# TOP-TIER EDUCATION FOR STUDENTS

## STANFORD UNIVERSITY CREATES A DYNAMIC PERFORMING ARTS VENUE.

BY JIM STOKES

Stanford University's Cubberley Auditorium, located in the graduate school of education, is a 390-seat space used for a number of purposes, including teaching, film, dance and performance. Accordingly, there was a need to significantly upgrade the existing sound-reinforcement system and install complete multichannel cinema audio and projection systems.

We'll be covering a lot of facets to the project, but first some background about Stanford, which is one of the world's leading research universities. It's known for its entrepreneurial character, drawn from the legacy of its founders, Jane and Leland Stanford, and its relationship to Silicon Valley.

View from the stage, showing rear, side and ceiling surround speakers, and dual 15-inch surround subwoofers.

Areas of excellence range from the humanities to social sciences to engineering and the sciences. Stanford is located in California's Bay Area, one of the most intellectually dynamic and culturally diverse areas of the US. Ray Dolby, whose namesake cinema technology is our subject, received a Bachelor of Science degree in electrical engineering in 1957 from Stanford.

### Birth Of A University

Let's go back to 1876, when California Governor Leland Stanford purchased 650 acres of Rancho Francisquito for a country home and began the development of his famous Palo Alto Stock Farm. He later bought adjoining properties totaling more than 8000 acres. The little town of Palo Alto (tall stick) emerged near the land. Named after a giant California redwood, the tree itself is still there and would later become the university's symbol and centerpiece of its official seal.

Leland Stanford, who grew up and studied law in New York, moved west after the Gold Rush and made his fortune in the railroads. He and his wife, Jane, had one son, Leland Jr., who died of typhoid fever in 1884. This traumatic event spurred the Stanfords to make the dedication: "The children of California shall be our children." They quickly set about finding a lasting way to memorialize their beloved son.

Ultimately, they decided to establish two institutions in Leland Junior's name: their namesake University and a museum. Furthermore, the university would be co-educational and nondenominational. Thus, on October 1, 1891, Stanford University opened its doors after six years of planning and building. The Stanfords engaged Frederick Law Olmsted, the famed landscape architect who created New York City's Central Park, to design the physical plan for the university. The collaboration was contentious, but finally resulted in an organization of quadrangles on an east-west axis. Today, as Stanford University continues to expand, the university's architects attempt to respect those original plans.

The facility's stellar AV attractions include a Dolby Labs 48-channel Atmos digital surround sound cinema audio system, SLS surround sound speakers and a Christie CP4220 4K DLP digital cinema projector. Tailored Technology (www.tailoredtechnology.com), San Jose CA, was the integration company. Our interviewee will be President Eric Hudgens. Ryan Hudgens and Stuart Nuttman, classroom technology specialists at Stanford, offer their perspective on the project. The Stanford tech support staff was responsible for the installation, under supervision of Eric Hudgens. (Ryan is Eric's son, which makes AV a generational family interest and business. More on that in a sidebar. To avoid name confusion, we will differentiate between father and son by first name or complete name.)

"You can't be more exacting than Dolby Labs!" exclaimed Eric Hudgens. "From the onset of the Stanford Cubberley project, Dolby Labs held us to the most demanding specifications that any audio project could attempt to meet. We took a lovely old 1935 auditorium and converted it into a multipurpose, 38,000 watt digital thrill ride.

"Timewise, it was exactly 90 days for the design phase," he added, "and for the install it was also 90 days, ironically."

On the Dolby and SLS side of the house, audio system design was a team effort among the following personnel: R. Bob Adams, SLS Technical Communications Manager; Rod Falconer, SLS Pro Audio Sales Manager, Worldwide; and Jose Castellon, Dolby Senior Applications Engineer, who directed and supervised the Atmos component. Overseeing the project was Andrew Poulain, Director of Cinema Products at Dolby Labs. We will feature comments from Dolby and SLS personnel, as well.

## Overview

The team discovered that the only blueprints of the room were from 1982, scanned from the originals, though multiple modifications had been made over the years. Many architectural constraints limited the speaker placement. As additional details of the building's construction emerged, a number of system-design modifications were made, each of which was examined from the perspective of its effect on the overall performance of the system.

