

# THE EFFECT OF FIELD OF VIEW OF A CAMERA ON ENHANCING THE IMMERSIVE FEELING OF THE AUDIENCE IN A NETWORKED DANCE PERFORMANCE

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## **Abstract**

Representation of lively telepresence via video has been one of the most significant tasks of networked dance performances. Different researchers have adopted different camera systems by using multiple 3D cameras, attaching cameras on a dancer's body, or creating an augmented reality system. However, because these systems are either performer-centered or high-cost, more search for an effective camera control is necessary. This paper suggests controlling the field of view (FOV) of a single camera in various ways to represent more vivid telepresence. The user survey conducted implied that FOV alone can affect the immersive feeling of the audience. The result would be helpful for making a more effective use of a simple camera system in a networked dance performance.

## **Keywords:**

telepresence, networked performance, camera, field of view

## Introduction

Networked performance is a performance where more than two locations are connected via internet to consist a single, real-time performance. In most cases, a camera takes video of a performer at one location and the video is sent to another location. Most networked performances are dance performances, and the key issue is to let the distant audience feel immersed into the video being displayed on a screen.

Several studies have addressed the problem of presenting vivid telepresence in this type of performances. It is clear that properties of a camera including field of view and angle need to be modulated for a choreography for camera instead of a stage. (Birringer, 2002: 83-94) Efforts for adjusting cameras include attaching a camera to dancer's body (Birringer, 2004: 165-178), using 3D cameras in different positions (Yang, 2006: 723-726), or using multiple sets of such 3D cameras (Sheppard, 2008: 579-588).

Camera attached on a body limit movements and expressive range of a dancer. They also convey dancer's view, not the view from the audience, thus not much helping to increase the immersive feeling of the audience. Using multiple 3D cameras also have its own disadvantages. The installation process is complicated because cameras should be placed in precise angles and positions. Combined with high cost, this makes it difficult to replicate the same effect in different settings.

Thus, it is necessary to find a way to enhance the immersive feeling of the audience by adjusting simple properties in a simple camera setting. The purpose of this study was to investigate how different field of views (FOVs) of a camera affect the perception of the audience. The purpose of this study was to find an effective way of using a camera in a networked dance performance to enhance the immersive feeling of the audience.

## Method

To evaluate the correlation between the FOV of a camera and liveliness, we conducted two types of assessment experiment under the following conditions: live appreciation and video appreciation. We performed a short dance piece titled *Hot Honey Rag*, which is the final dance piece (1:48) from Musical Chicago (Fig.1), and all sequences of the performance were recorded. For the video appreciation, four cameramen recorded the performance in different perspectives: full shot focus with a wide FOV, facial expression focus with a narrow FOV, and the one where FOV alternates from time to time. The alternating FOV version was edited with Sony Vegas program.



**Figure 1.** A scene from the *Hot Honey Rag* performance. This video was taken with a wide FOV.

For the first part of the experiment, 8 participants appreciated the live show performance in a theater. After the show, the first survey was conducted on them to measure how immersive and lively the performance was.

The second part of the experiment was divided into two subparts. Before starting the second part, we collected the recorded video materials from cameramen. Then, we edited the videos in three versions: 1) unedited full shot video with a wide FOV, 2) close-up video with a narrow FOV, and 3) combined video where the FOV continually alternates. Then 8 experiment participators watched three types of videos in a row. From the unedited full shot video with a wide FOV, participators were expected to be able to feel like they are sitting in the theater as the video shows the overall atmosphere of the venue. On the other hand, the close-up video highlighted the communication of performer's emotional expressions. Lastly, from the artificially edited video, participants watched a piece of well-designed video where the scenes were cross-edited to include multi-focusing on steps, facial expressions, or acting, to increase the sense of immersion.<sup>1</sup> At the end of each experiment, the participants responded to the survey. The survey questions were identical to the ones used in the first part of the experiment. Through this Experiment 2, participants had a chance to compare the effects of different camera FOVs on the liveliness.

