



# A Study on Characteristics of Space Perception for Dome Contents Creation

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# Background of this Study

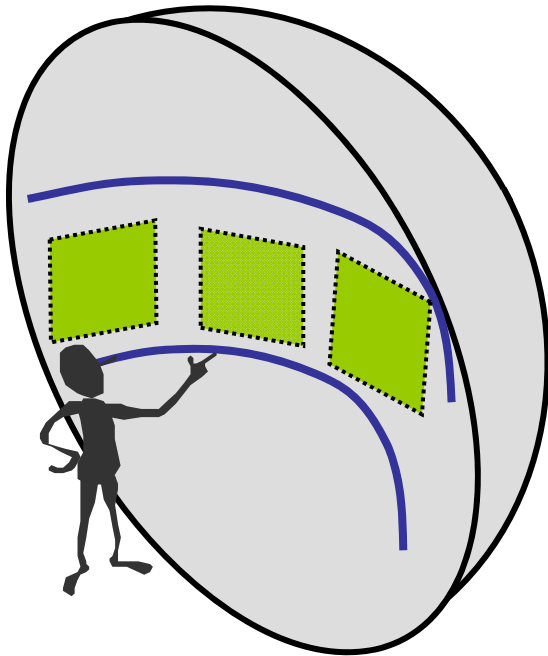
- Decrease of customers in planetarium
    - diversification of amusement facility
    - shortage of contents
  - Digitalization of planetarium facility
    - omni-directional image
    - shortage of creators
- ↓
- Purpose of this study
    - systematize production technique of space image in dome environment
    - promote utilization of planetarium facilities



planetarium facility

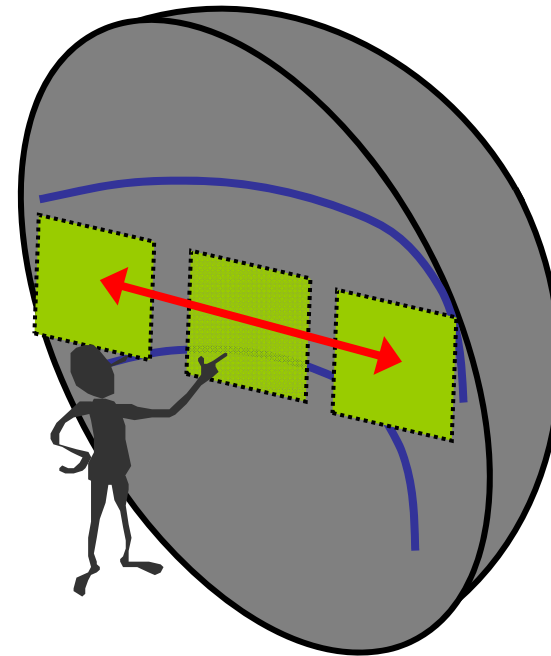
# Depth Sensation in Dome Environment

Static image is displayed  
when screen shape is  
recognized



- User feels the distorted image on the curved screen.

Moving image is displayed  
when screen shape is not  
recognized



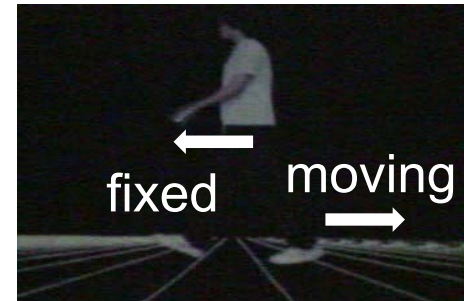
- User feels the correct image in the 3D space based on the motion parallax.

