6 3D-VMS Virtual Microphone System all'Opera

Text and illustrations from an article by Leonardo Scopece published on Elettronica e Telecomunicazioni, August 2011

1. Evolution

The 3D-VMS system, based on the Ambisonic theory, uses a multi-capsule probe to carry out multimicrophone shootings and enables the distribution of numerous audio capture spots on both the azimuthal and median planes (up to 7 virtual microphones).

The system hardware configuration and user interface are constantly evolving.

The configuration illustrated in the previous chapter included a microphone probe connected through the EMIB interface to the signal processing unit (in practice, a quad-core PC) controlled by a console (MacBook).

From the hardware point of view, the evolution of the system now enables a MacBook quad-core to act as both the processing unit and console providing for the GUI.

This innovation is very important from the operating point of view, since it

significantly facilitates the system management work carried out by the sound engineer, and it also paves the way for the development of future potential opportunities.

It will be possible to have a service audio/video synchronization through two “groups” of signals carried by an IP cable, and the introduction of the Time Code (required to synchronise the audio signals originated by the probe with the video signals from the video cameras used for TV shootings) will be facilitated.

The levels of performance of the system have been considered adequate for the audio shooting the performance of “Lucia di Lammermoor” at the Teatro Regio in Turin, broadcast live on Rai Radio 3, on the Euroradio network.

2. The new Interface

The suggestions from the Production department colleagues proved essential to ensure the significant improvement of the current version of the user interface. From the operating point of view, the innovations have made it possible to carry out recording and editing tests and the final implementation of the system for live broadcasting.

Figure 1 shows the post-production interface centred around a picture of the stage “embracing” a 360° visual field on the azimuthal plane.

