

Introduction of Research Work Using VR in Computational Mechanics Laboratory of Chuo University

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Topics

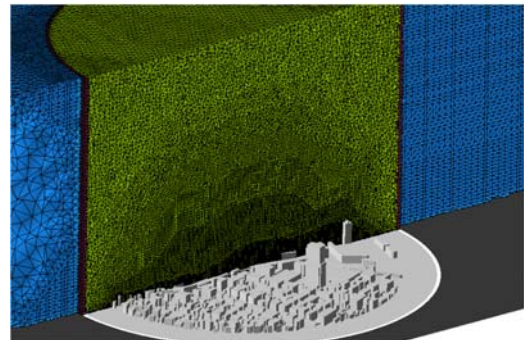
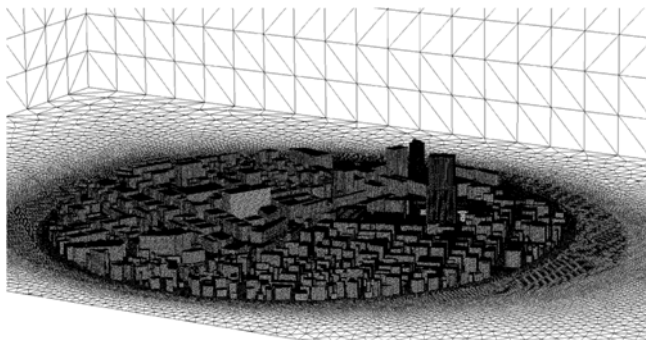
1. Introduction
2. VR Environments
3. Application Examples in Research and Education
4. Conclusions

Why do we need VR in computational mechanics?

The three dimensional numerical simulation become more popular in accordance with the development of hard- and soft-ware of computer.



The mesh generation method based on unstructured grid is usefully applied to the complicated domain.

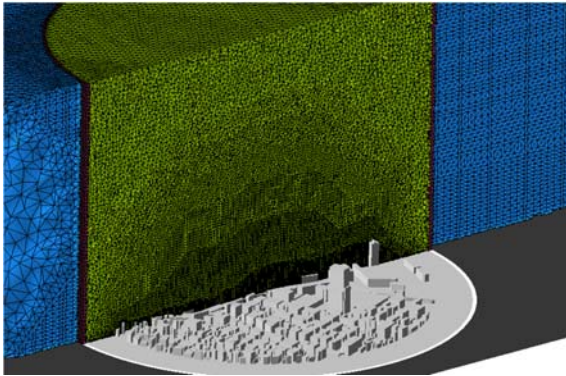


Mesh for wind flow in urban area

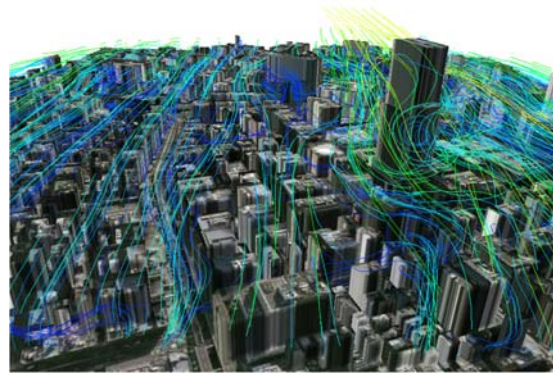
Why do we need VR in computational mechanics?

- 1) It is difficult to check the quality of shape model and mesh for the complicated spatial domain. (Pre-Process)
- 2) It is difficult to understand the three dimensional results since the computational results normally express on the screen or display using perspective drawing. (Post Process)

➔ **Application of VR technique to Pre and Post-processing**



Shape model and mesh



Computational results

VR System (Holostage)



7.1ch Sound System

Optics type motion tracker

2,100[mm]

2,800[mm]

2,100[mm]

PC cluster (1 master PC/4 slave PCs)

Semi-hard screen

VR System (software)