# Experimental on Depth Perception

- object: square, human



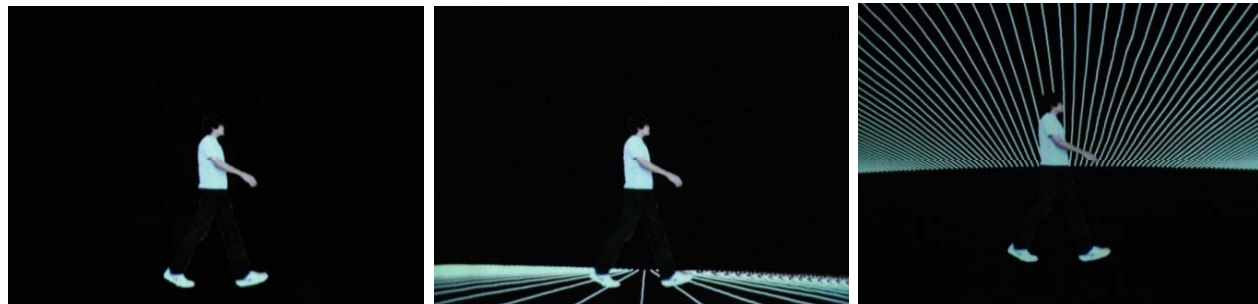
- view position: fixed and moving



- size: large, medium and small

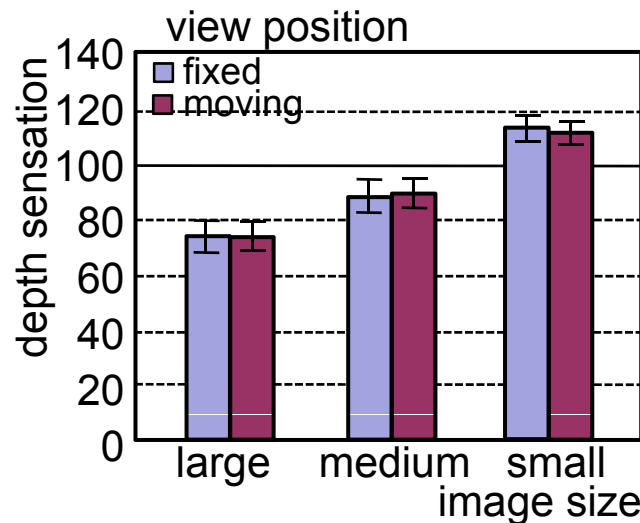
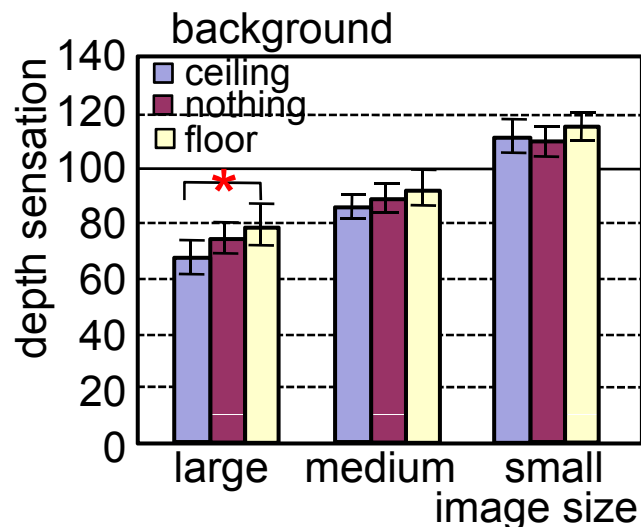
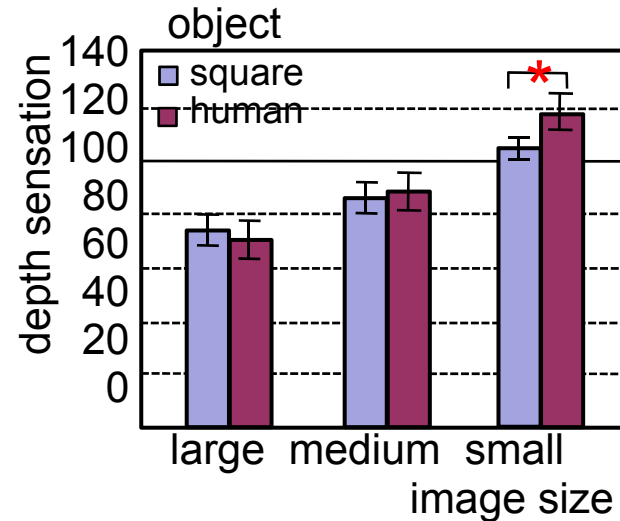
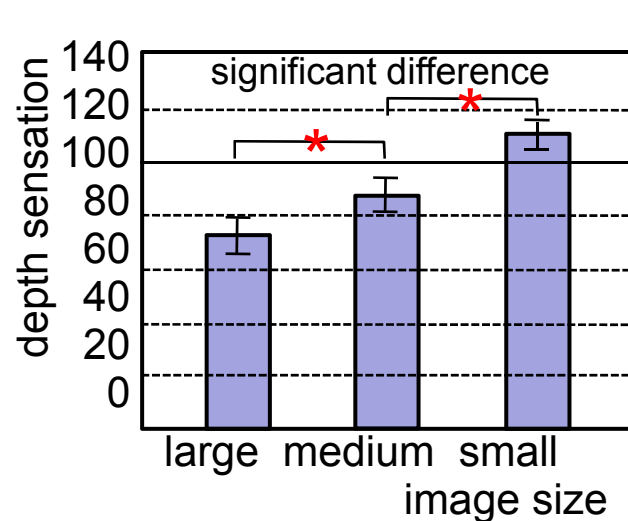