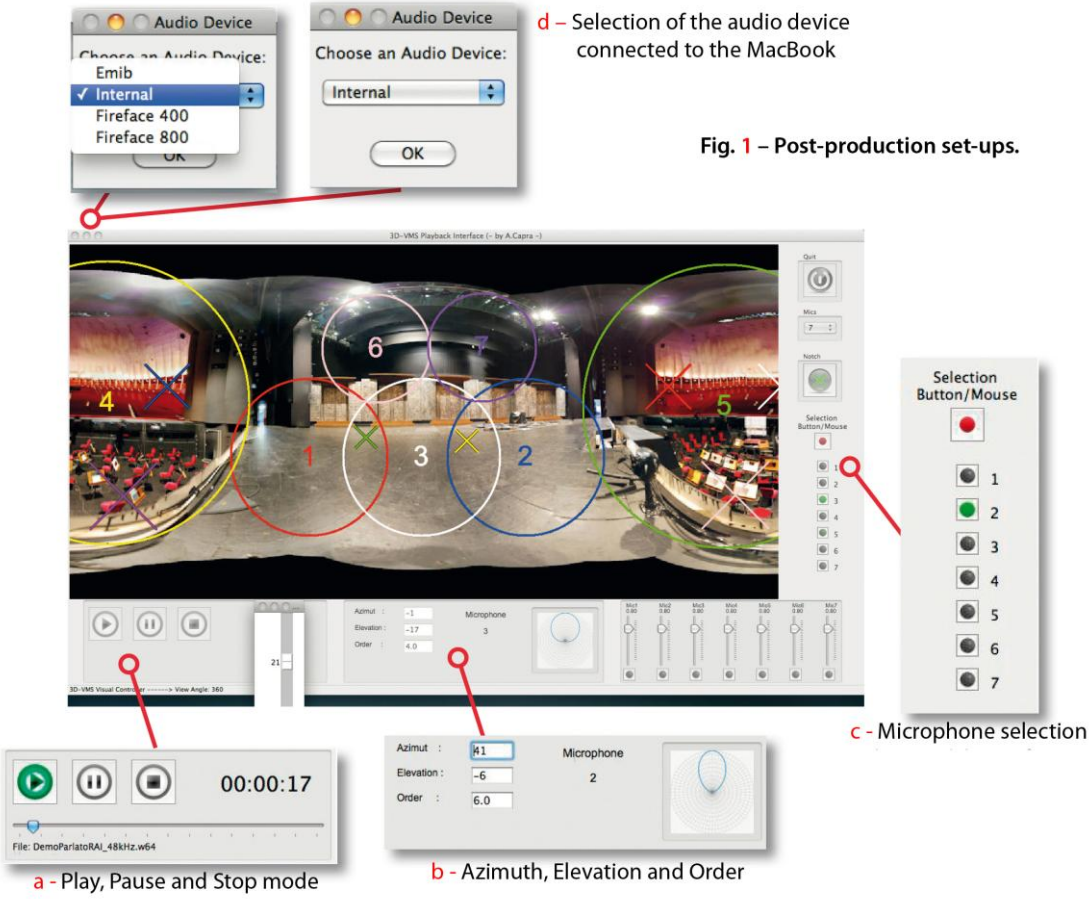

Fig. 1 – Post-production set-ups.

A number of specific features with which the previous interface was not provided should be noted:

- ✓ the possibility of displaying the minimum gains of the virtual microphones, indicated as "X" (*Notch*);
- ✓ the circles, representing the gain depth levels (directivity) correspond to an a 6 dB damping with respect to the centre;
- ✓ it is possible to select the *Play*, *Pause* and *Stop* modes during the analysis of the audio signal, verifying the sound at any given moment (a);
- ✓ it is possible to act within the *Azimuth*, *Elevation* and *Order* fields also by setting up the values directly (b);
- ✓ by activating the *Selection Button/Mouse* it is possible to select one of the stage microphones; in the previous version, due to the

contiguity of the circles, in some cases the selection (and the corresponding movement) acted on a microphone differing from the desired one (c);

- ✓ it is possible to act on the input gain to the Mac, in its audio recorder function, through a virtual doser;
- ✓ it is also possible to monitor the levels of the 32 microphones, opening, for example, the recording software *Plogue Bidule* and selecting *Monitor*;
- ✓ the audio device to be used can be chosen (d), among RME Fireface 400 or 800, EMIB or the MacBook itself (in this case, only for two virtual microphones);

Also the user interface regarding the *Real-Time* has been revolutionised (figure 2), and equipped with functions similar to those available for the post-production stage:

- ✓ it is possible to decide the number of microphones to be used (1, 2 or 7);
- ✓ the microphone may be selected using the *Selection Button/Mouse*;
- ✓ the position and directivity of the microphone can be set directly in the corresponding fields;
- ✓ it is possible to have a general idea of the zoom level set by observing in the corresponding window the polar diagram of the selected microphone;
- ✓ the recording level can be set by acting on a virtual doser, so as to avoid saturating and distorting the signal.

