Large viewing angle walk through type display using smoke screen

Koki SATO†, Kunihiko TAKANO††, **Makoto Ohki**†,

†Shonan Institute of Technology
1-1-25Nishikaigan,Tsujido,Fujisawa,Kanagawa,251-8511,Japan
††Tokyo Metropolitan College of Aeronautical Engineering
8-52-1 Minamisenjyu,Arakawa-ku,Tokyo,116-8523,Japan
E-mail: †satok@elec.shonan-it.ac.jp, : ††ktakano@kouku-u.ac.jp :
†ohki@elec.shonan-it.ac.jp

abstract

In the case of projection type display, it needs to use the screen in order to project the image clearly and wide viewing angle. We have been developing the step in type display system using the smoke screen. However, the image with smoke screen was flickered by gravity and air flow. Then we considered to reduce the flicker of the image and we found that flicker can be reduced and viewing angle becomes more large.

This time we report the large viewing angle step in type display system using screen made up with very small particle size smoke and flow controlled nozzle. Hence, at first we considered the most suitable particle for the screen and then the shape of screen and then we constructed the array of flow controlled smoke screen. By the results of experiment we could get considerably high contrast flicker-less image and get the viewing angle more than 60° by this flow controlled nozzle attached new type smoke screen and make clear the efficiency of this method.

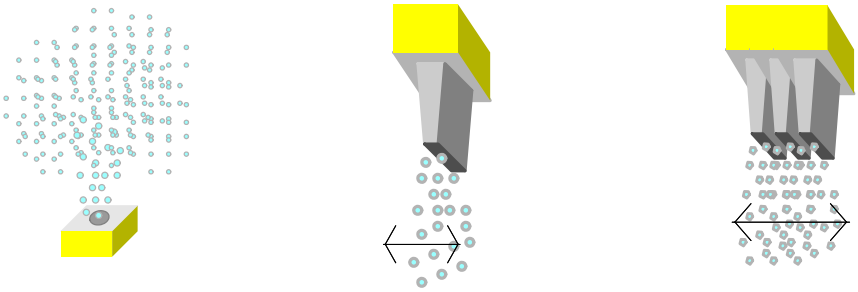
Keywords: flow controlled smoke screen, step in type display, large viewing angle, high contrast flicker-less image

1. Introduction

In this paper at first we show the special feature of this projection type display system using mist 3-D screen. Then we consider to reduce the flicker of the reconstructed image and we mention that flicker will be reduced using mist flow controlled nozzle. .For design the smoke flow controlled nozzle at first we analyze the most suitable type of nozzle for flow control by the flow dynamics theory.. Then we consider an array of flow controlled nozzle to enlarge the thickness of smoke screen. Finally we construct the most suitable smoke screen with an array of flow controlled nozzle and display the moving image on this smoke screen and make clear the efficiency of smoke screen to reduce flicker of the reconstructed image and make the. viewing area so large.

2. smoke screen with controlled nozzle

This method had a basic problem that the images composed of water particle are easily influenced by air current and gravity (Fig.1 (a)) [2, 4]. Then, we developed single screen with flow control device shown in Fig.1 (b). It became possible to observe less distorted image with this device. In addition, to expand the depth of a screen, the screen was improved to be arrayed as shown in Fig.1(c). This arrangement increased the thickness of the screen from 0.9[cm] to 4.9[cm]. At this point, we set the width of nozzle of the flow control device is 3.0[cm]. As well as it can control the flow by arraying these devices, it's also possible to change the size of the screen arbitrary by altering the shape of mouth and the number of devices.