- background: nothing, floor and ceiling



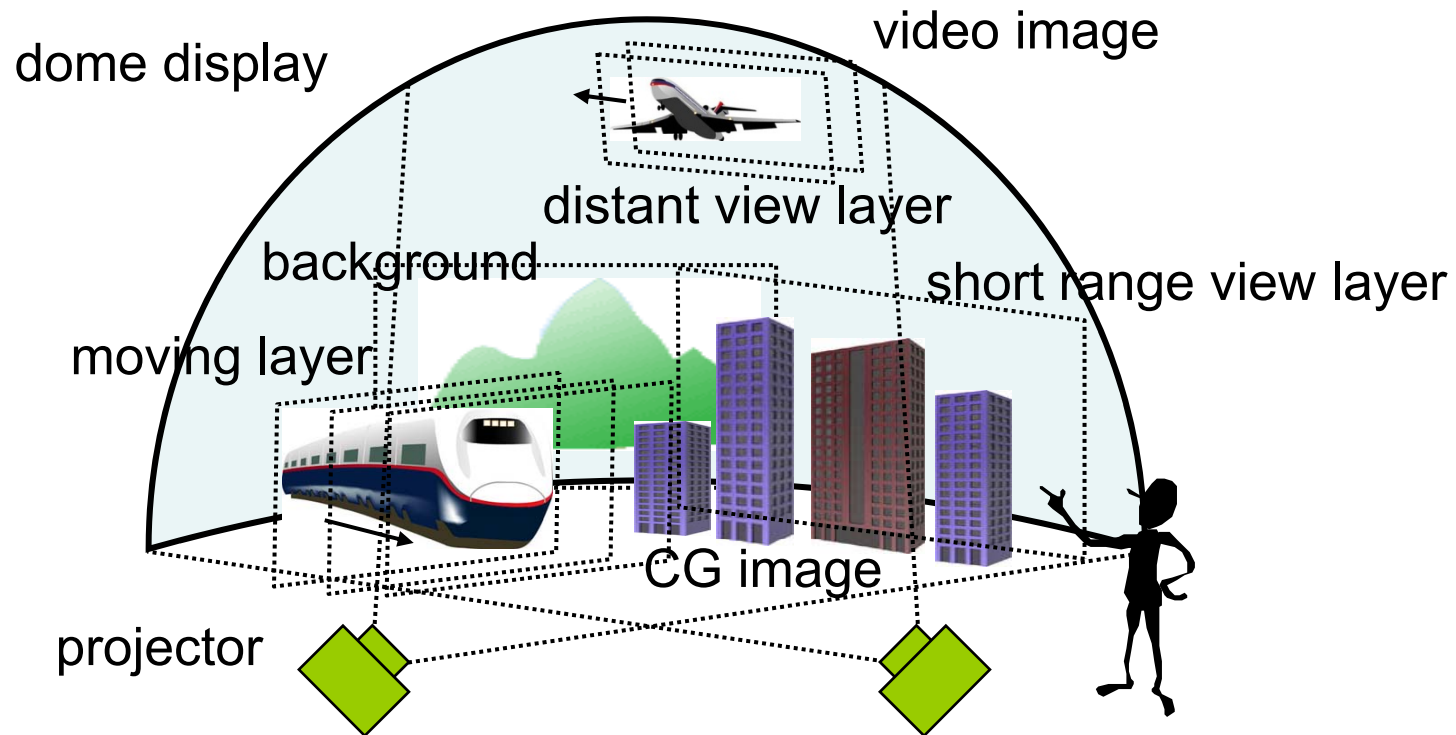
- 11 subjects were asked to answer the perceived distance of the displayed image using the magnitude estimation method.