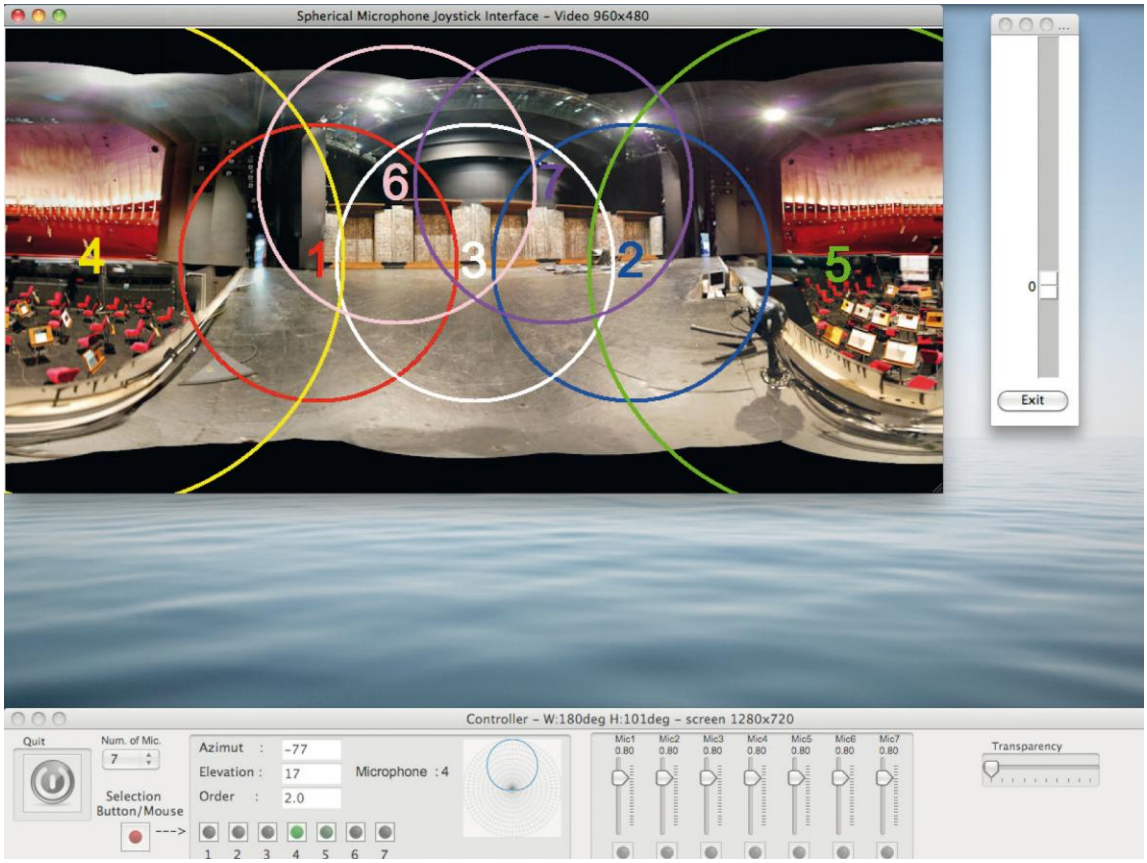

Fig. 2 – Real-Time Settings

3. The tests

3.1 Rigoletto

The audio shooting of the rehearsals of "Rigoletto" by Giuseppe Verdi (figure 3) at the Teatro Regio was carried out with one microphone probe located at the centre, near the stage, in order to capture both the frontal voices and the orchestra, positioned behind the probe.

Fig. 3 – Turin, April 9, 2011.
"Rigoletto" rehearsals at Teatro Regio.

When the results were analysed during the post-production stage, the virtual microphones were positioned as shown in Figure 4.

Fig. 4 – Graphic set-up for the audio shooting for "Rigoletto".

The audio result on the acoustic *cantato* front is extremely good: the voices are so "present" that it feels like the singers were equipped with individual microphones. Overall, the result conveys a well-balanced, non-invasive and pleasant feel of the stage, and the spatiality of the voices is realistic and pleasing.

Regarding the orchestra, instead, the results are inadequate, as expected. In fact, it is felt that the sounds of the instruments do not arrive directly to the microphone probe, but are reflected by the pit walls: the sounds are not obtained through the microphone pointed directly towards the paths of the sound waves generated by the musical instruments.

This experience has made it possible to identify an ideal audio shooting configuration, which was subsequently used for "La Traviata".

3.2 La Traviata

For the rehearsals of the "La Traviata" by Giuseppe Verdi (figure 5) two microphone probes have been used: one located in the same position used for "Rigoletto", at the centre, by the stage, and one located behind the conductor and oriented towards the centre of the orchestra pit.

Figures 6 and 7 illustrate the setting for the two probes: one oriented towards the stage and one towards the orchestra pit.

The result proved to be significantly improved, with reference to the pit

Fig. 5 – Turin, April 20 2011. Rehearsals of the "La Traviata" at the Teatro Regio.

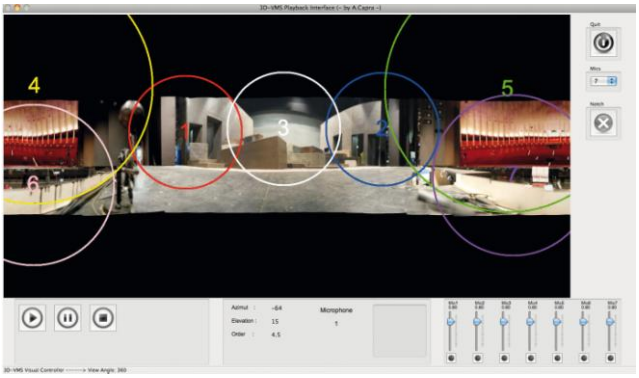

Fig. 6 – Graphic settings for the "La Traviata" stage.

Fig. 7 – Graphic settings for orchestra pit for "La Traviata".

contribution, with respect to the result obtained for "Rigoletto": the instruments are more "present" and "clean", although, undoubtedly, the feeling of the orchestra changes significantly. The instruments are not perceived as individually "focused", as it happens with the multimicrophone system, but in a way similar to the real listening conditions, facing the orchestra.