For visualization

- AVS/Express
- VR4 Max
- Fusion VR



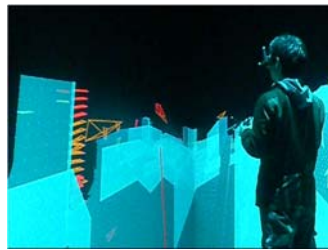
For auditory

- Max/MSP



For system development

- Cave library



Application of VR to Research and Education

Research

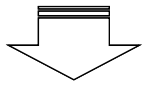
- Mesh visualization and modification system
- Flow visualization system for unstructured grid
(joint work with Kageyama and Ohno)
- Traffic noise simulation system
(joint work with Shimura and Tanigawa)
- Wind flow simulation in urban area
(joint work with Miyachi)
- Flood flow simulation in urban area

Education

- Application to road design
- Application to landscape design

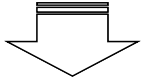
Application of VR Technique to 3D Numerical Simulation

Pre-Process (Modeling)



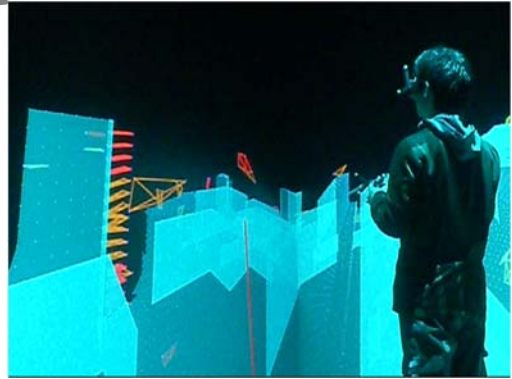
- Quality of shape model and mesh
- Modification of mesh idealization

Main-Process (Simulation)

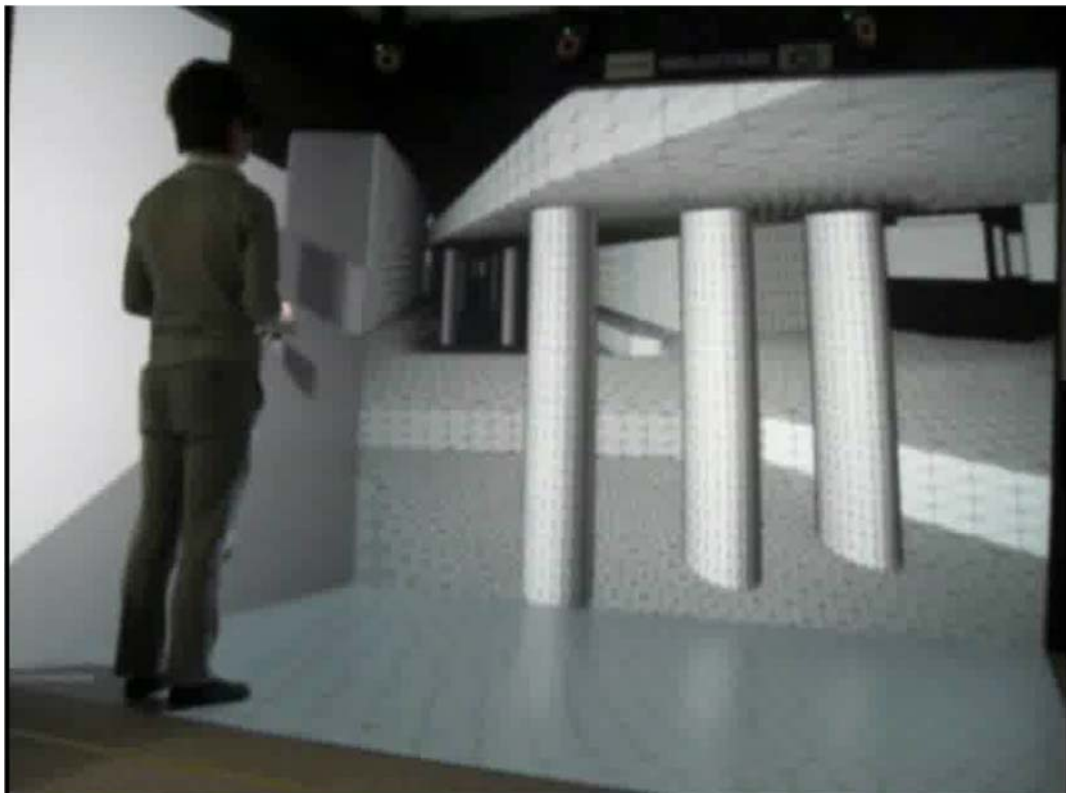


Post-Process (Visualization)