# Experimental Results of Depth Sensation



- Depth sensation was changed according to the image size.
- Change of depth sensation was larger when human image was displayed.
- View direction was controlled by the background when image was large.
- Camera work generated the same effect as the movement of object .

# Layered Image Representation



- Image space is constructed by placing layered image elements.
- Movement of image elements or movement of camera work are given.

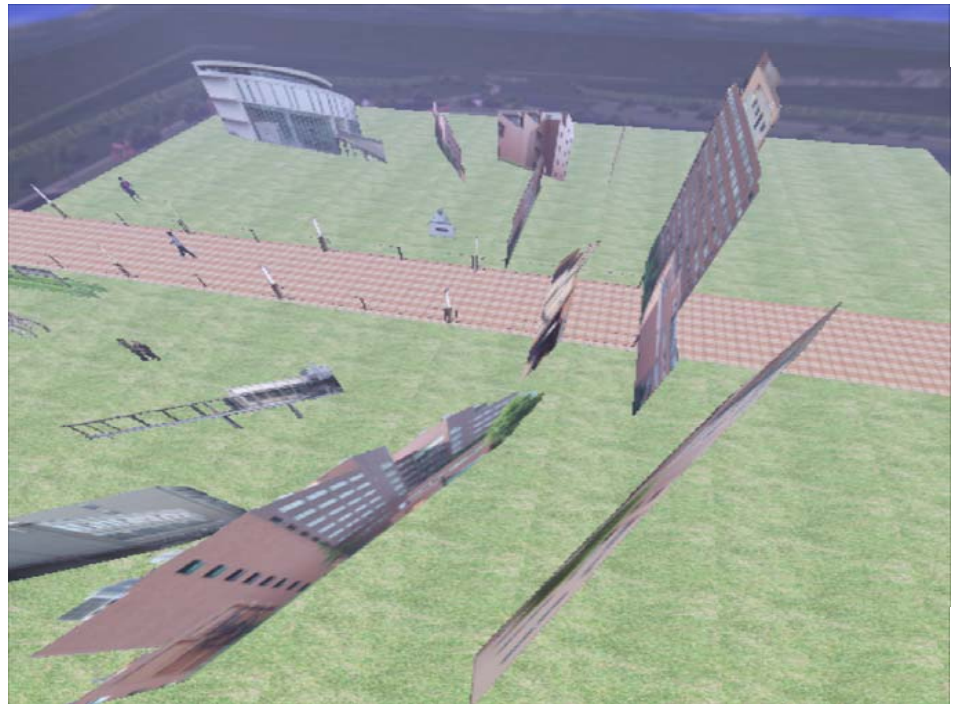


# Virtual World based on Layered Images

- Representation of 3D virtual world using 2D layered images



audience's view

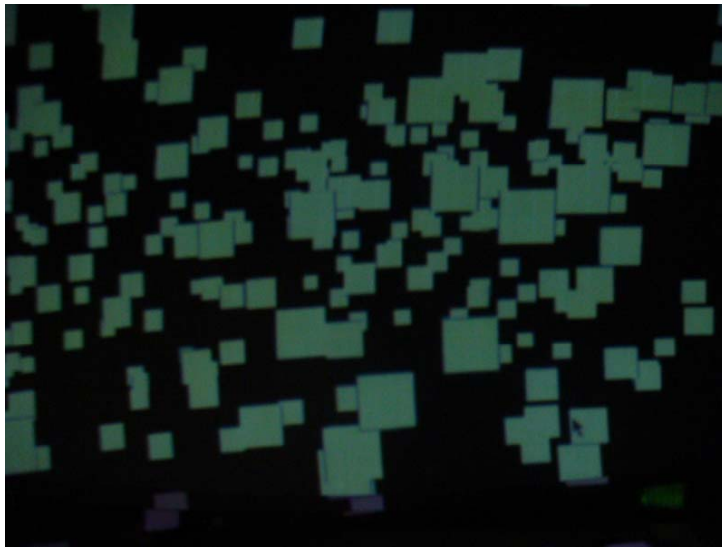


construction of layered image

# Experiment on Depth Sensation for Number of Layers

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- Moving square images were displayed in the dome environment, by changing the number of layers.
- Perceived vection was measured using the magnitude estimation method.