Gary Meissner, Dolby Senior Applications Engineer, configured the BLU Link Network, including linking and programming the BSS DSP and Crown amplifiers, and tuning and commissioning the Dolby CP850 Atmos surround processor. "This was certainly a very complex install with the triple-purpose nature of the system," he said. "Most of the commissioning time was devoted to getting this complex system tuned for all the different modes. The workmanship of the install was incredible. Very clean, and we only had one wiring error in all, with 47 separate speaker feeds. The end result is certainly an amazing-sounding system that can handle anything they want to throw at it."

Falconer used EASERA SysTune to tune the room's sound-reinforcement system via the BSS BLU-160 DSP. He noted that, once the system was dialed in, quite a bit of time was spent critically listening to various Atmos and hi-res audio tracks, with lots of positive comments. "The Stanford staff was very happy with the results and they were anxious to show off the system," he said. "The system sounds very accurate and powerful, and a number of people commented, 'Very smooth, transparent and open. Very good bass response. The system will get much louder than necessary'." In summary, Falconer asserted that it's a balanced, powerful, impressive system.

## More About System Tuning

Integrator Hudgens added more insight into the tuning process. "The system used for manual tuning within the BSS for driver correction, crossover alignment and parametric EQ for all non-cinema sources was Rational Acoustics Smaart 7 using six microphones in real-time live-average mode. The final tune on the Dolby CP850 processor for all cinema playback going through the CP850 was done using the Dolby Auto EQ system with Dolby DAD software. This is a high-resolution Dolby Lake filter bank, which used sweep tones with the same six-mic setup, but using Dolby's own software to calculate the filter coefficients for the Lake filter bank with better than 1/20 octave resolution.

"For PA tuning, EASERA SysTune was used. [Specifically,] DAD is the Dolby Atmos Designer software that we use to make

the DAC Atmos Configuration file that tells the CP850 processor the size and shape of the room, the number and locations of all the speakers, and which output feeds each one. This software also includes the Auto EQ system and adds the EQ parameters to the DAC file."

### Room Layout Challenges

As can be surmised, Dolby speaker layout was a challenge for the integrator. "You've got Dolby telling you precisely where the speakers must be with very little latitude," said Hudgens. "But then we have a sprinkler head, a light fixture and an acoustic panel in the way. So we did what we could to move things about and recalculate the Dolby layout. We had to do that a few times, asking each time for an option. There was a redesign phase where they recalculated. It went through three departments for approval. Finally, we got it."

Specifically, Hudgens noted that the biggest challenge for the integrator concerned the critical placement of the stage left/right side-channel column speakers, which are comprised of two bolted-together, skinny, seven-foot, vertically stacked, SLS CPC1212s for a towering height of 14 feet. "They're quite heavy," explained Hudgens, "and Dolby was absolutely demanding on the precise angles each of the four cabinets should have. We were then asked to tilt the lower ones at a vertical angle that's considerably different from the top one. Thus, the angles were very complex." The CPC1212s have a dual function as lecture/voice for the sound-reinforcement/PA system and right/left cinema surround without feedback in the Atmos playback mode.

## Father & Son Stanford University Project

Ryan Hudgens has been has been working in AV with his father "since I was three years old. I'm used to it. It's great." Therefore, the Stanford project was another opportunity to work with dad Eric, President of Tailored Technology. "I was happy that he was selected to do this project," said Ryan, who is a classroom technology specialist at Stanford.

