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Cybermedia Center / Graduate School of Information Science & Technology

◆A PDA-based See-through-the-Lens Interface for Large Display Systems

◆A Grid-aware Access Control and Data Filtering Mechanism

◆World-wide Visualization Environment for e-Science over High-speed Networks

◆A Data Grid Environment for Research Using Ultra-High Voltage Electron Microscopy

◆Observation System for Transient Phenomena and Weather Forecast on Sensor Network

OSAKA UNIVERSITY

Booth No. 2023

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A PDA-based See-through-the-Lens Interface for Large Display Systems

Cybermedia Center, Osaka University, Japan

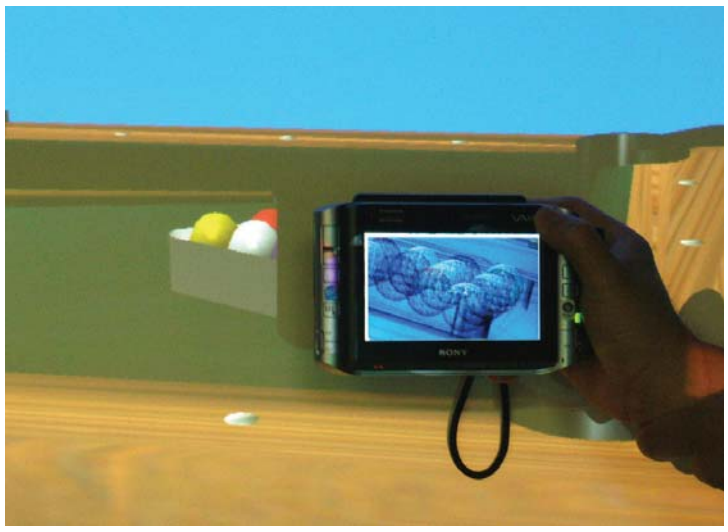

Fig.1 Our user interface in use

Introduction

Interaction in an immersive virtual environment is still limited by several factors such as imperfect depth cues and unstable hand placement in midair. In this poster, we summarize the design and implementation of a see-through the lens interface within an immersive environment (see Figure 1) to alleviate the abovementioned problems by simplifying the selection and manipulation processes using image based interaction techniques. A handheld device such as a PDA or a UMPC receives a video streaming in real-time corresponding to the area behind the PDA screen from the user's viewpoint. This gives an impression that the scene is seen through the PDA screen. Because most PDA screens are touch-sensitive, and because its 2D interface is fully programmable, flexibility in designing a 2D interface is quite high. Images on the screen can be used for direct manipulation, or stored for future reference. Selecting an element by touching the screen gives the user valuable feedback information that enhances the experience of the interface.

System Architecture

The prototype system was implemented as a client-server application for video streaming using the FFmpeg library (see Figure 2). We selected the MPEG codec using a TS (Transport Stream) over a UDP/IP protocol. To minimize the latency, our application produces only I-frames in the MPEG video streaming. We take advantage of the PTS (Presentation Time Stamp) that is included in every frame for performing the selection of objects on the PDA images. Every time an image destined to the PDA is rendered, we register its frustum and the user's viewpoint. Then, when the encoder assigns its PTS to the image, we store it together with its corresponding frustum and the user's viewpoint. On the client side, when the stream arrives, we decode and check for the PTS every frame. When user selects an object or freezes an image, we send its PTS, the command to be performed, and the touched screen position back to the server using a TCP/IP connection. Finally the server checks for the PTS and recovers the corresponding frustum and the user's viewpoint for rendering the image one more time in a background process and performs the selection test.

Performance Results

We employed the VR Juggler framework for high flexibility and interoperability. The server application has been tested on Linux and Windows using a Pentium 4 3.2GHz desktop computer with 1GB memory. A CAVE system using a Windows XP cluster with 17 nodes (Xeon 1.60GHz/1066MHz/Dual core, GPU ATI FireGL 7350/1GB Memory) has also been tested. A VAIO VGN-UX72 Intel Centrino Core 2 Solo, 1MB memory and a display of 1024 x 600 running Windows Vista was tested for the client's side. IEEE802.11g was used for the wireless connection. For the tracking system Flock of Birds and HiBall systems were used. With these equipments, the mobile device displayed 800 x 600 24-bits color images at 25 frames per second with a delay of around 1 sec.

