The French Horn vs The Concert Hall

Daryl Caswell
University of Calgary, 2500 University Dr. NW, Calgary, Alberta, T2N 1N4

Summary

The focus of work of this type is to bridge the communication gap between the arts and the sciences (in this case: music and acoustics) in order to bring about effective solutions to difficult problems which neither side can solve independently. The sound reflection problem experienced by the French horn player in a concert hall is an example of this kind of problem. Solutions to the reflection problem presented by the acoustician are most often judged to be inadequate by the musicians. In acoustics, as in most sciences, the common response to criticism from the arts is that until the concerns are expressed in scientific terms there can be no response. A more productive approach is to find the scientific basis behind the criticism and use this new information to both address the concerns of the artist and develop a better solution than could be had without the input of the artist. This paper is an example of the effectiveness of this approach.
The French horn is the only instrument played with the hand placed in the bell and with the bell pointing to the back of the hall. The sound of the horn is therefore affected by the player, his clothing and the back wall of the concert hall before it reaches the audience. The horn player must therefore deal with many unusual variables which are difficult to control. The result is that the horn player has a unique set of playing problems to overcome which are poorly understood by acousticians.

The problems arising from this unique playing position can be separated into three parts: the effect on the standing wave, the problem of reflected vs direct sound and the obvious time delay.

The Jack Singer Concert Hall in Calgary, Alberta was built in 1984. The horn players in the Calgary Philharmonic Orchestra have been complaining of acoustical problems related to excessive time delay, poor tone quality and loss of sound power since the orchestra first moved into the new hall. The attempts of the technicians to remedy the problems have met with little success and seem only to create new problems for the horn players which the technicians are unable to comprehend. The acoustical basis of the concerns of the horn players can be identified as follows:

1. The primary reflections must be early enough to provide a manageable time delay and avoid a loss in sound power.
2. The sound reflectors must return an acceptable balance of high and low frequencies.
3. The sound of the horn must be reflected away from the bell and dispersed into the audience to avoid interference with the standing wave in the horn and to provide the characteristic diffuse sound of the French horn.

An effective solution to the problem resulted from the construction of five reflectors specifically designed to address the concerns of the horn players. With the reflectors in place, the sound of the horn is reflected early but reflected away from the bell of the horn to avoid interference with the standing wave. As well the reflected sound is diffuse. The material and thickness of the reflector gives a well balanced spectrum which is acceptable to the horn players. The improved low frequency reflections eliminate the double attack problem and the loss of sound power by keeping the sound out of the area below the choir loft. The reflectors have been favourably received by the players, the conductor and the recording engineers who all feel that the problems have been solved.
An important by-product of this research is the development of a wavelet based sound analysis technique which uncovers aspects of tone quality that are unavailable by any other method.