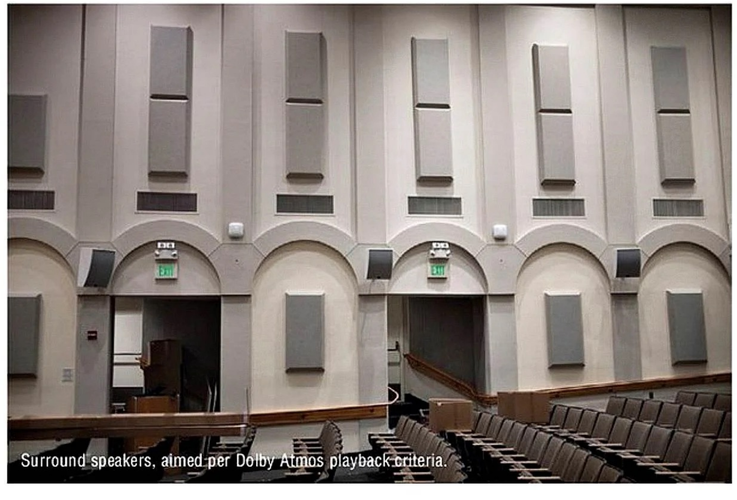
"It started with me being a single parent," said Eric. "Being a business owner and operator, Ryan spent a lot of time with me. My retail high-end audio store in Cupertino was very close to his school, and our shop was within walking distance from his school. So, every day after school, he came straight to the shop, did his homework and often went with my installers. As a result, from a very young age, he was absorbing the install work and what was going on sonically and visually.

"I kind of grew up the same way. My father and grandfather had a business going way back, too. Ryan's skills grew rapidly, and he really helped out a lot with the install business. We worked together for many years. Doing projects at Stanford, he was noticed and eventually offered a full-time position. It's a most wonderful place to work, so many of my employees were lost to the university. But I'm happy. It's a family, and they'll be protected as long as they keep working."

## Audio Flow

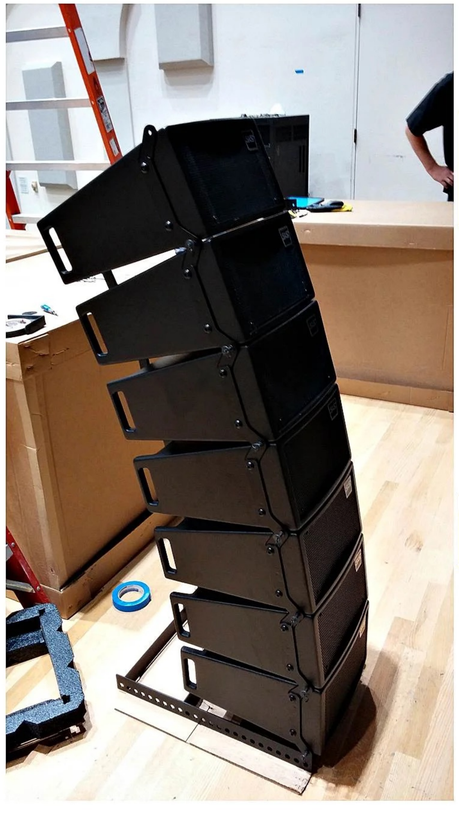
It's better to discuss the audio system flow separately. According to Tailored Technology's Eric Hudgens, sources go through the Dolby CP850 Atmos processor, which decodes and includes copy protection. Then it outputs to the BLU-160 DSP.

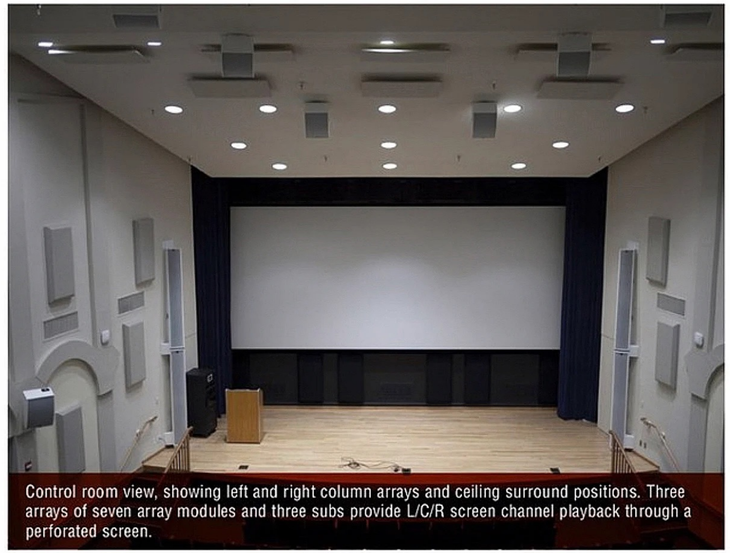
"It's an incredible traffic cop," said Hudgens. "The roadmap we've programmed into it looks like the underground of Manhattan! It has so much sophistication. I've done a lot of projects with BSS, but nothing like this. There are cascades of mixers, compressors, equalization, limiters and on and on. All this has to do with how you're going to route a two-channel system from the stage, or whether you're going to be bringing in something like 48 channels from the projection booth. It's sent over one Ethernet cable, which eventually feeds into the Crown amplifiers."


