THE VIRTUAL ORCHESTRA: TECHNICAL AND CREATIVE ISSUES

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The interactive multi-channel computer music system known as the Virtual Orchestra has been used several times in professional opera and theater as an alternative to a live pit orchestra. The technical issues associated with this emerging technology, and the logistical problems of implementing it are discussed. In addition, this paper describes the equally important issues regarding the creative impact this will have on the industry. In particular, this paper explores the role of the musician/technologist and suggests that many of the fundamental premises of opera production will change as the industry begins to retool. This would include the way opera is rehearsed and performed, how it is created and disseminated, and how it will adjust to changing demographics.

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1. INTRODUCTION

At no other time in history have musicians witnessed the degree of change and uncertainty which currently confronts the industry. As new musicians enter the field, it is certain that for many, the prerequisite for a working and productive career will include knowledge of not only music performance, theory, and aesthetics, but acoustics, psychoacoustics, computer science and audio engineering. While these broad fields have always been marginally represented in the course catalogs of conservatories and universities, they take on a new urgency as the industry retools and the emergence of this technology on the professional musical horizon becomes a reality. As we look ahead, we see a scenario in which the musician/technologist, working in ensemble with like-minded colleagues, becomes an integral component in an industry-wide labor shift intended to encapsulate the creative and realization process. With the introduction of advanced and sophisticated tools like the Virtual Orchestra (VO), musicians now have control over a diverse set of musical parameters far beyond those accessible with traditional

instruments or even synthesizer keyboards. While VO technology can increase the precision and control over a musical performance, it also puts more responsibility in the hands of fewer people.

The VO is a digital, computer-based multi-channel simulation of an acoustic orchestra. Capable of following a conductor's tempo during live performance, the VO requires no keyboards, synthesizer players, click tracks, or prerecorded audio materials. Used in over 800 performances, the VO is a sophisticated solution to orchestral realism and expression.

2. THE VIRTUAL ORCHESTRA AND THE MUSICIAN/TECHNOLOGIST

In the past, digital music technology was confined primarily to non-real-time music production environments such as film, television, radio, and the recording studio. The exception to this would be keyboard-based synthesizers which have populated the commercial music and live performing arts scene for over 20 years. These instruments, however, represent only an extension of traditional music realization techniques and are thus inherently limited. Recently, due to increased microprocessor speeds and larger memory capabilities, a new generation of digital music hardware and software has emerged. This technology is capable of producing stand-alone, intelligent, and non-tactile computer-based music systems. These systems can now be used for realizing music with the accuracy, realism, and speed necessary to qualify it as a real-time live performance instrument. It is now feasible to apply this technology to opera, theater, and ballet; mediums in which the integration of various art forms make the musical realization, interpretation and synchronization quite complex. Because these mediums are usually under the control of a live conductor, the VO is capable of following a fluctuating tempo and adjusting to subtle nuance in real time, even if these parameters change from performance to performance. The emergence and implementation of this technology into the live performance arts marks a radical departure from tradition, and significantly alters the division of labor equation. Unlike the traditional musician/instrumentalist responsible for the realization of a single component part of a larger whole, the musician/technologist must have a more comprehensive understanding and facility for interacting with various components of the whole. Along with a set of powerful technological tools, the musician/technologist must be armed with the knowledge of not only orchestration, synthesis, and musical interpretation, for example, but with a knowledge of acoustics and how the simulation of an environment is achieved through signal processing, imaging, etc. These characteristics and sensibilities point towards a new breed of musician.

3. DEPLOYMENT OF THE VIRTUAL ORCHESTRA

The VO comprises a group of loudspeakers, power amplifiers, signal processors, synthesizers, computers, and other processing devices which are positioned in the pit of an opera house or equivalent location in other auditoria. Although the standard VO deployment is currently 16 independent audio channels, in some

productions as many as 32 channels have been used. It frequently happens that the VO, and associated equipment, must be placed in position and ready to perform in varying periods of time. This load-in period can be from two weeks to as short as 3 h. In addition, touring the VO on the road imposes severe requirements including shipping and handling of the equipment, portability, and reliability of the hardware. One issue constantly faced with VO deployment is the lack of adequate electrical power in the pit. Older hall pits were designed to power a handful of music stand lights, not eight high-powered stereo amplifiers along with several hundred watts of computing and processing equipment.

Once the equipment is deployed and operational, the process of tuning the VO to the hall begins. Following a pink-noise calibration to the house curve, attention turns to the musical balancing of the VO. This process is analogous to the procedure followed by an acoustic orchestra. In co-operation with a music director or VO orchestraters, adjustments are made within the context of musical works. The overture to Mozart's "The Marriage of Figaro" is often used to establish the hall response to the string component of the VO. It is this process that allows for the subtle tuning of various musical nuances involving speaker position and angle, EQ, and other parametric changes that tend to become empirical or musical. For many of the VO's instruments it is necessary to audition them at their extremes. Woodwinds, brass and percussion are often auditioned using the prelude to Bizet's "Carmen". The large orchestral tutti sound of this excerpt is the acoustical benchmark of sonic robustness. In contrast, "Donde lieta" from La Boheme demands a level of subtlety and delicacy from all instruments. There is great flexibility in tuning the VO, and like an acoustic orchestra, this will include high level adjustments such as volume as well as low level changes in individual articulations, durations, etc.