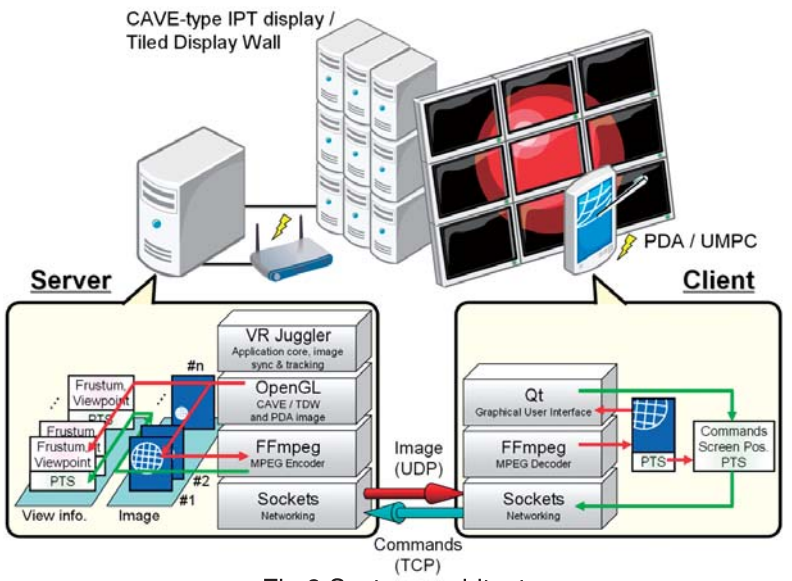

Fig.2 System architecture

Conclusion

We have proposed a PDA-based see-through the lens technique for interaction in an immersive virtual environment. With this interface the user is able to perform 3D operations on a 2D view of a virtual 3D space easily, which otherwise would be difficult or confusing to perform in 3D space. Future work includes conducting a rigorous user study and implementing various user interaction techniques.

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World-wide Visualization Environment for e-Science over High-speed Networks

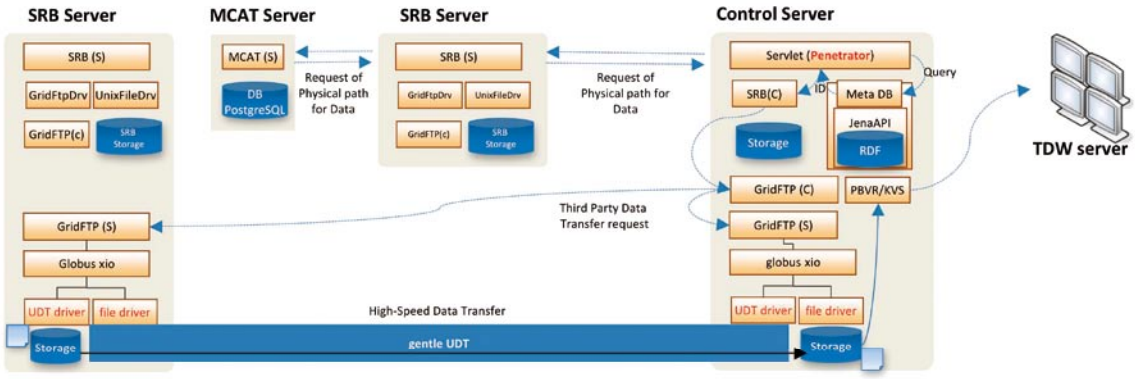
Cybermedia Center, Osaka University, Japan

The Applied Information System division of the Cybermedia Center aims for global computational and visualization services for scientific users. Not only large-scale computational facilities but also visualization service with petascale storage. We hope to promote next generation HPC/Visualization services with interdisciplinary scientists and companies.

HPC Analytic Science: Challenge for development of the world-wide platform of Visualization

Vorticity often causes chaos phenomenon in clinical cases. However, clinical cases are sometimes very hard to analyze and quantify as evidence. In some cases, Large Eddy Simulation (LES), a turbulence model, may help medical science computationally because it can estimate the effects of vorticity. Hence, speech science, which uses oral functions, will shift to a speech e-Science that regards vorticity as one of its main factors. (For LES analysis, we used FrontFlow/Blue.) However, LES analysis requires a huge amount of computational cost due to its algorism; moreover, a huge amount of analytical data needs to be exported in order to be visualized effectively. Therefore, the Cybermedia Center has been developing a remote visualization and database infrastructure similar to our SC07 demo that will share computational resources and visualization resources with speech scientists. Currently, as the core visualization technology, Particle- Based Volume Rendering was chosen because of its scalability and confidence of the interpolation for FEM simulation method.

Database and Visualization in e-Science Infrastructure



Scientific Visualization Middleware: Expansion modules for Tiled Display Wall

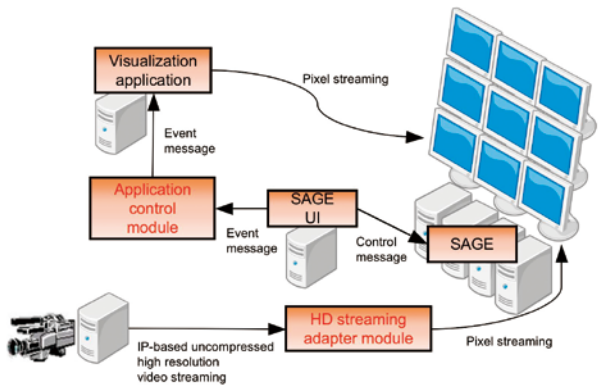
Application Control Module for SAGE

Recently, SAGE (Scalable Adaptive Graphics Environment) has been received attention as a middleware that allows scientists to control and drive a TDW. The most promising feature of SAGE is that it enables scientists at a site to visualize scientific data on a TDW located at the site through the use of network streaming technology even if the scientific data are stored and generated on different sites.