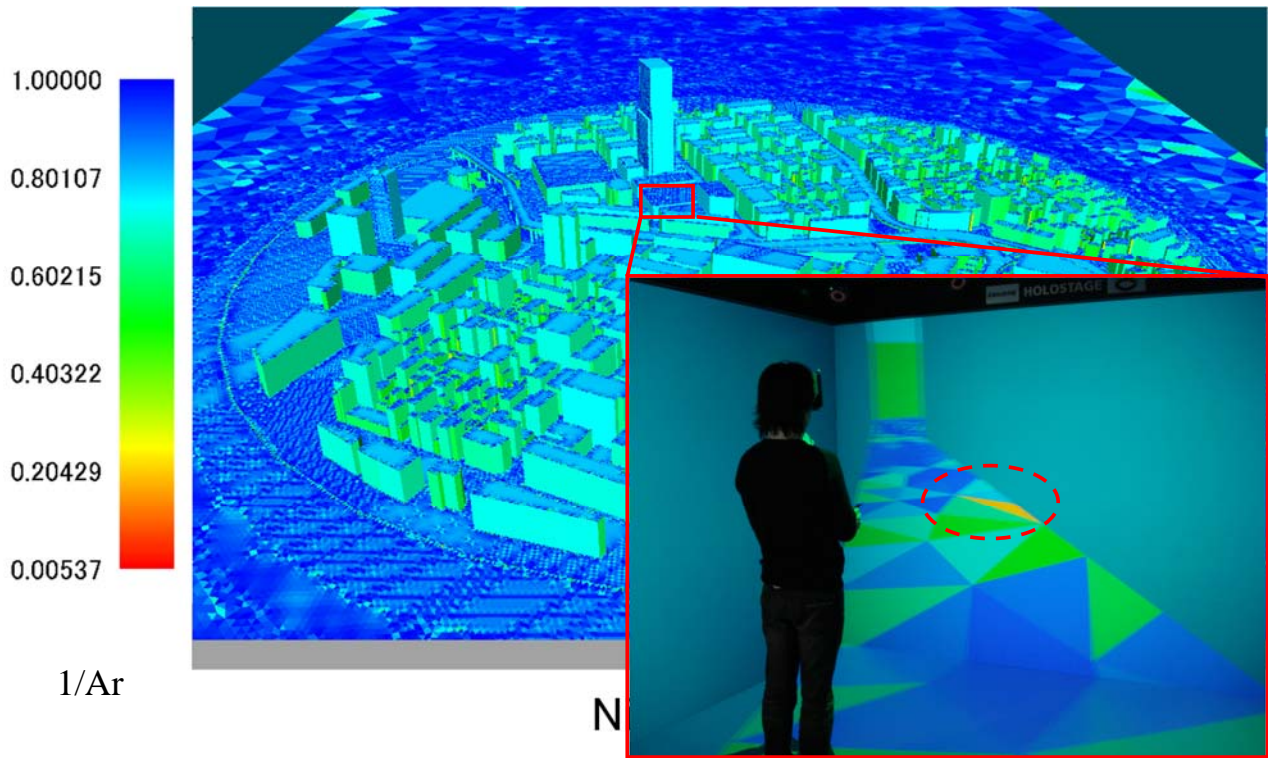
- Understanding for details of three dimensional numerical results (air and water flow/ noise)



