Development of a simulator for aids to navigation

Nippon Koki Kogyo Co.,Ltd.

Forum8 Co.,Ltd.

Project background

- Meeting of Nippon Koki Kogyo and Forum8 in Detroit in 2014

- Bring aids to navigation knowledge to virtual reality

- Bring virtual reality to flexibility to aids to navigation simulation.

Profile of Nippon Koki Kogyo Co.,Ltd

- History

  Nippon Koki Kogyo was established at Yokohama, in July 1919.

  For the first time in the world , we put to practical use the LED lantern in 1988 which was delivered to the Port of Kobe

- Products

  <Visual aids to navigation>

  LED lanterns, Rotating beacons, Direction lights,

  Lights on bridges, Floating marks, Rader reflector

  <Aviation lighting>

  Obstruction lights, Rotating beacons, Aerodrome lights

- Major customers

  Japan coast guard, Civil aviation bureau, Ministry of defense,

  Electric power companies, Telecommunication operators, and more

Forum8 VR-Design Studio

- Terrain
- Transport infrastructures
- Water / Forests
- Parks / Public facilities

Versatile 3D environment modeling tool

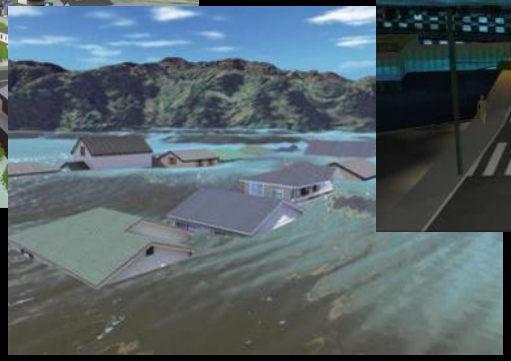
- Traffic and driving
- Lighting
- Hazards
- Construction
- Urban planning