Surround speakers, aimed per Dolby Atmos playback criteria.

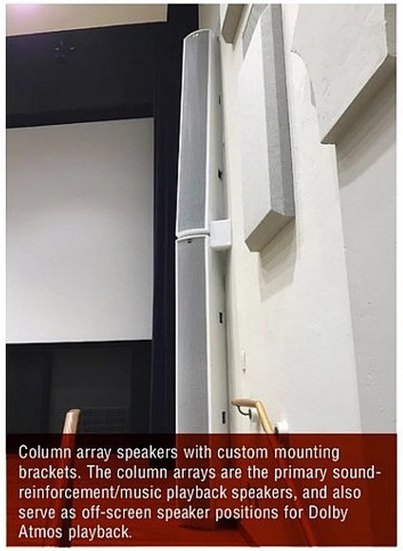
In the final sound-reinforcement configuration, the CPC1212s were supported by the left and right dual 18-inch LFE (low-frequency effects) subs. The upper pair is tilted up to cover the balcony, while the lower pair covers the main floor. They are driven by Crown amplifiers.

The mounting solution was custom bracketing provided by a local shop in San Jose; the columns were bolted to each side wall at the edge of the stage. The result was that the dual stacks are capable of 130-decibel full-time output with hardly any measurable distortion. "All of the glory goes to the 3D CAD program and my machinist," declared Hudgens. "The assemblies had





Control room view, showing left and right column arrays and ceiling surround positions. Three arrays of seven array modules and three subs provide L/C/R screen channel playback through a perforated screen.



Column array speakers with custom mounting brackets. The column arrays are the primary sound-reinforcement/music playback speakers, and also serve as off-screen speaker positions for Dolby Atmos playback.

## Equipment

**Speakers**

Adaptive Technologies MM-024 MultiMounts
2 SLS 115-I room rear low-frequency-support speakers
7 SLS CPA6600v2-I-BK behind-screen HM center-channel speakers
7 SLS CPA6600v2-I-BK behind-screen HM right-channel speakers
7 SLS CPA6600v2-I-BK behind-screen HM left-channel speakers
2 SLS CPC1212-I-WT PA (lecture/voice) + left-side surround speakers
2 SLS CPC1212-I-WT PA (lecture/voice) + right-side surround speakers
4 SLS CS1290C ceiling (mounted) surround speakers
8 SLS CS1290S wall (mounted) surround speakers
3 SLS CS218XL behind screen HM left-, right-, center-channel speakers
6 SLS CS890C ceiling (mounted) surround speakers
10 SLS CS890S wall (mounted) surround speakers

**Amplification Stage Power Rack**

Belden 10 gauge high-strand speaker cable (7000')
4 Crown DCI41250N 4-channel x1250W network amps
1 Crown DCI42400N 4-channel x2400W network amp
1 Crown DCI4300N 4-channel x300W network amp
3 Crown DCI8300N 8-channel x300W network amps

**Projection, Control**

1 BSS BLU-160 audio signal processor
1 Christie CP4220 digital cinema projector
1 Christie IMB-S2 integrated media block
1 Christie SKA-3D cinema video processor
1 Crestron DMPS3-300-C 4K DigitalMedia control processor
2 Crestron TSW-750 2 touchscreens
1 Dolby Labs CP850 Dolby Atmos processor
1 Oppo BDP-103 Blu-ray player
1 Panasonic PT-DZ13KU large-venue data projector
1 Samsung UBD-K8500 4K disc player
1 Seymour AV/Screen Excellence RF310WS-4K Enlighter-PRO acoustically transparent projection screen

*List is edited from information supplied by Tailored Technologies.*

The cinema processor provides custom sound-reinforcement voicing and Atmos surround playback processing.

to rotate into the wall because we had no room. There's a staircase coming up on each side of the stage, which couldn't be obstructed."