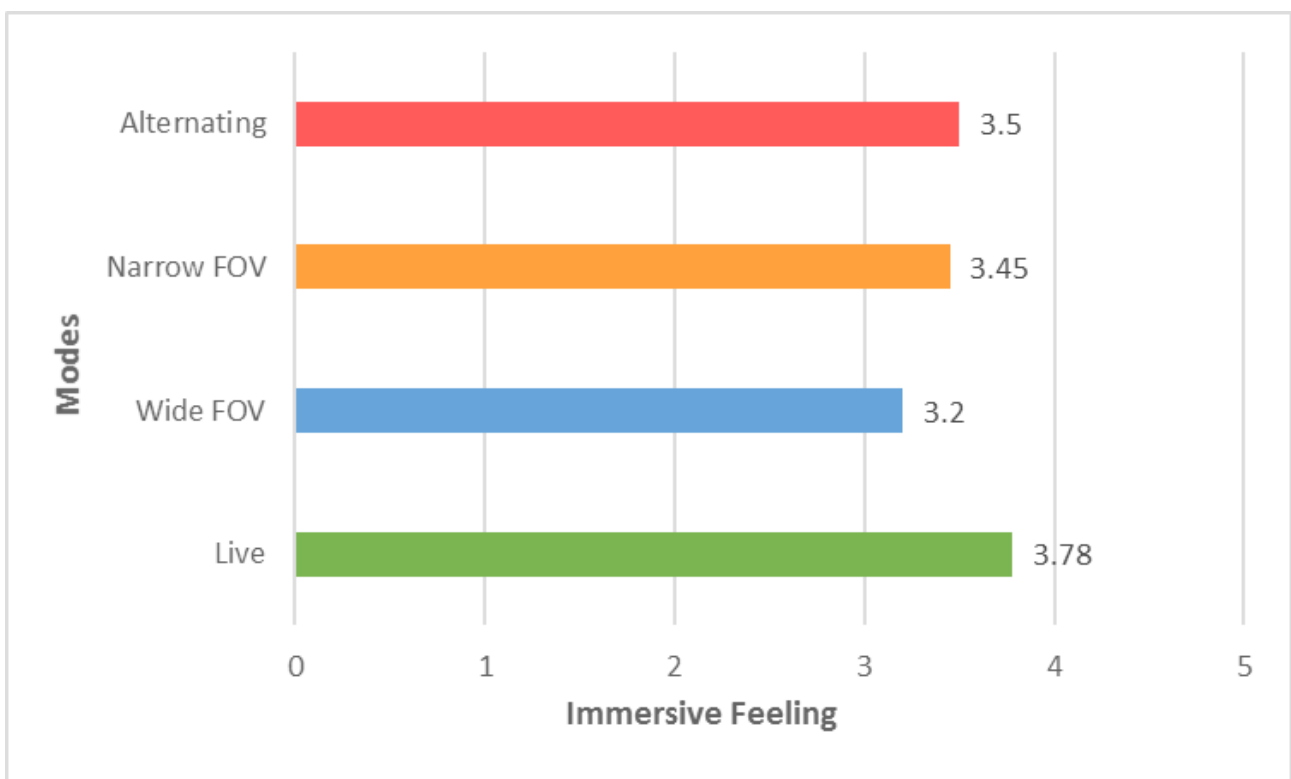
## Results & Conclusions

Live performance										
Respondent Information	1	2	3	4	5	6	7	8	Average for each questionnaire	Average
	Male 26-30	Female 26-30	Male 26-30	Male 26-30	Male 21-25	Male 26-30	Male 21-25	Male 26-30		
Live	4	3	5	4	4	5	4	4	4.13	3.78
	4	2	5	3	5	4	3	5	3.88	
	3	2	5	3	4	4	3	4	3.50	
	4	2	5	3	3	5	4	5	3.88	
	4	2	4	4	3	3	4	4	3.50	

