AES Audio Engineering Society - Pacific Northwest Section

Around the Puget Sound, Seattle, Washington, U.S.A.

February Meeting Notice
Subjective Microphone Comparisons
with
Juergen Wahl
Sennheiser /Neumann Microphones

Co-Sponsored by the AES PNW Section
&
the AES Student Section at the Art Institute of Seattle

Art Institute of Seattle
7:30pm, Monday, February 28, 2005

Directions to Art Institute of Seattle

Abstract

The purpose of this workshop is to analyze the variables that make it so difficult to predict a microphone's performance in actual applications, and to understand why microphones with seemingly identical technical specifications sound differently, even when used under the same circumstances. The seminar will demonstrate how to concentrate on less complex segments of performance behavior. For example, when evaluating electronic performance, we can concentrate on good signal-to-noise ratio, low self-noise during very quite passages, and minimal distortion components in the non-linear operating range. To evaluate the microphone's acoustic behavior we listen for the imaging of instruments, how it captures room acoustic, reverberation, ambience, and distant instruments. When we analyze the tonal characteristic of the microphone under test, we may include the natural frequency response for all instruments, the extended frequency range, the transient response, the uniform polar pattern, the detailed resolution of harmonic components, and how the microphone works together with other microphones.

Introduction

Microphones have been with us for more than 70 years. We have become dependent on their ability to convert acoustic energy into an electrical signal. The design engineers provide us with a long list of specifications for each microphone. This usually includes a detailed explanation of their working principles and operational characteristics. Acoustic and electrical specifications are the basic information available to us. From that, we need to decide which microphone to select for the task that we want to accomplish. The purpose of this discussion is to analyze the variables that make it difficult to predict a microphone's performance. That includes the formidable task to understand why microphones with seemingly identical technical specifications sound differently, even when used under the same circumstances.

Objective tests and evaluations

There is a big gap between the uses of microphones in the "real" audio world when compared to their design and manufacturing environment. We can create an ideal situation for the development of microphones in the laboratory. There is sophisticated test equipment available and the properties of the microphone, as an acoustic transducer system often with sophisticated electronic circuitry, take shape during many generations of prototypes in a laboratory and an anechoic chamber. This situation is far removed from the intended use in a recording studio or in a concert hall. However, we need this controlled and predictable test bed to evaluate our progress and to finalize the design parameters. This R&D environment also allows us to make scientific comparisons between different microphone types and transducer principles. Finally, it is possible to standardize the artificial surroundings and use them for quality assurance. The results, whether published or internal, are very objective.

Real world applications

Naturally, the environment in which performers, artists, talents, Tonmeister, application engineers, and all other microphone users work is anything but standardized. There have always been and still are great difficulties to transpose the engineering data from the specification brochure to the user's world in a comprehensible method - mainly due to the multitude of variables. As an example, we have no universal specification that describes the dynamic behavior or transient response characteristic of a typical studio microphone. Therefore, any attempt to characterize and evaluate the performance of a microphone in the natural acoustic space with real performers must be a matter of very subjective impressions. The question arises: How can we narrow the differences between the purely objective technical specifications and predicted performance characteristics based on those specs, and the seemingly different or unexpected results that we routinely achieve when using the microphones in audio applications?

Subjective microphone evaluations

The key to a meaningful subjective evaluation is the understanding of variables that are in the acoustic environment and the recording chain. We also have to stay away from poetic descriptions, whether complimentary or acidic, that evaluators often use when their technical vocabulary is insufficient to describe the sonic impressions they perceive and would like to convey. Again, the intention of this argument is not to eliminate the variables, but to understand and be aware of their influence on the behavior of the microphone. Let us start with the acoustic environment, for example in a recording studio. There is a ratio of direct to reverberant sound depending on the room and the distance of the mic from the sound source. We recognize that various polar patterns either reduce or take advantage of the acoustic properties in space. No sound source radiates its own frequency spectrum with uniform directivity. The arrangement of the microphone will have a profound affect on the captured tonal spectrum due to its distance and absolute position.