4. AUDIO COMPONENTS OF THE VIRTUAL ORCHESTRA

The selection of VO audio components relates strongly to the type of musical instrument being played through a particular channel. Brass and percussion demand high audio power and large loudspeakers, while strings and woodwinds are somewhere in between for audio power demand. In practice, for purposes of quick replacement and interchangeability, all of the audio amplifiers are identical and rated to deliver the required performance of the percussion section. The loudspeakers are individually selected to provide the optimum tonal quality for the particular musical instrument family with which they are used. Timpani, bass drum, contra-bass and tuba require subwoofers placed on the pit floor and coupled to high-quality upper range loudspeakers for cymbals, snare drum, etc. In most cases, we position the speakers to simulate the principal radiation of the instrument. The tuba's loudspeaker should face upward for best results and the clarinet loudspeakers are angled toward the pit floor, for example.

By far, the most difficult sections are the first and second violins. Regardless of which loudspeaker is used, several are deployed for each section in order to generate the time smear associated with multiple violins bowing together, but spaced apart in the pit. In addition, minor statistical errors are

introduced to intonation and attack and releases. Currently, the VO uses planar distributed-mode loudspeakers for the violin section. There is no attempt at the moment to stimulate violin directional charateristics. There are many elements to be considered for loudspeaker selection, not the least of which is survivability in a rough transport environment. Inevitably, the most sonically desirable loudspeaker may simply not be up to the task and some compromise is needed.

One advantage of the VO is that it can reproduce the sound levels of a very large orchestra in the relatively small pit. Humperdink's "Hansel and Gretel," which has been publicly performed with musicians in the pit can be a bit disarming in a small space when the VO reproduces it accurately. Since the VO loudspeakers are spread across the entire width of the pit, and the orchestral sections appear in their proper location, the soundscape is rendered with astonishing realism to every seat in the hall, as well as to the podium and to the stage. The conductor is able to localize each source easily for psychoacoustic comfort and to control sectional balances when required.

5. THE VIRTUAL ORCHESTRA'S INFLUENCE ON PRODUCTION

The VO, and related music technologies, will have a significant and positive impact on the production of opera, musical theater, and ballet. This will be attributed to the VO's ability to influence the creative process with a high degree of interactivity as well as logistical and economic flexibility. This is a condition which does not exist with the current acoustic pit orchestra. Most opera productions, for example, begin rehearsal three or four weeks prior to the first performance. It is during this period that various elements of the production are explored and eventually finalized. This would include not only the vocal preparation, but staging, set construction, costume fitting, etc. Some elements of the production may often begin a year in advance such as interpretation and staging, set design, costume design, and lighting design. However, inclusion of the opera orchestra into this scenario usually begins only a few days before the first performance. With VO technology it is possible to have a complete musical realization in place from the first rehersal or earlier. The benefits of such a scenario are obvious. In addition, the availability of the full musical score, during the entire rehearsal period, would allow for some degree of experimentation, adaptation, or contemporization of the score, etc. similar to what goes on in other areas of production. It is this immediate and interactive accessibility to the structural and sonic components of the musical score which will have a major impact on the performing arts in the coming decade.

While the opera purist would balk at this suggestion, it may be the very lack of modernization and contemporization that is begining to label the medium as somewhat culturally irrelevant. It is ironic that while every other area of theatrical production has felt the impact of our cultural evolution, the realization of the musical score has not. Throughout this century we have witnessed extraordinary developments both aesthetically and technically in the theatrical arts with no sustained resistance from the audience. In addition, the music of our culture, whether popular, jazz, or film music, is often characterized by reorchestration, manipulation, variation, or arrangement by other artists or ensembles. So why has

the opera and ballet score remained untouched as the creative world around it has evolved? Is it artistic purism and integrity that has kept the musical realization of this vast literature frozen in time? I would think not. It is not a question of whether to do it or not to do it, but an admittance that "we can't do it." It is both logistically and financially impossible to undertake the necessary exploration and creative development with a 40 piece pit orchestra under the watchful eye of the union and at union pay scale. However, with the VO and new technologies, the industry now finds itself with alternatives.

The continuation and growth of any art form depends on the infusion and creation of new works, the cultivation of new ideas, ad the dissemination of the work. In addition, the creative activity of an organization needs to address new audiences and target the demographic reality of the country. This implies that the creative work must be disseminated through touring and recording, two areas which are extremely problematic with the acoustic orchestra and traditional production strategies. Because of the portability and compactness of the VO, it is now feasible to take the production to the people, play larger venues, and target a population inaccessible to the opera and performing arts genres. To a generation nurtured on CD quality sound, amplified music, television and film, the idiomatic use of advanced sound technology would be appropriate and relevant to emerging audiences and changing aesthetics. With VO technology and well-trained musician/technologists, it is possible to overcome many of the obstacles inherent in the performing arts industry.