

Flexible Acoustic Control at Cornerstone Arts Center

By Mel Lambert

Putting Meyer Sound's Constellation to work at a multipurpose venue



With more than 30 Constellation installations around the world, Meyer Sound may be onto something innovative. As the recent system now in use at Colorado College's new Cornerstone Arts Center demonstrates, flexibility is a major key to the success of any processor-assisted acoustic environment. As an alternative to conventional acoustic solutions, which range from movable reflective/absorbent surfaces through powered drape systems to removable shell schemes and/or secondary chambers, Meyer's Constellation electroacoustic architecture offers user-configurable control of early reflections and reverberation parameters. Constellation also provides the ability to create different audio environments for stage performers and the viewing audience.

The recently completed Edith Kinney Gaylord Cornerstone Arts Center includes several instructional and performance spaces, the largest

of which is the 450-seat interdisciplinary South Theatre. Here, audiences enjoy a wide variety of educational and cultural events, ranging from lectures and plays to orchestral concerts and dance recitals. Colorado College is a private, four-year, co-educational liberal arts and sciences college based in Colorado Springs.

"South Theatre is an interdisciplinary facility that has to accommodate drama and music performances," explains Michael Grace, professor of music and a delegate from the college's music department during the planning stages. "As such, it needs to provide acoustic environments that are suitable for choral, orchestral, and operatic events, as well as plays and the like. We looked at a number of alternatives and, after discussions with the architects and acoustical consultants, opted for Constellation as presenting the most cost-effective and flexible design for our new space." The

architect of record for the \$33.4-million project—named after its beneficent donor—was Antoine Predock, with D. L. Adams Associates serving as consultants in acoustics and performing arts technologies; audio installation was by CEAVCO Audio Visual.

"At the outset, the college faced a major challenge for the South Theatre," says Edward Logsdon, D. L. Adams' principal in charge of the project. "Different people wanted the space to do different things. The theatre department was most outspoken; they outlined production styles planned for the room. Then the music department told us that they needed the room for student recitals and for the annual summer music festival. Acoustically, we were looking at completely opposing requirements. That pointed us in the direction of an electroacoustical solution."

Constellation is derived from the patented Variable Room Acoustic System (VRAS) developed by LCS Audio, a firm purchased by Meyer Sound in 2005. In early 2006, Logsdon invited an admittedly skeptical delegation from the college to hear a VRAS system installed at the 800-seat Vernon and District Performing Arts Center, a similar facility in British Columbia. "I was enthusiastic about what I'd heard," Grace recalls, "and supported moving forward with such a system." For the South Theatre project, Logsdon says that he evaluated four different electronic systems before settling on a Meyer design that would involve two distinct control zones: one for the audience area, and the other for the stage as a "virtual orchestral shell."

According to Steve Ellison, co-founder of LCS Audio and currently Meyer Sound's applications director, LCS Series, "Working closely with Edward Logsdon and Stephanie Adams-Ball [from D. L. Adams], we

designed a Constellation system that offers the full suite of features. First, we wanted the system to enrich the audience's acoustical experience of musical performance by offering three different settings, with wide-bandwidth RT60s from just under one second—in the 'off' position—to over 2.5 seconds, which is very long. The new system also enhances the experience for musicians on stage through Constellation Ensemble, an integrated electronic orchestra shell that provides early reflections and reverberation to the stage area. Additionally, two different VoiceLift settings were included: a Stage VoiceLift, to allow lecturers to be heard more clearly without wearing microphones, and a Global VoiceLift, to enhance two-way communication between lecturers and students."

The Constellation rig for South Theatre includes eight cardioid microphones mounted over the stage area, and 16 omnidirectional microphones suspended above the audience, to capture the room's acoustic energy. "The system includes one MS-Constellation and three MS-VRAS processors," Ellison adds. "These generate carefully balanced early reflections and reverberation through a total of seven UMS-1P subwoofers and 53 MM-4XP miniature loudspeakers." These are located at pre-calculated positions throughout the room in order to provide balanced energy distribution while minimizing any perceived localization. "The [loudspeaker] signals are regenerated in the room through Constellation to create a natural-sounding extension of the room's physical acoustics," the applications director stresses. Constellation is a fully integrated turnkey solution that includes support as well as equipment. Each installation is tailored to the characteristics and demands of the venue; Constellation is described as scalable, making it suitable for venues of variable size and type.

Acoustic coverage for larger environments requires additional microphones and loudspeakers. "For instance," Ellison continues, "the Constellation system installed at the

1,400-seat Laboral Ciudad de la Cultura in Gijon, Spain, uses 40 microphones, 119 loudspeakers, and seven processors. Constellation systems that are integrated with audio show control designs, such as Cirque du Soleil's *Love*, are even more extensive. While the maximum size with our current processor is 280-by-400, the new D-Mitri core [available Q1 2010 with AVB networking and a second-generation VRAS algorithm] will accommodate virtually an unlimited number of transducers," using a 96kHz sample rate and 24-bit A/D/A conversion with up to 64-bit floating-point processing.

