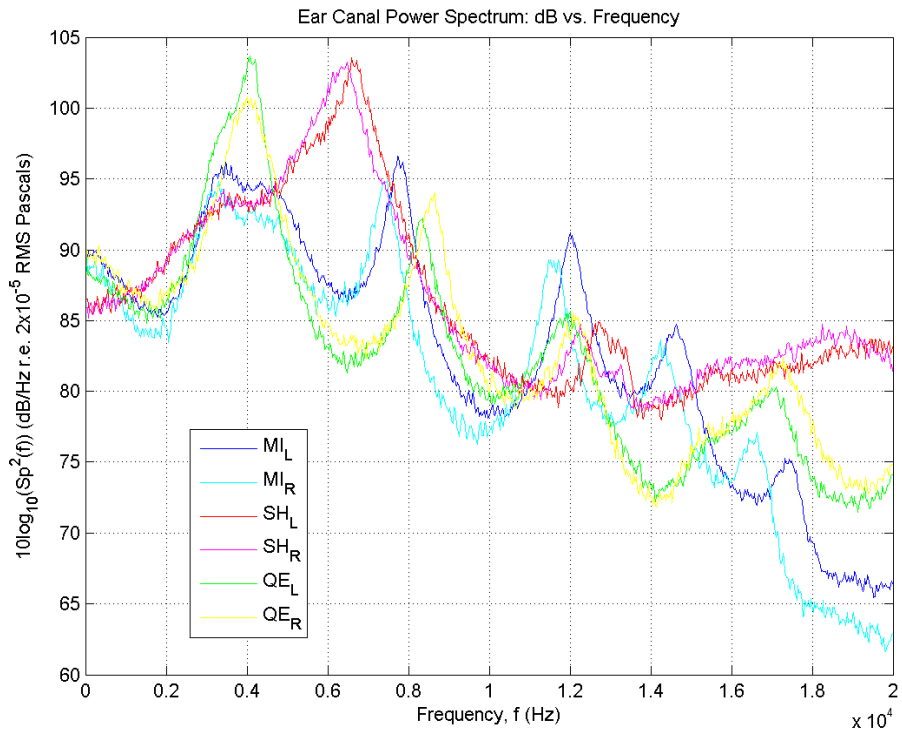
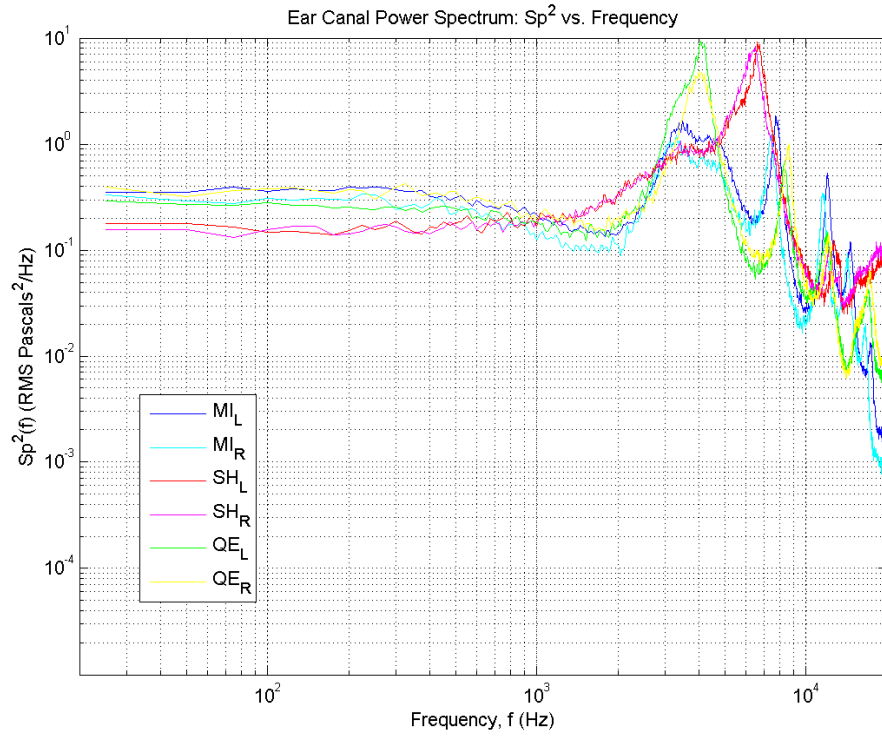


Figure 10, 11.

And this time, all of their frequency response changed a lot. See figures shown below.





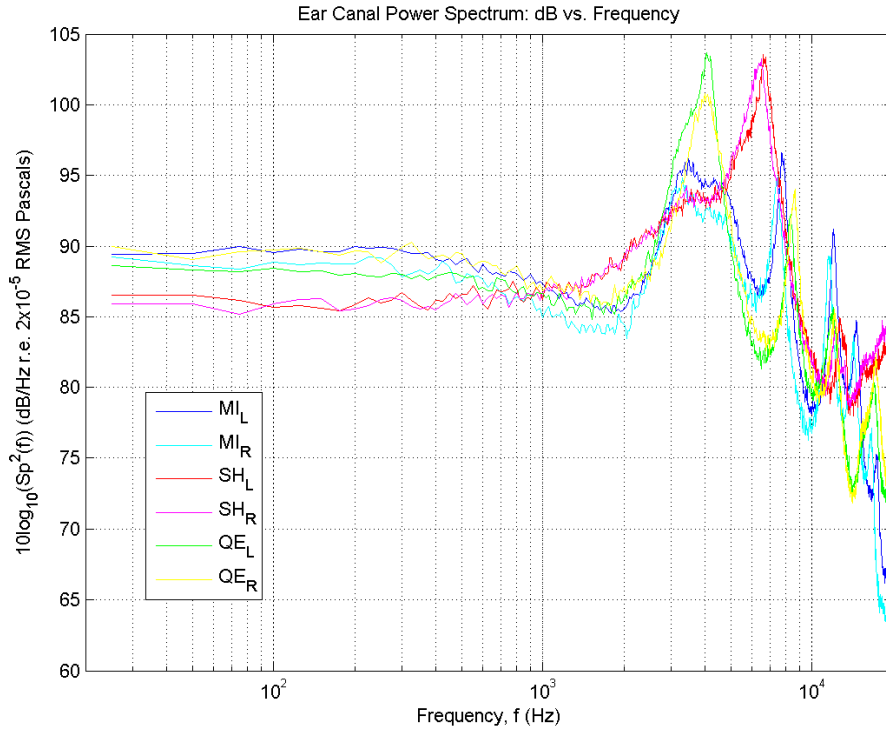


Figure 12, 13, 14, 15.

IV. Conclusion and Acknowledge

From the graph, we see that the Monster Inspiration owns the smoothest frequency response, for which we expect. That means expensive earphones are not always better than cheaper one in any aspects. And another important discovery is that, the ear canal affects the frequency response of a headphone. We can see that frequency response of earphones with simulating canal is smoother than that of earphones without canal.