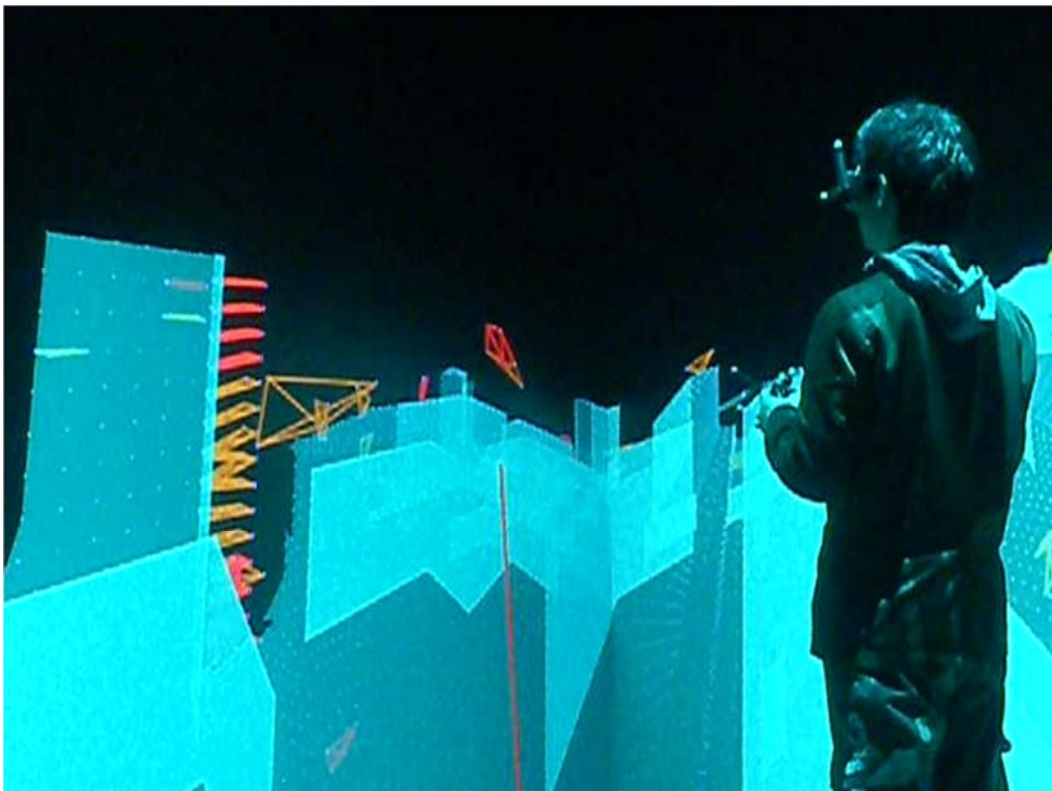
Mesh Visualization System



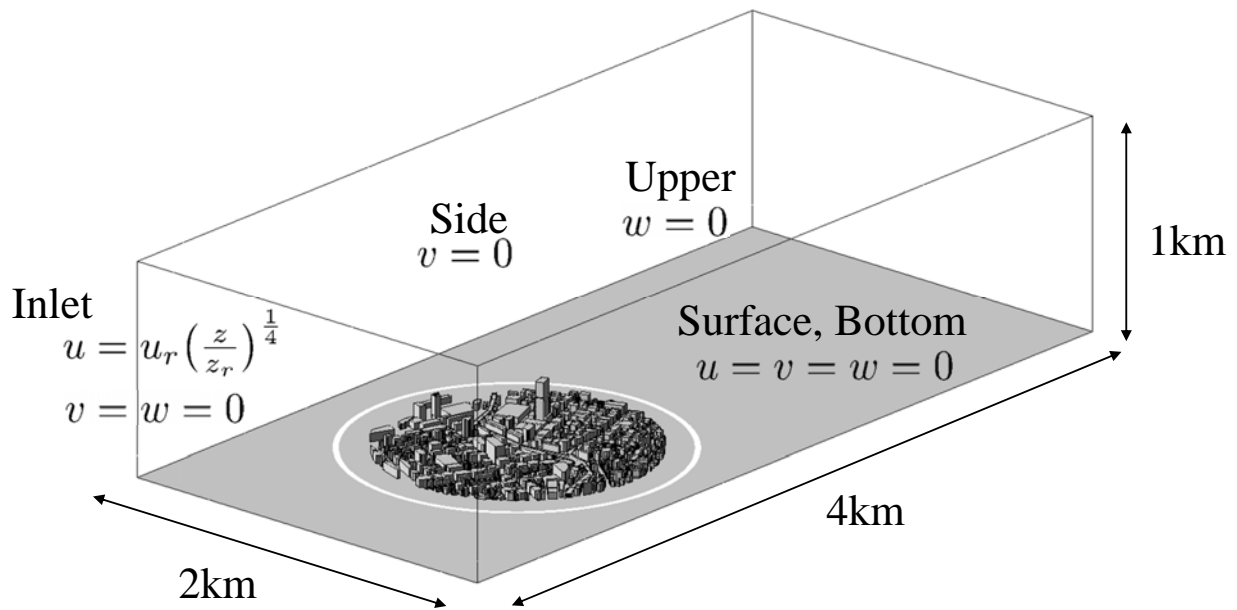
Visualization of Quality of Mesh



Mesh Modification System



Wind Flow Simulation (Boundary condition)