"The number of channels and loudspeakers," the applications director explains, "depends upon a number of key parameters. The first consideration is the size of the venue, and its natural reverberation time. If the RT60 is between 1.3 and 1.5 seconds—a typical auditorium—we will need to include fewer loudspeaker channels than would be required, for example, with a more dead acoustic. The number of microphones and loudspeakers depends upon the required power gain and reverberation times.

"The physical layout of the transducers is constrained by the Reverb Radius, which determines minimum distances between microphones and loudspeakers, mics and sound sources, and loudspeakers and the audience. As Reverb Radius increases, the power requirement of the loud-

speakers also increases. Maximum reverberant gain is proportional to power gain; maximum power gain is proportional to channel count, or the minimum of the number of mics and loudspeakers. Increasing the number of loudspeakers decreases the amount of energy that goes through any individual loudspeaker, and hence reduces the likelihood of localization."

The choice of which Meyer loudspeakers will be used is determined by the system designer, and depends upon the power, frequency range, and coverage pattern required to properly and completely envelop the space. "We design systems to support a reverberant level of 105dB throughout the auditorium," Ellison continues, "which again determines the number and choice of loudspeaker models. Any Meyer speaker can be used in the design of a Constellation system; the mixture of MM-4XPs, Stella Series, and our subwoofers is dependent upon the size and coverage required in the audience and stage areas. Small 4" Stella-4s might be used for under-balcony locations, whereas wide-coverage UPJ or UPJunior units might be required to deliver higher output levels. We have a lot of experience with outfitting a number of spaces, and can recommend a system configuration that will fulfill the design's specific requirements. After the Constellation system has been installed, a Meyer crew calibrates the configuration and



Photos: Timothy Hursley

then voices it in conjunction with the consultant and customer."

"The Constellation system's processor rack was installed in the South Theatre's AV equipment room located close to the FOH mix position," recalls Ben Gleason from CEAVCO Audio Visual. "All of the microphones and loudspeaker locations were specified by the master design. The height of mics located above the stage area was of critical importance." The MM-4 XP miniature self-powered loudspeakers are designed to be DC-powered via Belden five-core cable. A 32-channel Soundcraft GB8 analog console, augmented by DVD and CD players, plus an outboard effects rack, handles conventional mixing duties.

Four of the seven Meyer UMS-SM subwoofers are located in a curve within the catwalk above the stage thrust, with the remaining three above the audience. "The subwoofers are essential for the performers and audience," Logsdon says, "since they augment

the low-frequency output of the smaller MM-4XP cabinets, which feature a single 4" driver." For other installations, designers can choose from a range of Meyer Sound loudspeakers, including the new MM-10 miniature subwoofer and Stella Series circular units.

Explaining the rationale for referring to the stage shell as a "virtual environment," Stephanie A. Adams-Ball, project manager for D. L. Adams Associates, offers a simple analogy: "A typical stage orchestra shell is made up of side walls, a rear wall, and ceiling reflectors placed near the performers. The shell reflects sound to the audience, as well as helping performers hear themselves and one another. In the case of the South Theatre, the microphones act as the receiving wall and ceiling surfaces, while the loudspeakers act as the reflections/reverberation off those surfaces. That is why we refer to it as a virtual shell." All three rows of speakers and microphones mounted over the stage

can also be flown up when the stage-enhancement system is not being used.

The comprehensive system-commissioning process, performed by D. L. Adams Associates and representatives from Meyer Sound's Constellation team, made extensive use of live musicians on stage, including orchestra rehearsals and invitation-only performances. "This allowed ample time for the critical 'by ear' adjustments that would seamlessly blend Constellation's augmented reverberation with the room's own characteristics," Logsdon says. "As a result, the intimate 450-seat theatre—with a nominal reverberation time of 0.9 seconds—nevertheless provides superb acoustical ambience for any orchestral performance."

"We provided the theatre with an initial set of presets that we thought would handle most situations," Adams-Ball says. "After a year's experience with the system, that number has been expanded to offer more flexi-

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bility. We preferred to offer a basic set that can be used to familiarize the average user with what we consider to be the most useful settings, and then let the college staff come to us again when they had developed a wish list of additional parameters that are now labeled according to the event being staged. Constellation is very powerful in that respect, but we prefer clients to walk before they can run!

"During our return visit with Meyer technical staff, we asked the college to provide a number of different sound sources, ranging from a solo piano, singers, and violinists, to a bluegrass band. During the five-hour session, we were able to refine level and reverb settings so that the stage musicians and audience members could be provided with a number of additional settings. Are there enough? There seems to be, although we hear that the staff tend to use three or four more frequently than some of the others."

Colorado College's Constellation



The center's production staff. Left to right: Dave Armstrong, director of ITS media user, and telecom services; Randy Babb, director of media services; Thos Lesser, special events technical supervisor; Jason Taylor, audio visual support technician; and Dan Wiencek, media services coordinator.

made its public debut at the opening concert of the 2008 Summer Music Festival, with a program that included Beethoven's magnificent Ninth Symphony. "The sound in the audience is wonderful," Grace reports. "The adjustment range works well for nearly any performance group. In addition to

the opening orchestral concert, I have also heard solo singers, chamber music groups, and two-piano ensembles, and they all sounded good."