Various type of simulations

- Meetings on VR-Cloud®
- Training
- Testing
- Project promotion

Communication and outputs

Urban planning



Tsunami simulation

Driving simulation at night

Meeting over Internet

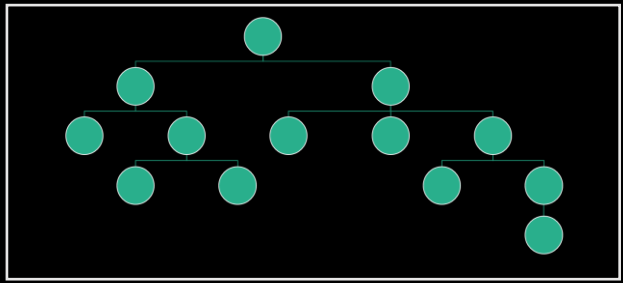
Focus of the development

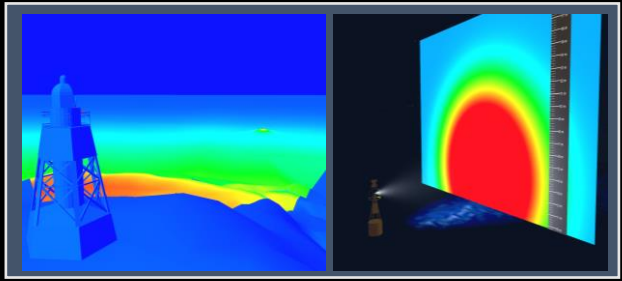
Provide a real feeling of the light

- For a better understanding

Real time visualization

- To efficiently test many scenarios



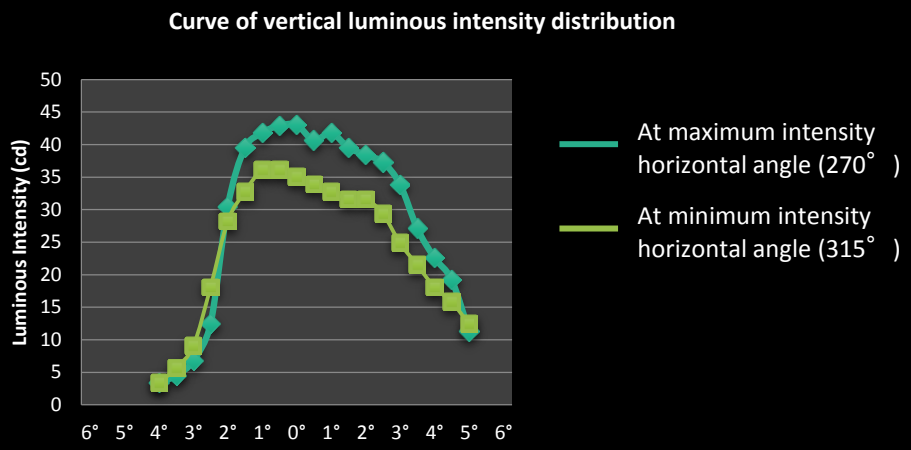


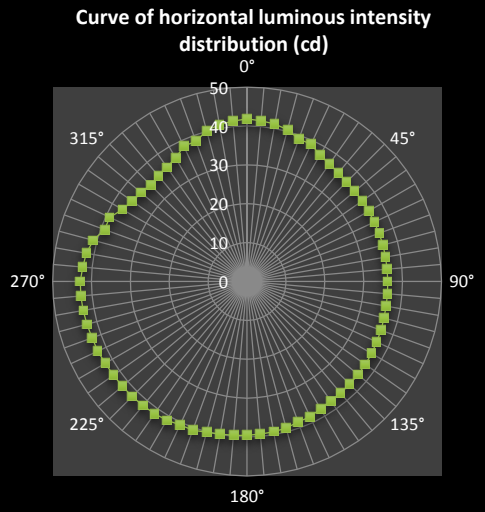
Input of actual measurement data

- For an accurate result

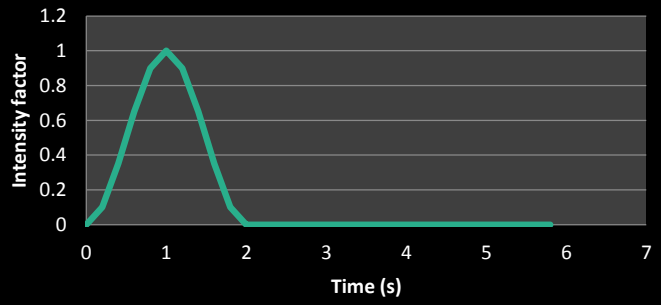
Light source definition

- Photometric data input





- Lighting character: period and intensity variation over time in the period
- Rotating light: revolving speed



- Filter: filter colour (CIE) or transparency modifying the light intensity or color depending on the horizontal angle

Rendering of a receiving surface

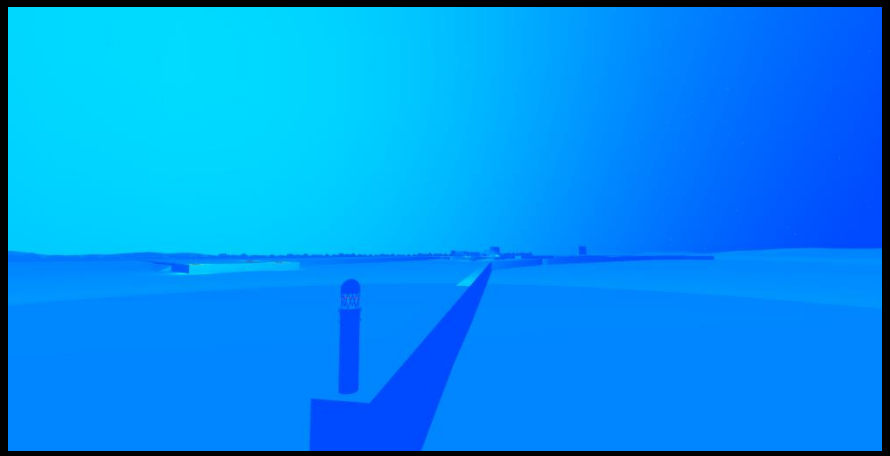
- Standard attenuation function:

$$\mathrm{E} = \frac{\mathrm{I} \times \tau^{\frac{d}{1NM}}}{d^2}$$

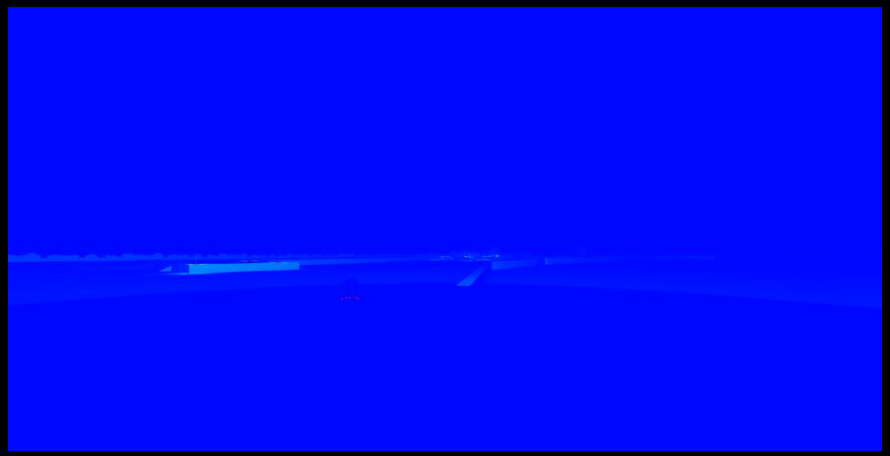
E = illuminance in Lux
I = luminous intensity in Candela.
τ= Air transmittance
1NM = length of one nautical mile (1852m)

- The calculation of the illuminance is carried out on the GPU of the computer for each pixels of the rendered image
- Conversion of Lux to RGB: gradient display or realistic display