(a) Conventional screen with no flow control

(b) Single screen with flow control

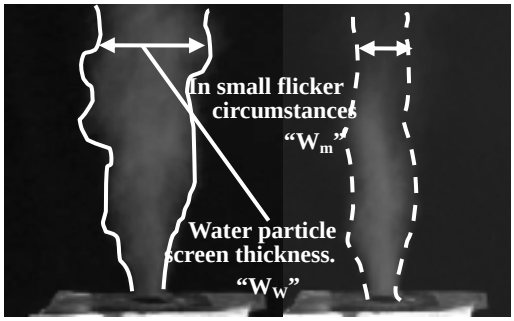
(c)An array screen with flow control

Fig.1 The stabilization of flow

3. Experimental results

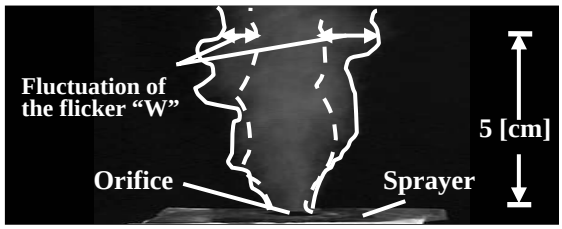
3.1 Characteristics of smoke screen

We set an array screen and recorded with DV camera to examine how much the distortion was diminished, and the result was quantified. A scale was used to see a change in size of distortion. Spraying smoke in the air for ten seconds, a change in Ww (thickness of the screen) was measured every seconds at 5[cm] away from the nozzle. A minimum value was referred as Wm where thickness of the screen was minimized, and a value subtracted the minimum value from each measurements was referred as W (size of distortion) and quantified (Fig.2). We took binary process to measure W numerically.



(a)Maximum of screen thickness.

(b)Minimum of screen thickness.



(c)The measurement flicker thickness.

Fig.2 The example of measurement of flicker thickness

The result of the distortion is shown in Fig.3. It is obvious from this figure that the smoke screen without flow control device is more influenced by air current or gravity and causes more distortion. On the other hand, by this experiment using flow control device, we improved the distortion and the volume screen was less influenced from air current or gravity. An array screen had larger distortion compared to a volume screen because screen of each array were influenced by another array's flow. But maximum size of distortion was within 1[cm].

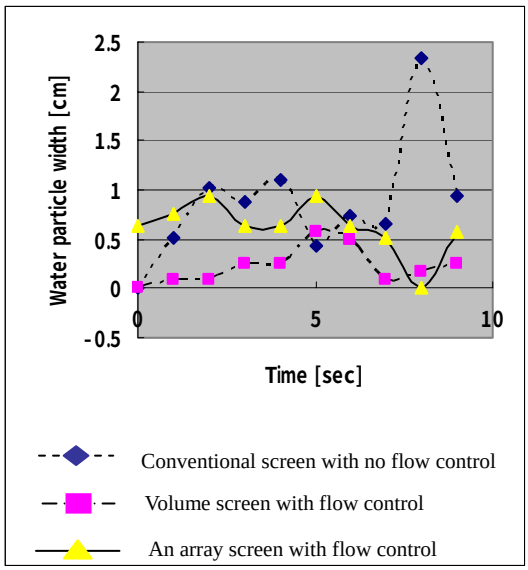
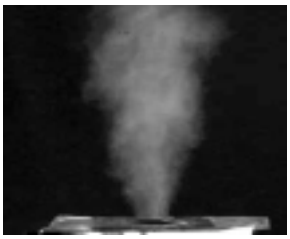


Fig.3 Thickness of screen with respect to time.



(a)Existent screen
with no flow control

(b) Volume screen
with flow control

(c-1)Front view of array screen

(c-2) Side view of array screen

Fig. 4 Flow images of 3D screen

Fig.4 (a)～Fig.4(c) show the flow of (a)Existent screen with no flow control (b) Volume screen with flow control (c-1)Front view of array screen (c-2) Side view of array screen. In the case of array screen the thickness of the screen becomes about five times comparing to the volume types screen.

As a result of this study, an array screen with flow control is assumed to be effective to form smoke particle screen which has enough thickness and less distortion.

3.2 Image reconstruction

The total size of 3D screen is shown in Fig.9, there the size of the screen is 20(H)×30(L)×4.9(D) cm
The CG color moving image displayed on this array screen shown in Fig.5(a) The image shows considerablely high contrast. Also we can get step-in image as shown in Fig.5(b).

(a) displayied CG color image (b) displayed step in image

Fig.5 Projected Image on the smoke screen

4. Conclusion

We demonstrated the technique to improve the flicker of image on the screen and the size of the image with the array screen.. This study enabled us to generate better images than those which are projected by a volume screen. As a challenge hereafter, we should examine to improve the screen's quality furthermore and research for high contrast color image .

References

[1] K.Okada, T.Koitabashi, T.Honda and J.Tsujiuchi :'' Three Dimensional Movie by a Projection Type Hologram'', Hodic Circular No.1, pp.23-26(1996)

[2] Norihiro MINAMI, Kunihiko TAKANO, and Koki SATO:''A study of projection type 3D-Screen for Holography 3D-TV'', ITE Winter Annual Convention 2000, pp67(2000)

[3] Kaeriyama Toshiyuki :''DLP Projection System'', Display and Image, Vol.9, No.2, pp79-86(2001)

[4] Kunihiko Takano, Koki Sato and Makoto Ohki :''On a Holographic 3D Screen Display using Scattering of Particles'', The Institute of image Information and Television Engineers, Vol.57, No.4, pp476-482(2003)