Wind Flow Simulation (Computed Streamline)



Visualization System for Unstructured Grid

Visualization of vector field

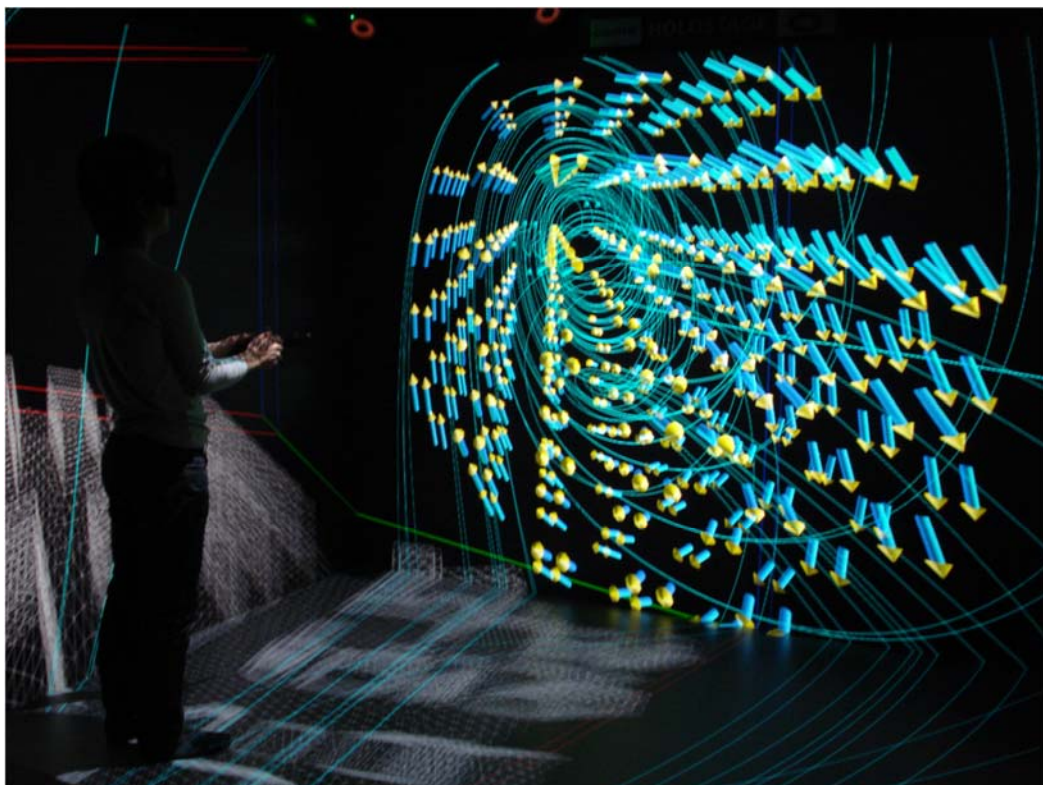
- Field Lines (stream line)
- Particle Tracer (line force)
- Line Advector (vorticity)
- Local Arrows (flow using arrow)
- Hotaru (macroscopic flow using particle)
- Snow (microscopic flow using particle)
- Probe (numerical value at the designated point)