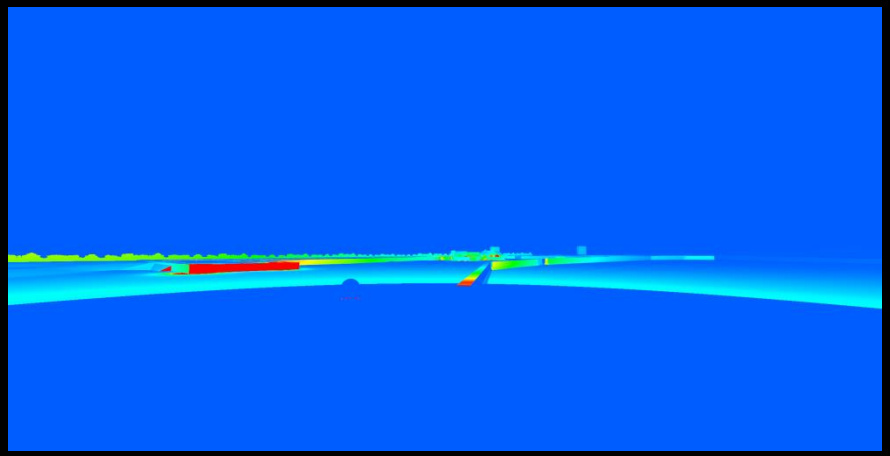
Rendering of a surface: gradient display



Scene 1 full moon



Scene 1 no moon

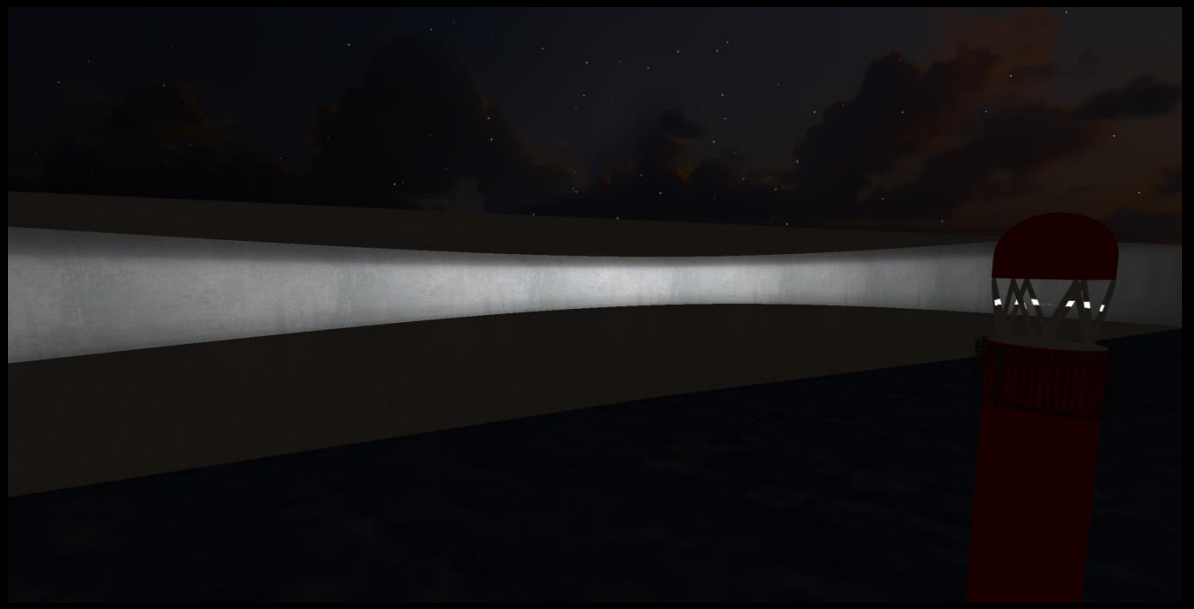


Scene 1 no moon narrow gradient setting

Scene 1 no moon no lighthouse

Rendering of a surface: realistic display

- Normalization of the Lux value by the Weber–Fechner law or Stevens' power law to the desired range fits in the screen luminance range.
- Conversion to RGB using the gamma value of the screen



Rendering of a light source

- 3 technics to represent the light:
  - Light arriving to the eye taking in account the visibility range
  - Light beam (reflection of light on particles in air) rendered depending on atmosphere transmissivity factor.
  - Lantern shape (sphere, cylindrical)

Next developments

- Validation of the rendering parameters in order to accurately reproduce the visual range
- Dynamic range of the RGB normalization in order to simulate the adaptation of the eye to the total light intensity
- Reflecting surface material parameters
- Improve physical atmosphere model (fog, rain, clouds)
- Implementation of a model for secondary light sources
- Port and equipment 3D model library

Perspectives and goals

- Improve simulation and planning for new lights or existing navigational aids.
- Use in navigation simulators
- Integration with VTS and real time representation of actual navigation situation