Most microphones work very well and predictably when not stressed past their linear transfer characteristic. During an overall evaluation, it is important to subject the mic to its limits, both at the top of the dynamic range with maximum sound pressure level, and at the extreme low signal level, where noise artifacts eventually will become apparent. Most notable causes for variables are the sound sources themselves. Not all sound sources strain the microphone to the limits of frequency range, frequency response, and transient response. In the lab, we use pink noise, electrical high voltage sparks, and other test signals. However, most musical instruments, including the human voice, cannot produce the range that will stress modern microphones.

A musical instrument that comes close to the mentioned requirements is a grand piano. If we document carefully the circumstances of a test setup, we can repeat and compare most of the elements, necessary for a meaningful evaluation and comparison of different microphones. (There will be a demonstration of such

possible approach during the presentation.) Contrary to a textbook, where all chapters are in sequential order, the laws of physics always work simultaneously. We have to keep that in mind for any microphone evaluation. For example, proximity effect, inverse square law, propagation of sound, speed of plosive sound energy, physical size of the microphone construction, and so on, are all active at the same time. That makes it difficult for the human ear (more the brain's interpretation) to differentiate the unlike contribution of each phenomenon.

To ease with this task we can listen for distinct segments of the overall sonic picture. For example, when evaluating electronic performance, we can concentrate on good signal-to-noise ratio, low self-noise during very quite passages, and distortion components in the non-linear operating range. If we evaluate the mic's acoustic behavior we listen for the imaging of instruments, how it captures room acoustic, reverberation, ambience, and the capture of distant instruments. Separately we analyze the tonal characteristic of the microphone under test. That may include the natural frequency response for all instruments, the extended frequency range, the transient response, the uniform polar pattern, the detailed resolution of harmonic components, and how does the mic blend with other microphones.

It takes some practice to isolate and concentrate the attention on the smaller assignments, especially since they do overlap and interact. However, it is worth the effort, because, after analyzing each of the three clusters, it is usually easier to arrive at a subjective summary that can be a fair evaluation of the microphone.

Summary

A subjective evaluation of microphones is possible, meaningful, and approximates the design engineer's objective, if we are attentive of the variables that may alter our impression during an application test. If we can reduce the variables and keep a record of the setup and other conditions so they can be repeated independently, the evaluation has a significant importance for the user. Finally, such an approach will train the listener to observe detailed microphone characteristics.

Juergen Wahl

Mr. Juergen Wahl holds degrees in electronic engineering and economics. He received his early education in Germany and studied at UC Redlands, UCLA Extension, and CSUN (Northridge) in California. He has been principal applications engineer for Neumann and Sennheiser microphones in the USA for many years.

From early youth his interest focused on electronics and music, which later determined his professional career. For several years, he worked at Thomas Organ on basic research of electronic keyboard instruments. Later he joined the engineering team at UREI where he was involved in the development of audio signal processing equipment, some with now legendary reputation. After additional years with JBL as applications engineer, he joined Gotham Audio. It was in this capacity that he also specialized on the use of microphones.

Mr. Wahl is a Fellow and Life Member of the AES and, until recently, served on the Board of Governors and Membership Committee. He is past chairperson, vice-chair, and committee member of the Los Angeles chapter, and acted as paper session and workshop chair during many AES conventions. As a visiting lecturer, he has presented numerous papers, has given many technical seminars, and conducted workshops for AES chapters and interest groups of diverse backgrounds in the USA, Canada, Latin America, Europe, and the Far East.

He has been with the Aspen Summer Music Festival since he joined the faculty of their Recording Institute in

1989. His lecture tours and Master Classes included most music conservatories, universities, schools for audio engineers, and selected audiences, such as NARAS, the US Air Force, and the Voice of America. Mr. Wahl is a Life Member of the Society of Broadcast Engineers.

Directions

Directions to AIS

117th AES
JJ Johnston PowerPoint Presentations

PowerPoint from Session TS-1: Physics of Sound and Hearing
PowerPoint from October 2004 PNW Section Meeting

Our meetings are open to anyone interested in Audio. AES membership is NOT required for you to attend our meetings.

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