132.C.G.Simulation of the Appearance of Aeronautical Ground Lights in Narita Airport

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1.INTRODUCTION

For safe take-off, landing and taxing of an airplane on the ground, aeronautical ground lights must be set up appropriately with suitable optic axis and should be viewed from pilot's eyes with proper luminous intensity distribution under various weather conditions. C.G.Simulation will be effective to analyze the appearance of lights for this purpose. The data about light intensity distributions of aeronautical grounds lights in Narita Airport are reserved in data base. And using these data, C.G.Simulation of the appearance of light patterns from a pilot's view are analyzed.

2.CONCEPT

2.1 Aeronautical ground lights

In Narita Airport, about 6000 of aeronautical ground lights composed of 30 types of lights are arranged around the runway and taxiway. Thanks for the cooperation of New Tokyo International Airport Authority, we have gotten many blueprints of the map of ground light. From these data, data base about position, optic axis and luminous intensity distributions of lighting fittings are composed. (see Fig.1).

Fig.1 Panoramic view of Narita Airport aeronautical ground lights

2.2 C.G.Simulation

This C.G.Simulation program follows the next processes.

- ① Calculate position and size of each light on the screen at constant interval of time, depending on position of light, position of viewpoint and direction of viewline.
- ② Calculate the illuminance at viewpoint caused by each light, depending on optic axis, luminance intensity distribution and the relation of position between light fittings and viewpoint. The illuminance is converted to the color on the screen.
- ③ Store the information for position, size, and color of each light on the screen to data file.
- ④ Read the data file and show on display at constant interval of time.

Fig. 2 Arrangement of lights in virtual XYZ coordinate (World coordinate)

Fig. 3 Rotation of viewline around the Z axis in the horizontal plane (World coordinate to viewpoint coordinate)

Fig. 4 Projection of light to screen (Viewpoint coordinate to screen coordinate)

Fig. 5 Example of simulation
 viewpoint position $(2406, 7.5, 10)$
 viewline angle $(0, 0, 8.82)$

For the analysis of position, size and color of each light on the display, following 3 source data are required.

- ① Position, and optic axis of each fixed light.
- ② Luminous intensity distribution of each kind of fixed light.
- ③ Viewing position and viewline direction at each observing time with constant interval.

Prepared 3 source data are used for conversion of coordinate system .

- ① Arrange all object in the virtual space according to actual arrangement (world coordinate, see Fig. 2).
- ② Set the viewpoint at the origin of the coordinate, and set new X' axis as the viewline. Calculating the relation of position between viewpoint and every objects on virtual space from arbitrary viewpoint (viewpoint coordinate, Fig. 3).
- ③ Project all objects arranged in viewpoint coordinate on to the display. Calculate illuminance at viewpoint caused by every lights, and converting illuminance to color (screen coordinate, Fig. 4).

3.RESULT

Above all, it become possible to calculate the appearance of light patterns from the pilot's view at arbitrary position of viewpoint and in arbitrary direction of viewline. Using appropriate data and algorithm, illuminance on the pilot's eye position caused by the aeronautical ground lights can be simulated.

At present, this program can not express arbitrary formed structure because every objects in the airport are perceived as a dot. And this program can not deal with glare objects. So, this Simulation program have to be upgraded for more fidelity including following subjects.

- ① Introducing Polygon model (or Solid model).
- ② Expressing glared object.