

USING THE EF400 ACOUSTIC ECHO CANCELLER IN ROLL-ABOUT VIDEO CONFERENCING SYSTEMS

INTRODUCTION

Because of its fully automatic adaptation, the EF400 is extremely well suited for use in a roll-about video conferencing system. When you move the system to a new room, you don't have to train the EF400 on the new environment: it will adapt to the new echo path automatically. You don't even have to store different information for different rooms. Even with these capabilities, there are some precautions you should take when designing a roll-about system. The real difficulty with roll-about systems is the tendency to put the microphone very near to the loudspeakers, but (relatively) far away from the users.

THE WAY NOT TO DO IT (AND WHY NOT)

Usually in a roll-about system, a television is on top of the cart, and a video camera is mounted on top of the television. This allows the user to look at the television screen, and appear to be looking into the camera as well. Very often, the television has built in speakers, and the video camera has a built in microphone. The obvious thing is to use the existing speakers and microphone in the audio portion of the conferencing system. Unfortunately, this is not a good setup in terms of audio quality and acoustic gain. We admit it seems like the most convenient solution, but it just won't sound good.

Are You Vacuuming In There?

If the microphone is on top of the television, it is probably about 6 or 8 feet away from the user. Depending on the construction of the room, it is probably about the same distance from an air conditioning vent. Since many video camera microphones are omnidirectional, this means you are picking up the HVAC (not to mention computer fans, outside noise, etc) just as much as you are picking up the user. That's potentially a lot of noise, and could result in a degradation of speech intelligibility.

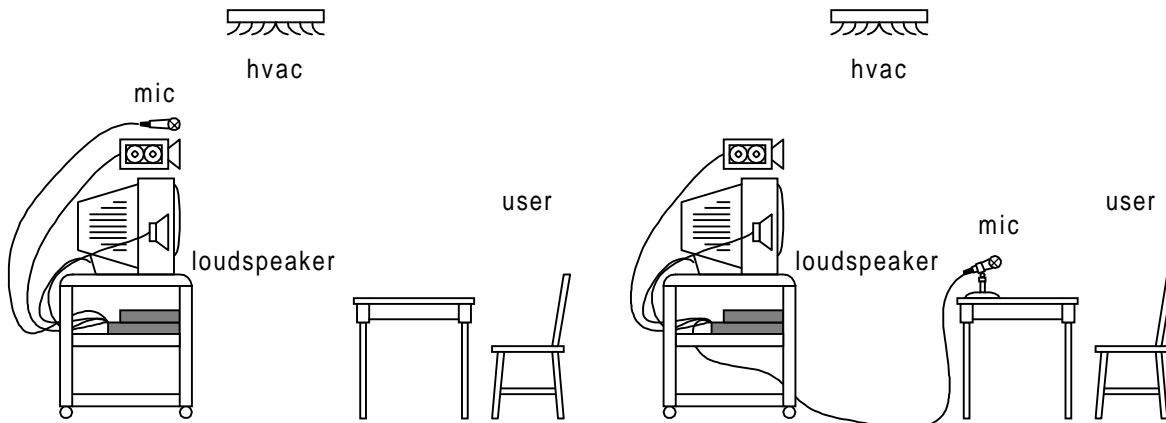


Figure 1a: Bad configuration.

Figure 1b: Good configuration.

Too Close for Comfort

When the microphone is on top of the television, it's only about two feet away from the television's loudspeakers. And it's still about 6 or 8 feet away from the user. The signal the microphone picks up from the loudspeaker will be *very* loud. In fact, it's probably so loud that the acoustic echo canceller won't be able to cancel it. Let's look at an example.

The loudspeaker and microphone are 6 feet away from the user, but the microphone is only two feet away from the loudspeaker. The user wants the signal from the loudspeakers to be at a level of 70 dB SPL by the time it reaches his ears. If you measure the level of the user's speech from 3 feet away, it is also 70 dB SPL. Since the loudspeaker is 3 times closer to the microphone than it is to the user, it is producing a signal level of about 79.5 dB SPL at the microphone. But since the user is 6 feet away from the microphone instead of 3, he is only producing a level of 64 dB SPL at the microphone. This means at the microphone, the loudspeaker is 15.5 dB louder than the user. That's a lot of acoustic gain!

The EF400 can handle up to 10 dB of acoustic gain, and works best below 0 dB. In this system, with over 15 dB of acoustic gain, the EF400 will not converge. Other acoustic echo cancellers on the market are only specified to work up to 0 dB of acoustic gain. Even with the EF400's additional capabilities, you're going to have to do something about reducing the acoustic gain.

You can find out whether you have too much acoustic gain on the EF400 by watching the front panel LED meters. When someone on the remote end talks, the microphone levels show how much of the loudspeaker signal is being picked up by the microphone. Make sure everyone on the local end is quiet. If the microphone levels are much higher than the remote levels while someone on the remote end is talking, you have too much acoustic gain.

THE WAY TO DO IT (AND WHY)

The best way to remedy these problems is to use a microphone that is close to the user (within 3 feet of the person). This will improve the signal-to-noise ratio as well as reduce acoustic coupling between the loudspeaker and microphone. You can still use the loudspeakers that are built into the television, but we definitely recommend moving the microphone closer to the user. It would also be best to use a directional microphone, aimed away from the loudspeakers.

Quieter Than One Of Those Fancy Import Cars

Now that the microphone is only 3 feet away from the user, the user is about twice as loud as he was before at the microphone. This gives you an extra 6 dB of signal-to-noise ratio, because things like HVAC are probably at about the same level where the microphone is now.

No Gain, No Pain

By moving the microphone to 3 feet away from the user, we have improved our acoustic gain situation quite a bit. As in our previous example, the user is providing 70 dB SPL at a distance of 3 feet, which is right at the microphone. The loudspeaker is still 6 feet away from the user, but is now 3 feet away from the microphone. It will produce a level of 76 dB SPL at the microphone, which is only 6 dB louder than the user. We have reduced the acoustic coupling by more than 9 dB. If you use a cardioid (directional) microphone, you will probably end up with less than 0 dB of acoustic gain.