One of the pianists was his wife Susan Grace, an artist-in-residence and music director for the festival. "It doesn't sound electronically enhanced," she

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says of the theater's Constellation system, "but rather like the hall has natural acoustics. As a performer on stage, I was very pleased with the presence of the sound."

Logsdon's faith in Meyer Sound's electroacoustic architecture was primarily justified by the fact that members of the audience remain blissfully unaware of the system's existence. "With Constellation, you really cannot tell that it's there—unless you suddenly turn it off," he observes. "The general public at the concerts I attended had no clue [that the electronic system was in operation]. It was just one standing ovation after another. That's all we wanted to hear!"

"Most new venues are being built to be multipurpose," says John Meyer, Meyer Sound's president/CEO, "while existing ones are broadening their scope of events. This [need for multi-functionality] creates new demands on venue acoustics that call for a new way of approaching them. Constellation is a powerful and carefully considered response to the formidable acoustical needs of multipurpose venues." 

Mel Lambert has been intimately involved with production industries on both sides of the Atlantic for more years than he cares to remember. He is now principal of Media&Marketing, a Los Angeles-based consulting service for the professional audio industry, and can be reached at mel.lambert@MEDIAandMARKETING.com; +1/818.558-3924.

Constellation Electroacoustic Architecture: A Technical Overview

Meyer Sound's Constellation was developed to provide multipurpose performance venues with the ability to create appropriate acoustics for a wide range of musical, operatic, dramatic, and theatrical events, each of which are accessible via a single key-stroke. The fully scalable system integrates design, calibration, and certification with a flexible hardware and software package: It was designed specifically to bring the acoustics of the world's finest concert halls and performance spaces to a wide range of venues, at a fraction of the cost of physical modifications.

Constellation's core technologies were innovated by Level Control Systems, using algorithms developed by Dr. Mark Poletti, of The University of Auckland, and subsequently licensed to LCS by Industrial Research Limited, a research enterprise that funds and exploits the commercial potential of scientific and engineering developments. Poletti's Variable Room Acoustic System/VRAS algorithms, which are used within each VRAS module developed by LCS for the original Matrix3 system, produce realistic-sounding early reflections plus complex reverberation patterns. When Meyer Sound acquired LCS in November 2005, additional resources were available to extend VRAS technology; Constellation was launched in October 2006, and incorporates Meyer-brand loudspeakers plus microphones developed specifically for the system.

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A series of precision microphones located at critical locations within the space connect to a processor engine where separate first-reflection and reverb algorithms are used to develop output signals appropriate for an array of high-performance loudspeakers mounted above and/or around the perimeter. These signals are intended to augment the existing acoustics of a space to create a simulated environment with natural characteristics and enhanced flexibility. Unlike mechanical solutions that involve movable reflective/absorbent surfaces, powered drape systems, removable shell schemes and/or secondary chambers, Constellation can produce an unlimited number of acoustical signatures, from basic VoiceLift, to improve vocal intelligibility, through extended RT60s, which are appropriate for larger auditoria. Constellation playback loudspeakers can also be used as part of an existing sound-reinforcement system.

Constellation is said to provide both audience and performers with the optimum acoustical characteristics for a lecture, theatrical production, music concert, or other event. For the audience, a music concert in a multipurpose venue can be augmented to offer the "warmth" and resonance of a concert hall, while a play in the same space exhibits increased intelligibility. By mounting loudspeakers within the stage performance area—and using a discrete-ensemble, zone-based acoustic setting—the system creates an on-stage acoustical experience for musicians.

Based on technology from the LCS Series Matrix3, the Constellation core employs VRAS processing in combination with self-powered loudspeakers and certified microphones. One MS-


VRAS processor is required for each zone in a multizone system; expansion processors with eight-input/16-output and 16-in/eight-out configurations are available for additional inputs and outputs. System control is via an intuitive PC-based interface.

In addition to "bread-and-butter" early-reflection and reverb settings, advanced user modes include:

VoiceLift, which improves intelligibility in applications where groups of people need to understand presenters clearly, without having to directly mic the participants. It provides power gain and early reflections that are said to be critical in bringing presence and immediacy to spoken-word presentations.

Ensemble, which provides an electronic version of the traditional orchestra shell to help performers hear their fellow performers and everything happening onstage.

Experience, which provides acoustic soundscapes as a tool for sound designers to embellish the acoustic feel for their productions. It can integrate with existing Meyer Sound reinforcement systems and Matrix3 audio show control systems.

The recently announced D-Mitri digital audio platform replaces the original Matrix3 core, and now offers 24-bit A/D/A conversion at a 96kHz sample rate, with up to 64-bit floating-point processing and a second-generation VRAS algorithm. A Gigabit networked environment utilizes open systems, including AVB, OSC, and Python scripting. Other new features include surround playback in any number of channels and simultaneous multichannel recording/playback. 

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