Performance presented as a video										
Respondent Information	1	2	3	4	5	6	7	8	Average for each questionnaire	Average
	Female 26-30	Male 21-25	Male 21-25	Female 26-30	Male 21-25	Female 31-35	Male 26-30	Male 26-30		
Wide FOV	3	3	5	2	1	5	3	5	4.13	3.20
	2	2	5	2	1	4	2	3	2.63	
	4	2	3	3	1	4	4	3	3.00	
	3	2	3	3	1	3	5	4	3.00	
	4	2	3	3	1	5	4	4	3.25	
Narrow FOV	3	4	4	3	4	2	3	4	3.38	3.50
	2	4	4	3	3	4	3	2	3.13	
	3	4	3	3	4	4	3	4	3.50	
	4	4	4	4	5	4	4	4	4.13	
	3	4	3	3	3	4	4	3	3.38	
Alternating	3	3	3	4	1	2	5	3	3.00	3.45
	3	4	4	4	1	5	4	3	3.50	
	4	3	3	3	1	5	5	2	3.25	
	4	4	3	4	1	5	5	5	3.88	
	4	4	3	4	1	5	5	3	3.63	

**Table 1.** The survey results from the two-part experiment.



**Image 2.** The effect of a camera FOV on the immersive feeling of the audience into a performance.

Figure 2 summarizes the result of the survey answered by the audiences. This result clearly indicates that FOV of a camera affects the immersive feeling of the audience. Among the four ways of presenting a performance, the live performance turned out to be the most immersive to the audience. Among the three different modes of the video, the one where the angles and FOVs constantly changed felt to be liveliest. Narrow FOV was almost same as alternating version in terms of the immersive feeling, and wide FOV gave the least impact to the audience.

It seems that the audience is most satisfied when they are offered with various aspects of a single performance. In the alternating mode, the audience can notice the appearance of the stage in overall, the facial expressions of the dancers, and specifically interesting body movements in a single video. This gives them an integrative experience which makes the performance interesting and lively.

In narrow FOV mode, the audience can feel the expressions of a dancer when the upper body is focused. When the lower body is focused, they can closely observe and understand how the body parts are moving. This enables the audience to build an intimate relationship with the performer and by showing detailed images.

Wide FOV turned out to be most ineffective for the immersive feeling, and this is probably because it works in the opposite way from the way the narrow FOV mode works. This mode increases the distance between the performer and the audience, thus decreasing the liveliness and intimate relationship between them.

## Discussion

This research showed that the telepresence of a performer was affected by adjusting only a simple feature of a camera. This conclusion would help to make a networked performance more immersive for the distant audience who are watching the performance in a video form via a screen.

But there still remain some possibilities of improvement. First, the performance prepared for this research was relatively short. Controlling camera features can have unexpected effects in longer performances by aiding the storytelling. Also, since only dance piece was performed in this research, the effect of camera features on other types of performances need to be tested.

Another point is that a camera has various features other than the FOV. Because FOV is one of the most basic and simple features of a camera, the delivery of a networked performance can supposedly be more effective if FOV is controlled in combination with other features including angles, lenses, exposures, etc. The effect of each feature and the combined effects of them are the subjects for further investigation.

## Notes

- 1 The video URLs for these three versions of the performance are available:  
Narrow FOV: <http://youtu.be/6DH0clgO12c>  
Wide FOV: <http://youtu.be/p-iXFhr56AM>  
Alternating: <http://youtu.be/Pm1vYrkZoiQ>

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## URLs

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<http://www.youtube.com/watch?v=-IWWW4D8xSs>  
<http://youtu.be/6DHOclgO12c>  
<http://youtu.be/p-iXFhr56AM>  
<http://youtu.be/Pm1vYrkZoiQ>



## About the authors

**Joong Hee Soh** received B.S. in Life Science and Biotechnology from Yonsei University, Korea, and received M.S. From Graduate School of Culture Technology, KAIST. As a semi-professional dancer, she is mainly interested in applying digital technologies to theater arts. Particular interests include automatic control of stage lighting, enhancing immersive feeling of networked digital performance, and interactive dance using Arduino and/or Kinect

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