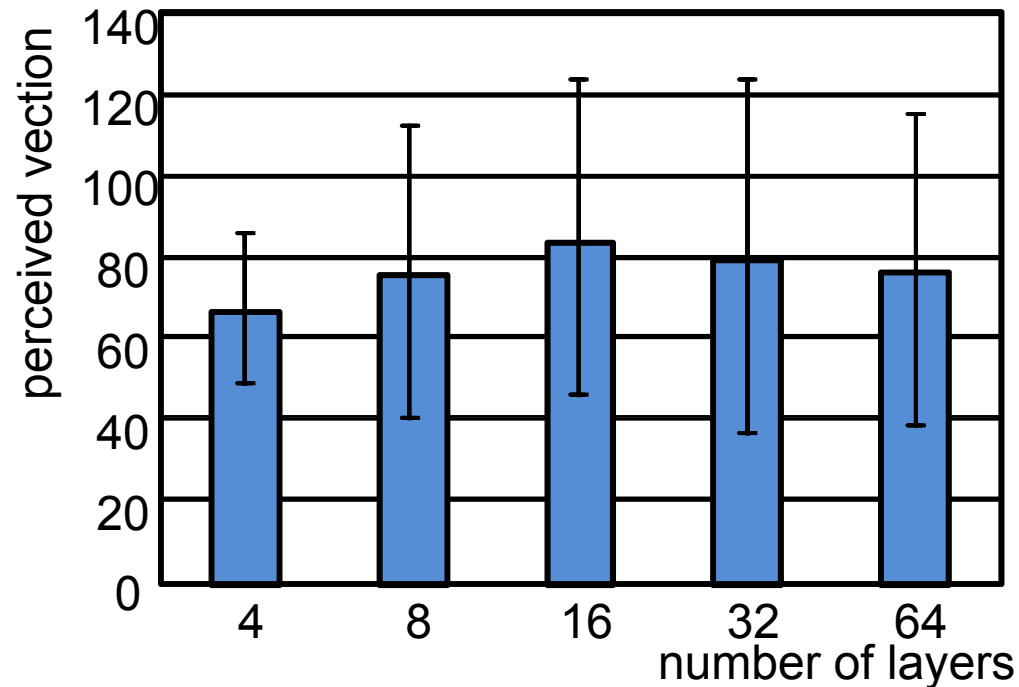


- Standard stimulus for the value of 50 was given by the image of 2 layers.
- Number of layers of the comparison stimulus was changed from 4 to 64.
- Each image was displayed in 15 seconds.
- Number of subjects was 8.



# Result of Experiment

- There was no significant difference among perceived vection when the number of layers was changed.
- Perceived vection was saturated, when the number of layers was 4.



- Image space can be represented using a few layers such as short range view layer, distant view layer and background image layer.

# Contents Evaluation



## - Method of experiment

Planetarium: Hokutopia (18 diameter)

LCD projector with fish-eye lense

Subjects: 13 university students

Evaluation method: five-grade system

Contents: Tsukuba express, University campus



# Result of Contents Evaluation

1 $\longleftrightarrow$ 5: did not recognize screen shape	4.20
1 $\longleftrightarrow$ 5: felt presence	4.13
1 $\longleftrightarrow$ 5: pleasant	4.13
1 $\longleftrightarrow$ 5: powerful image	3.73
1 $\longleftrightarrow$ 5: depth sensation	3.67
1 $\longleftrightarrow$ 5: comfortable	2.80
1 $\longleftrightarrow$ 5: untired	2.73
1 $\longleftrightarrow$ 5: did not perceive layers	2.67
1 $\longleftrightarrow$ 5: did not feel strange	2.20
1 $\longleftrightarrow$ 5: natural movement	2.07

- **Image space** in which users did not recognize screen shape was represented.
- Frequent **camera work** generated unnatural movement.

# Conclusions

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- Layered image representation method using the effect of motion parallax was developed.
- Perceived depth sensation for the number of layers was measured using the psychophysical experiment.
- From the result, we can understand that image space can be represented using a few layers.
- Future work will include the detailed investigation for the depth sensation when the number of layers is 2-4.