Visualization of scalar field

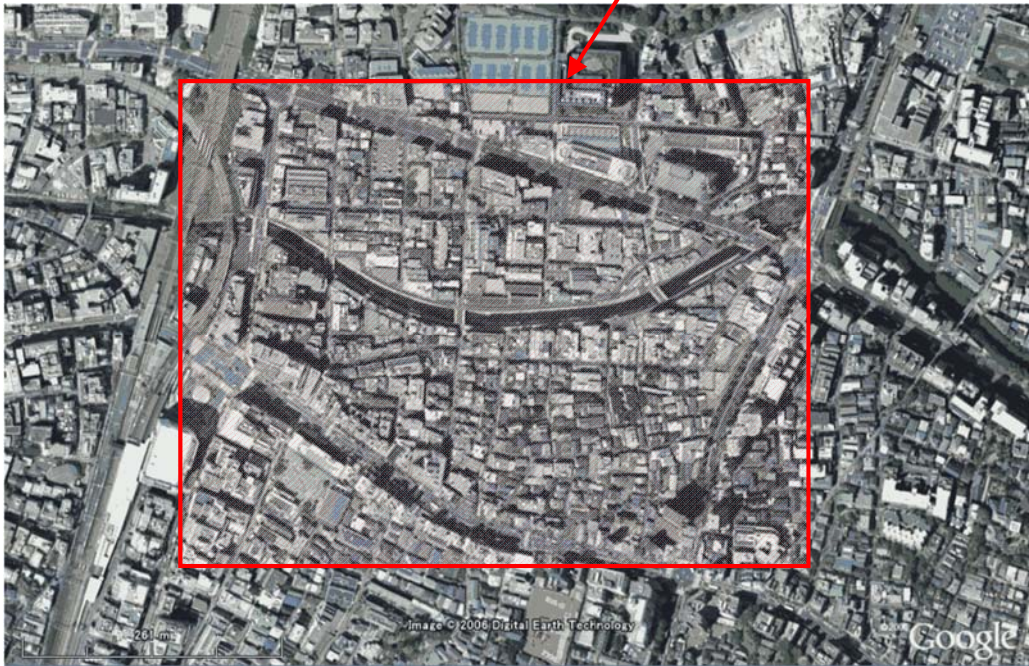
- Isosurface (isosurface)
- Local Slicer (scalar distribution specified section)
- Ortho Slicer (scalar distribution each coordinates section)
- Volume Rendering (volume rendering)
- Probe (numerical value at the designated point)

