Combining voice-lift and performance sound functions at Toronto’s Koerner Hall

The Integrated Sound System

By: Alan Handelman

The hall was built with an awareness of the power of performance to inspire and motivate music students. Koerner Hall was also built to be an exciting new landmark on Toronto’s cultural map, not unlike Lincoln Center in New York with its constituent conservatory, The Juilliard School. Situated in the heart of the city, steps away from the newly renovated Royal Ontario Museum, Koerner Hall is much larger than most school recital halls, yet is only half the size of a typical metropolitan concert hall.

According to the project architect, KPMB, the venue “signals the expanded role of the RCM as a cultural destination for public enjoyment. With its distinctive interior and world-class acoustics, Koerner Hall will create a recognizable icon for the RCM, locally and internationally.” Indeed, Tulas Centre’s facilities extend well beyond those normally associated with educational institutions: It includes three tiers of glass-backed house areas for performers, a café at the ground-floor level, and a unique collection of antique musical instruments donated by Michael Koerner (Koerner, a venture capitalist, is a leading arts donor; he also helped to start Stanley Clarke, and Bela Fleck are among the dozens of headliners featured this year. Koerner Hall achieved the highest possible acoustic rating—N1—rendering it ideal for the finest acoustic performances of classical music, jazz, and world music, but the addition of variable acoustics by the acoustician Bob Essert, of Sound Space Design, makes it equally well-suited to amplified music, lectures, and film presentations. The hall’s design is based on the classical European shoebox format, and features two balcony tiers above the main orchestra level, and a third technical balcony, finished to provide optimal sightlines for live televised broadcasts of performances. The hall’s most visually striking feature is an acoustically transparent veil of twisting oak “strings” that form the backdrop for the chorus at the first balcony level, then hover over the stage below the fixed acoustic canopy and extend into and over the hall at the technical balcony level. The hall’s floors, as well as the balcony seats and fronts, are also finished in natural oak, which contrasts with the undulating black plaster panels that line the hall.

The voice-lift system “Concert halls need public address systems that are separate from any music reinforcement systems they may need,” says Philip Giddings, president of Engineering Harmonics. “Music systems tend to be large and fairly obtrusive, yet if they’re hung in the middle of a beautifully finished concert hall, they can be an eyesore. For announcements prior to or during a recital, or for lectures, you need something smaller and visually unobtrusive.”

To this end, Engineering Harmonics worked with Renkus-Heinz to design a unique, and almost invisible, retractable “voice stick,” comprised of three off-white R-H ICONYX digitally steerable array systems, just a little over 6” high and arranged back-to-back in a circle 120” apart, sandwiched between two ¼”-thick aluminum discs, 18” in diameter and flown over the stage on a three-point hang from the top of the top plate. Readers may recall that a preliminary last of this system, carried out in Toronto’s Roy Thomson Hall,
The voice stick, as seen from the rear of the stage.

was first reported in the August 2007 issue of LSA.)

The voice stick is augmented by two additional IC16 arrays, camou-
flaged behind acoustically transparent fabric in the front walls on either side of the stage.

Each IC16 is comprised of two IC8 enclosures, one mounted on top of the other, to provide sixteen 1” driv-
ers on each of the three sides of the voice-stick. The Iconyx system is unique in that each of the 16 discrete drivers in each array receives an indi-
vividly filtered and delayed signal, enabling the array to produce up to eight independently specified vertical beams and steering angles up to ±30°. Because each IC16 in the voice stick can be configured to produce multiple beams, an upper beam can be aimed to provide coverage for the choir-level seating, while a lower beam can be programmed to cover the balcony seating levels.

In the voice stick’s front-firing IC16, the upper beam radiates directly for-
ward at +3.7°, with a vertical coverage angle of 10° to cover the upper-
level seating; the lower beam radiates downward at -13.5°, again with a coverage angle of 10° vertically, to provide coverage for the seats in the choir at the first balcony level.

In each of the two IC16s mounted in the front wall at either side of the stage, the upper beam radiates ever so slightly downward at -1.5°, within a vertical angle of 10° to provide coverage for the orchestra and parterre-
level; the lower beam is aimed downward at -14°, within a vertical coverage angle of 20°, to provide front fill. (See page 75 for a graphic repre-
sentation of the data.)

Beamline control software communicates with the loudspeakers through an RJ45 (Renaus-Heinz Audio Operations Network) to permit adjust-
ment of coverage, as well as the loudspeakers’ apparent acoustic cen-
ters, while physically moving the array itself, in order to improve local-
ization of the sound source. Power cables and the RHAO control cable are threaded up through the center of the voice stick behind the three Iconyx columns.

“With the voice-lift system, we are trying to provide intelligibility, not sound reinforcement,” Van Dijk says. “In a reinforcement situation, you want the loudspeaker to perform and to have the directivity to project sound energy exactly where the people are sitting. You are not really working with the acoustics of the room—in fact, most of the time the acoustics of the room detract from amplified music. With a voice-lift system, you are working with the directivity to provide the sound energy directly to the ears of the listeners.”

In the voice-lift system, the voice stick is located directly in front of the center of the stage, it works very well with the acoustics of the room, with all the reflections that lift the voice off the stage and make it sound good. The lift and apparent image blend seamlessly; there is no cognitive dissonance due to audio not localizing with the per-
former visually. If I had used a more conventional array, it would have been difficult, if not impossible, to get that lift without hearing it as a point source, with an accompanying tonal shift rising from the loudspeaker itself imparting its own character to the sound, by virtue of its geometry and size.