We will offer further perspectives, as related by the two Stanford classroom technology specialists, about these new system speakers and the misfortune of the replaced existing PA later.

Now that we've covered the sound-reinforcement speakers, here's a summary of the Atmos surround sound SLS speakers. They consist of three seven-element arrays of CPC6600V2s for screen channels. The 30 surround channels are comprised of CS890Ss and CS1290Ss for the side, rear and balcony channels, and CS890Cs and CS1290Ss for the ceiling channels, along with the aforementioned CPC1212 stage-mounted columns.

For low-frequency support, there are three CS218XL subs for screen channel LFEs and bass management (bass supplement for front surround channels), and two 115-I subs for surround bass management. All speakers are driven by Crown amplifiers. Readers should also view the equipment list, where the speakers are further broken out as line items. All visible speakers were painted white before shipping.

### Insiders' Perspectives

As mentioned, Stuart Nuttman and Ryan Hudgens are classroom technology specialists at Stanford. As such, they were heavily involved in the AV project. Although the more elaborate design was done by Eric Hudgens and the Dolby team, Ryan and Nuttman designed the way the AV would flow from stage to booth. "We had to be aware of the auditorium's architectural layout," Ryan said, adding, "The room has a pretty complicated ceiling."

"I call Stuart and Ryan 'firemen' because they have to move instantaneously [on the job]," said Eric. "We've done a lot of the subcontracting installs in the larger rooms at Stanford, so I got to work with those two a lot. They are the finest technicians I've ever known."

The two technology specialists' goal was to accommodate the multi-use room used by different kinds of people with varying degrees of AV knowledge, making access as simple and easy as possible. Thus, there are two Crestron TSW-750 touchscreens, one located by the stage and the other in the control booth. "For typical classroom use, we like to have a VGA and a couple HDMI connections and a Blu-ray player," Nuttman pointed out. "That's typically what a professor will use. So, all those options are right there onstage for them to connect or call up on the touchscreen. [For example,] Persian Studies was doing a play here. They've used the space off and on since we installed it, and they always speak highly of the room."

### Ease Of Use

"A professor can walk in without having to call someone to figure out how to hook up a laptop," explained Ryan. "When the auditorium is full, the user has to be able to grab a microphone and be heard. We had great functionality and flexibility with the BLU-160, working with Eric, Dolby and SLS creating a preset where, if someone plays an Atmos Blu-ray on stage, he can pause it and still have the microphone work. They don't even have to change any settings on the touchscreen."

Nuttman explained that the space is comprised of a stage, a sloped main-floor seating area and a balcony with the projection booth in the middle of seating. The widest point is 53 feet in the back of the room. The side walls slope narrowly toward the screen. The top of the stage is nearly 30 feet. Clearly, the auditorium has its dimensional ups and downs, which lead to rigging rigors and catwalk capers. However, install challenges were hidden. Accordingly, the two classroom technology specialists highlighted some of the obstacles overcome, despite working on a scaffold and a catwalk in the hot summertime. On the plus side, the project took place at a time when there were no events, conferences or classes, and was completed before the next quarter started.

### Architectural Roadblocks

"The game was to put in as many ceiling speakers evenly spaced with different architectural roadblocks," declared Ryan. "Above the stage, a floating ceiling slants, with the lowest point above the screen. Our

Rear surround positions showing the loudspeakers, each mounted to facilitate precise aiming per Dolby Atmos criteria.


first speaker pair is landing on the hanging ceiling that slopes downward toward the screen. We were able to miss all the different sprinklers, all the recess lights and all the sound treatments that are on the ceiling."

Stanford had put in an LED lighting system about a year ago. Middle Atlantic equipment racks are bolted to the floor in the stage area and in the projection booth where the Dolby processor and BLU-160 are located.