Interactive Visualization System

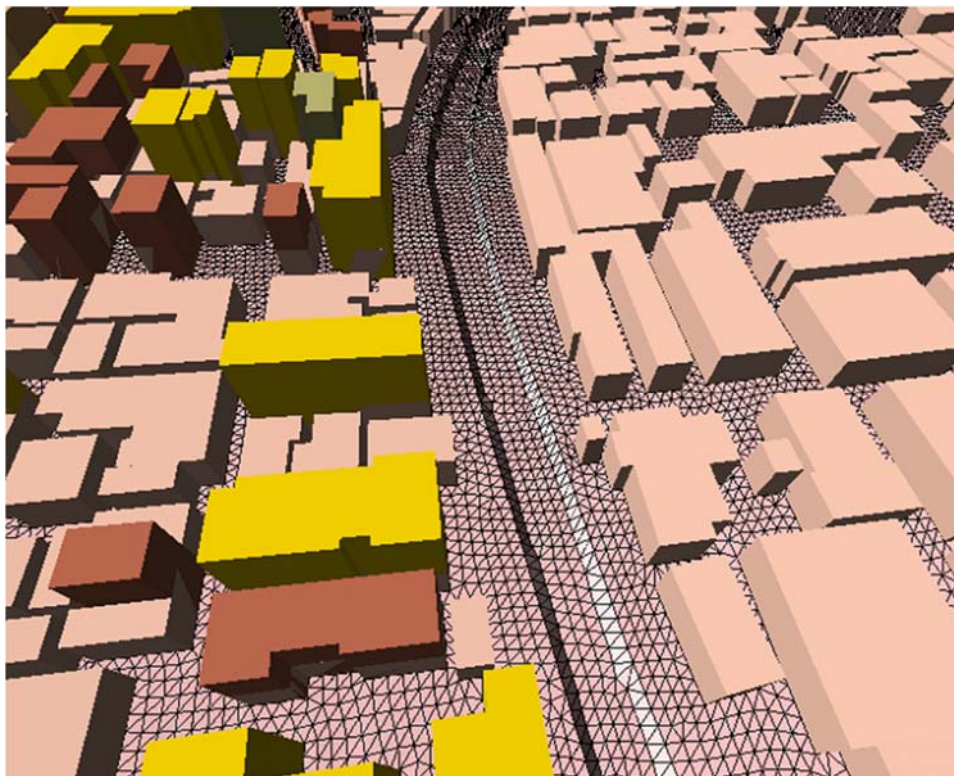


Flood Flow Simulation in Urban Area

Takadano-baba, Tokyo



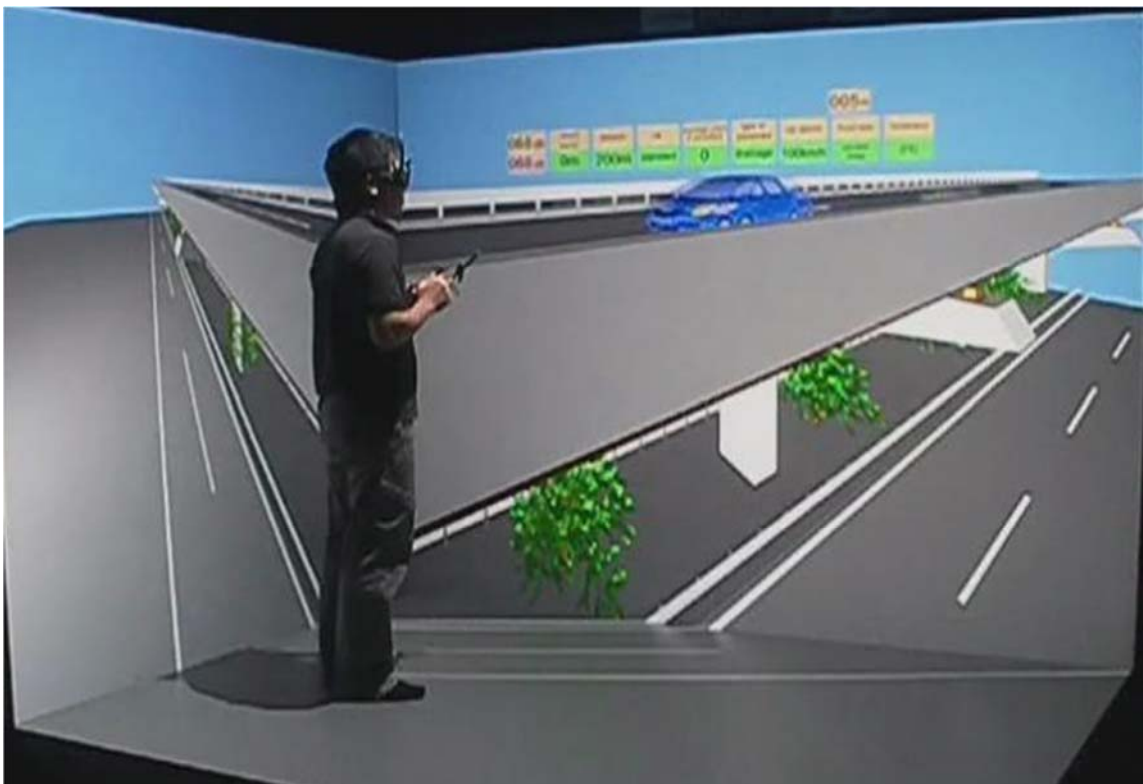
Finite Element Mesh Around River



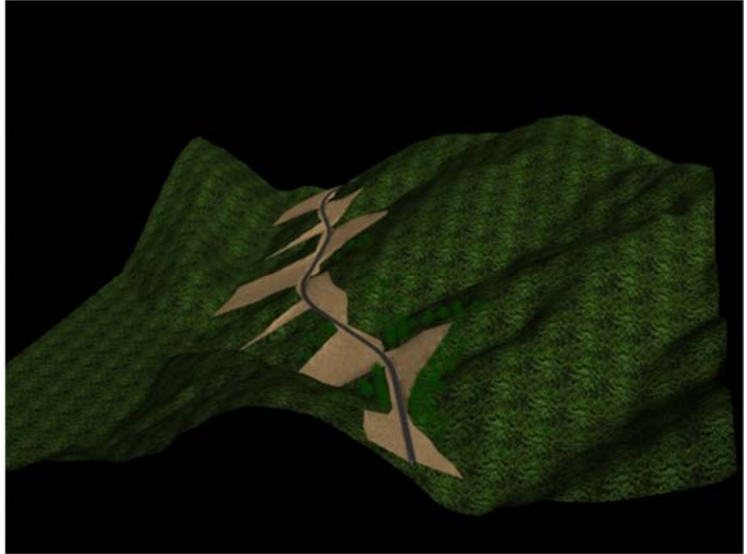
Application to Flood Disaster Simulation



