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
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

- 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.
- 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

<table>
<thead>
<tr>
<th>1 ←→ 5:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>did not recognize screen shape</td>
<td>4.20</td>
</tr>
<tr>
<td>felt presence</td>
<td>4.13</td>
</tr>
<tr>
<td>pleasant</td>
<td>4.13</td>
</tr>
<tr>
<td>powerful image</td>
<td>3.73</td>
</tr>
<tr>
<td>depth sensation</td>
<td>3.67</td>
</tr>
<tr>
<td>comfortable</td>
<td>2.80</td>
</tr>
<tr>
<td>untired</td>
<td>2.73</td>
</tr>
<tr>
<td>did not perceive layers</td>
<td>2.67</td>
</tr>
<tr>
<td>did not feel strange</td>
<td>2.20</td>
</tr>
<tr>
<td>natural movement</td>
<td>2.07</td>
</tr>
</tbody>
</table>

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

- 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.