The sound-reinforcement system

The sound-reinforcement system for amplified performances consists of a single retractable center-line array comprising eight JBL Vertec VT4887A compact bi-amped three-way loudspeaker systems, augmented by two VarVox VT4887A subwoofers hung in the canopy.

The Vertac center cluster covers a portion of the orchestra level and the way up to the top balcony. Coverage for the front of the orchestra is provid-
ed by seven Renkus-Heinz SGX41 loudspeakers concealed in the stage lip, or, alternatively, eight SGX41s in the tip of the lift that is deployed. The SGX41 loudspeaker was selected because it uses the same coaxial transducer as the Iconyx IC16, and is therefore an appropriate match to the main system.

Two Renkus Heinz SGX121s, mounted in the catwalk, provide delayed over-balcony fill, as do a pair of Tannoy CMS101Dca loudspeakers at the sides of the parterre level. All passive loudspeakers are powered by Crown IC Series amplifiers.

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um,” Giddings says. “And the inte-
gration of the sound-reinforcement
and voice-lift systems is nothing
short of brilliant.”

The house mix position and sound control room
Yet another design innovation was the
preparation for a permanent mix posi-
tion at the rear of the parterre level on
the centerline, just steps from the
door to the sound control room locat-
ed house right of the centerline (sym-
metrical with the lighting control room situated
house left of the centerline).

The house mix position comprises a
wheelie dolly for sound equipment,
blood and houses its line for
microphones, analog and digital audio
including CAT 6 and fiber-optic cable,
and a wheeled dolly for sound equipment,
microphones, analog and digital audio
as archiving. Two Sennheiser MKH-
416 shotgun microphones suspended
from the catwalk provide a program
sound feed, which is split into a USB
microphone preamplifier connected to
the sound control room, with the
exception of hearing-assistance trans-
mitters and amplifiers that power
passive loudspeakers with the associ-
dated DSP. These are housed in an
amp rack room on the fourth level
next to the dimmer room.

“They expended the money and
effort to have a permanent mix posi-
tion—something that is missed on so
many projects—which we strongly rec-
ommend and coordinated closely
with the architect,” says Van Dijk. “It’s
fantastic, because it accommodates
touring professionals who may be
unfamiliar with the venue, giving them
a comfortable place to mix that’s right
next to the dimmer room.

“Secondly, for a teaching facility, it’s
preferable that the house mix position
is always there,” he says, “People can
come in and work with whatever is
going on in the venue, and get a good
sense of what they’re doing. You could
sit in a control booth and be teaching
someone about sound, but it’s not the
same as being immersed in the sound
environment and hearing it naturally.
You can’t really learn about sound very
well when you’re removed from it in a
booth. Now students can go back and
forth from the mix position to the
booth, where the main equipment is
housed. Alternatively, they can do
smaller reinforced events from the
booth. We’ve tried to integrate the
monitors—which are properly delayed
to coincide with arrival times from the
stage—so that the monitoring level
reflects what’s going on in the hall, and
they get a sense of accurate levels.
It’s too loud in the booth, it’s probably
too loud in the hall.”

A four-channel monitor feed is
derived from the Soundcraft Si3 64-
input digital house mixing console;
there is no separate monitor console or
large splitter system that would be
required to go along with it.

Additionally, the Si3 allows saving and
calling back of shows as necessary.

“For budget reasons, we originally
specified a Yamaha MTCL, one of the
most commonly encountered digital
consols,” says Van Dijk. “Due to the
price-performance design, it doesn’t
offer all the bells and whistles that
touring professionals might want to
use. Granted, many of these people
will bring in their own console, but,
from a facilities standpoint, the client
wanted something with improved
microphone preamp performance.
The Si3 was born of the Studer Vista
series consoles, and you definitely
hear that sound quality. The Yamaha
MTCL offers a fantastic feature set,
but it’s too much of a good thing. We’ve
tried to make it as budget friendly as
possible.”

Yet another design innovation was the
incorporation of net two rking infras tructure for
the things to plug into it.”

In future, they see real-time musi-
cal collaboration as a reality. To make
it as close to real-time as possible,
they’ll be using a dedicated data path
and will know exactly what the propa-
gation time is. This is the Telus Centre,
after all, and Telus has guaranteed a
500km away, and you’ll hear it in
all the acoustic splendor of Koerner
Hall,” Van Dijk explains.

“The house mix position provides
for hard drive immediately. Van Dijk
says “I love the XPCs because they’re
quiet; you can put them in the room
with you and they work.”

A broadcast-quality Hitachi DK-432
camera feeds an HD signal via HD
modulators to flat panel displays
deployed in the lobbies and back of
to hard drive immediately. Van Dijk
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A broadcast-quality Hitachi DK-432
camera feeds an HD signal via HD
modulators to flat panel displays
deployed in the lobbies and back of
house, and to a low-noise Dell PC,
which is fitted with an Eton HDE2-
ACR 100 video capture card and sim-
plic recording software for archiving.

This setup permits capture of a high-
quality stereo audio and video feed of
a recital or concert, which can be
augmented to a high-definition image.
Digital signage content will
provide an impressive broadcast quality
image.

A further requirement was the capa-
ibility of recording in-house recitals and
events for practice and review, as well
as archiving. Two Sennheiser MKH-
416 shotgun microphones suspended
from the catwalk provide a program
sound feed, which is split into a USB
microphone preamplifier connected to
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