Application to Road Traffic Noise Simulation



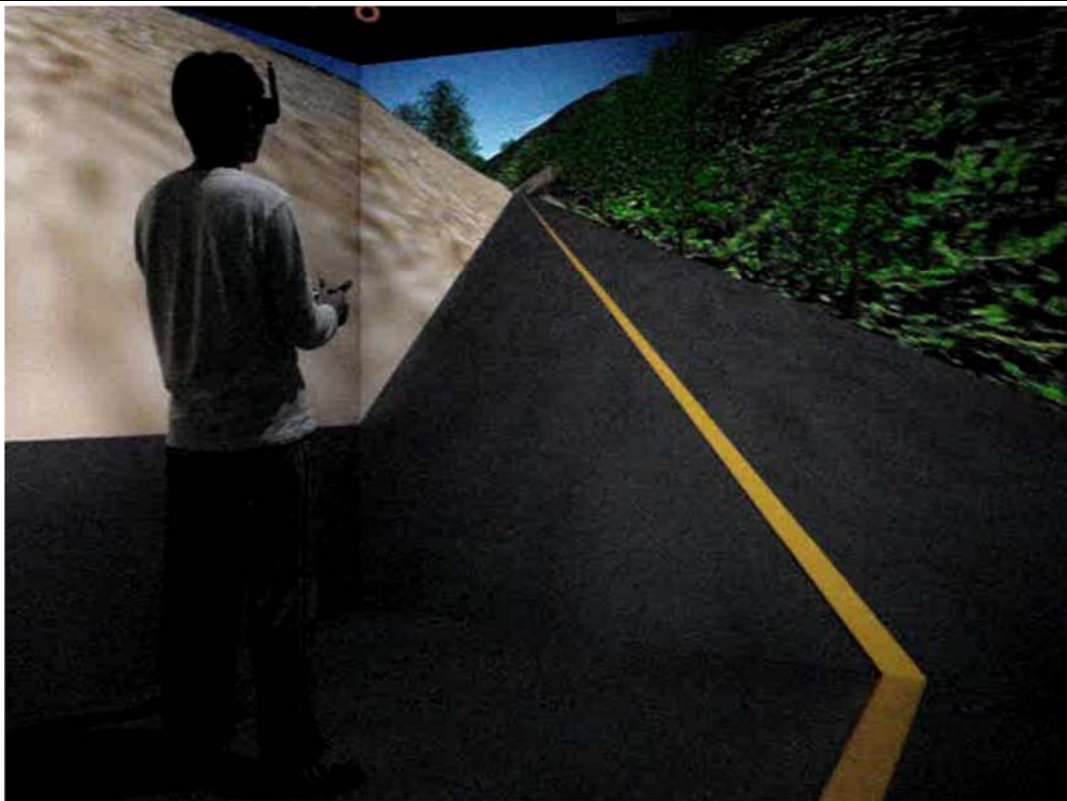
Application to Educations



The class for space design
in Chuo University
(Design of highway: junior)

We employ the VR to investigate the road alignment.

Application to Educations



Application to Educations



Special event for junior-high school and high-school students

We employ the VR to investigate the landscape design.

Conclusions

Research

- Development of Mesh visualization and modification system
- Development of Flow visualization system for unstructured grid
- Traffic noise simulation system
- Wind flow simulation in urban area
- Flood flow simulation in urban area

Education

- Application to road design/landscape design

It can be concluded that the application of VR provide useful tools to realize the high quality computing for large scale three-dimensional simulations.