As for the stage, the result proved very good and provides the same feeling mentioned above.

A potential problem might be originated by the addition of the vocal contributions on the two probes, influenced by the different paths of the same. From the technical point of view, the probes, located at approximately six metres from one another, capture the same sound, but with a certain delay. This phenomenon proved unnoticeable by the listener, probably thanks to the theatre's acoustics and to the ideal orientation of the pit virtual microphones.

The surround effect was obtained using the contributions provided by virtual microphones 4 and 5 synthetized by the

stage probe (figure 6), while the contribution of the pit probe was not used due to strong interferences from the reflecting surface represented by the wall located behind the Conductor.

4. On air

4.1 Lucia di Lammermoor

Following a careful assessment of the results of the tests described above, Rai has decided to use the 3D-VMS system for the performance of Gaetano Donizetti's "Lucia di Lammermoor" (figure 8).

The opera was broadcast live by Rai Radio 3 and distributed by Euroradio[Note1]. In fact it is one of the 324 concerts held within the *Euroradio Summer Festival* del 2011.

Figure 9 illustrates the graphic setting of the virtual microphones defined during the rehearsals and maintained during the live broadcast.

The 3D-VMS system was adopted for the stage, while the orchestra audio

Fig. 8 – Turin, June 21, 2011. "Lucia di Lammermoor" at the Teatro Regio.

Fig. 9 – Graphic settings for "Lucia di Lammermoor".

shooting was carried out using the traditional multimicrophone system.

The sound generated by the 3D-VMS system is full, pleasing and free from *fading* (gradual increase or decrease of the signal level due to the passage from one microphone to the adjacent one), excellent on-stage shooting continuity

and excellent in-depth disposition and width of the voices from the stage.

The signals processed by the 3D-VMS system are considered as signals originated by on-stage microphones and mixed together with those originated by the microphone located in the orchestra pit (figure 10).

The delay in the signals processed by the 3D-VMS systems with respect to the real signals is of 134 ms. Consequently, an equal delay was introduced on the signals originated by the conventional microphones.

Note 1 – Euroradio and the EBU digital audio high-quality programmes exchange

Figure 10 – Mixing of the 7 live signals live obtained through the 3D VMS system and the pit microphones.

5. Events which are still awaiting an analysis

We wish to mention two other events which in the near future will be analysed with the 3D-VMS system during the post-production stage.

On May 16, 2011, at the Studio 3 of the Rai TV Production Centre in Milan, an audio shooting of the West-Eastern Divan Orchestra directed by Maestro Daniel Barenboim was carried out. The orchestra performed two parts from Beethoven's "Eroica" and Tchaikovsky's "Pathétique", which were broadcast during an episode of the "Che tempo che fa" TV programme conducted by Fabio Fazio on channel Rai 3.

The microphone probe was suspended at the same height of the lighting system, over the orchestra.

On June 29, 2011, in close collaboration with Vatican Radio on the occasion of the Mass celebrated by the Pope in the Saint Peter's Basilica, with the participation of the Santa Cecilia Choir and Orchestra, directed by Don Massimo Palombella, an audio shooting

was carried out by Vatican Radio and Rai. Rai implemented two 3D-VMS microphones and one Holophone H2Pro microphone.

Acknowledgements

We wish to thank all those who have contributed to the audio shootings on which this article is based, in particular: Vatican Radio, for the organization at the Saint Peter's Basilica, the managers and engineers of the Teatro Regio in Turin for the audio shootings of "Rigoletto" and "La Traviata"; our Rai colleagues Andrea Canino, Maurizio Trevisan, Roberto Cotto and Luca De Murtas for the shooting, the mixage and the broadcast of "Lucia di Lammermoor", musical assistant Felice Marenco for the evaluation of the results; our Rai colleague from the Rai Research Centre, Enrico Cavallini, for his support regarding the equipment and the photographs taken during all the tests.

The 3D-VM system is based on the Ambisonic technology and on research and development programmes by the Rai Research Centre in close collaboration with Prof. Angelo Farina and Ing. Andrea Capra of the Industrial Engineering Department of the University of Parma.