"This is a room within a room," Nuttman pointed out. "There was an original plaster-walled auditorium. Of course, they sheet-rocked a room within that. So, in order to redo the lighting, for example, they had to cut and saw through the existing plaster ceiling, which is still there. When it came time for us to run our wiring and hang all of the speakers, we really had to deal with two ceilings. The wall where the projection screen is mounted is plaster, as well.

### Where To Locate The Subs?

"One of our biggest issues was where to put the three subwoofer cabinets that have two 18-inch drivers," Nuttman added. "They can't go on the stage, and they can't go on a wall. We found an area above and near the projection screen. After some poking and prodding, we found an empty cavity behind that plaster wall. Within that wall was a concrete ledge that ran across horizontally. We were able to cut three openings, side by side. We built wood cabinets and bolted those to the concrete to house the subs. None of that is seen because it's behind the projection screen."

Two SLS CPC1212 left/right side tower speakers, have the dual role of lecture/voice and cinema surround without interference or feedback. "The existing PA was awful," said Ryan. "There was not enough coverage from the existing center stack. This old system was not done by us. There were huge windows in the audience where you couldn't hear the speaker." In the new

Detail showing rear- and side-surround speaker aiming, and the down-firing surround subwoofer.

system, the presenter has the freedom to move about the front presentation area and up and down the adjoining stairs with a wireless mic and not get feedback, even if the presenter walked right in front of each pair of 1212 loudspeaker towers. The angled columns cover the entire auditorium from the ground floor to the balcony.

PA and stage microphones include existing cord models and new Shure SLX wireless, which include accompanying SLX 4 receivers, SLX 1 transmitters and WL93 lavaliers. "They were able to patch into our new system over XLR via their existing Allen & Heath 16-channel mixer," said Ryan. "That includes all the different patches in the room, with around 10 XLR hookups." There are a number of two-channel sources that feed the 48-channel playback system.

"The various sources throughout the auditorium are located across the stage and on a couple of wall spots," added Nuttman. "That's all bussed upstairs into the booth and into the mixer. Then it's all piped out through the BLU-160."

The large, heavy Christie CP4220 digital 4K cinema projector was a challenge to install. In terms of numbers, it's 19 inches high, 26 inches wide and 49 inches deep, and 245 pounds installed. The two Stanford technology specialists struggled up the four steps to the control booth with the projector and guided it into this final position. Two 16-millimeter and two 35-millimeter film projectors that were no longer in use were in the way, Ryan reported, "So we had to move them."

Outside the projection room and hanging from the ceiling is a Panasonic PT-DZ13KU large-venue data projector that professors use for presentations. "It's a good dual-lamp arc welder itself," quipped Eric Hudgens.

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"They've played some cinema on it, and it will give the Christie a pretty good run for its money. There's also a Samsung UBD-K8500 4K disc player. This Samsung is a state-of-the-art 4K player that's really a go-to source if you're going to watch a movie that's not on the hard drive server." Additionally, there's an Oppo BDP-103 Blu-ray player.

"Putting in the screen was pretty painless." said Ryan. "We replaced an existing vinyl perforated screen with the Seymour AV/Screen Excellence Enlighter PRO acoustical transparent screen, which allows more sound to pass through. It was the same screen as in the new Dolby building in San Francisco."

"The old screen was in pretty bad shape," said Eric Hudgens. "There was a problem with professors treating screens like whiteboards. They write on them like a piece of paper, so the old screen had a lot of scratching on it. Andrew Poulain of Dolby recommended we look at the screen in San Francisco." The result was that the Seymour product found a home in Cubberley Auditorium.

"It's a woven fabric, not a perforated vinyl," added Hudgens. "It has a very natural look. We were blessed because the stage was quite large. Six of us stretched the cloth, got in into position and, voila, you've got a nice screen. However, it was only two weeks old when a professor scraped it with a bamboo stick."

"For a room not dedicated for theater from the start, I think the sound that we've accomplished here far exceeds any theater I've been to," said Ryan Hudgens.