However, SAGE does not have any function or method to let the visualization application know user input from its user interface, SAGE UI. Thus, users have to use the application's interface directly without using SAGE UI. For the unification of these interfaces, we develop a built-in application control module for SAGE.

HD Streaming Adapter Module for SAGE

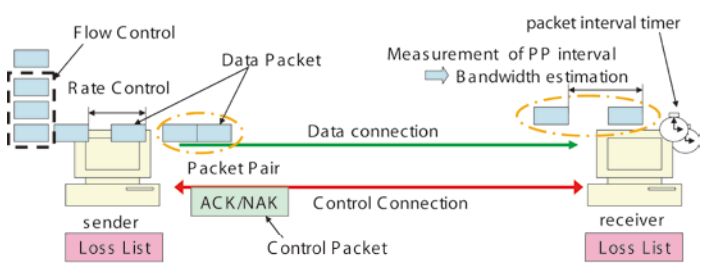
The advancement of networking technology allows transmission of uncompressed High Definition video over the Internet. We have been developing an HD streaming adapter module for SAGE that allows HD streaming video to be displayed in real-time on a SAGE-based TDW.

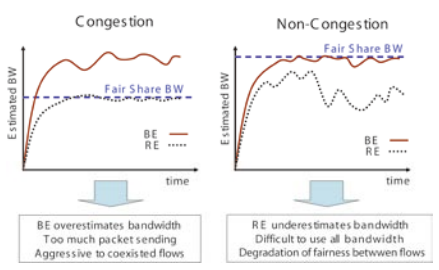


High-Speed Data Transfer Protocol: gentle UDT with fairness over High-speed networks

e-Science applications such as some Grid applications, World-wide data sharing applications, etc., require the transfer of large amounts of data over long distance networks. The throughput of conventional TCP (Reno or NewReno) over LFNs (Long Fat pipe Networks) is much smaller than the application requirements. High-speed protocols are being developed to overcome this problem. However, the fairness of these high-speed protocols with conventional TCP is not sufficient in LFNs.

Therefore we propose high-speed transport protocols considering fairness with other traffic in LFNs. One protocol is a "gentle UDT". The original UDT (UDP based data transfer protocol) is a high-speed protocol that estimates available bandwidth on the receiver side by using packet-pair algorithms. However, the fairness of UDT with conventional TCP and UDT itself over LFNs is not good enough because of late detection of congestion. Our gentle UDT can improve the fairness and achieve enough throughput over LFNs. We develop an estimation algorithm using a packet train with early recognition of congestion, and develop the AIMD algorithm with this recognition.





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A Grid-aware Access Control and Data Filtering Mechanism

Cybermedia Center, Osaka University, Japan

Recently, the Grid has increasingly gathered the attention and interest of scientists and researchers as a building block technology for computational infrastructure. In reality, however, the Grid is not utilized well in today's actual scientific research areas because of security problems. Generally, in a Grid environment, many users with various user attributes are supposed to utilize a diversity of computational and data resources. For this reason, an access control solution that forces users to access such resources properly depending on the users' attributes is essential.

Architecture of our Grid-aware Access Control and Data Filtering Mechanism

In general, access control is performed through the two operations of authentication and authorization. Authentication is an operation of verifying the identity of the individuals, and authorization is an operation that determines what kind of actions can be permitted to the identified individuals.

Our Grid-aware access control and data filtering mechanism takes advantage of the synergy of Grid Security Infrastructure (GSI) and MyProxy as authentication technologies, Privilege and Role Management Infrastructure Standards (PERMIS) as an authorization technology, and XSLT (XML Stylesheet Language Transformations) as an filtering technology. Our Grid-aware access control allows users to access data of their interest based on Role-based Access Control (RBAC) using digital certificates.

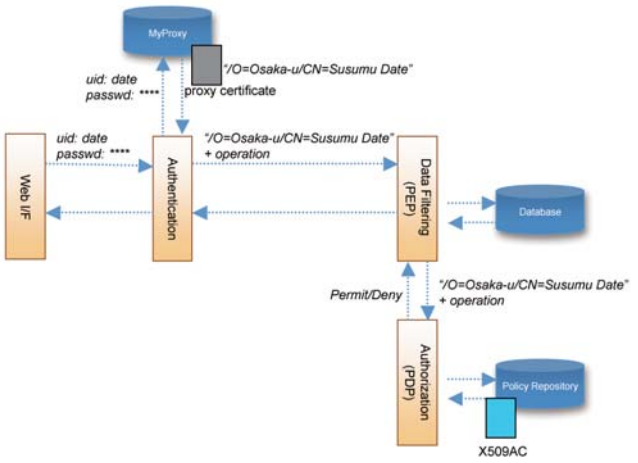

Fig.1: Access Control and Data Filtering Mechanism in Action

The mechanism is composed of Authentication, Authorization, and Data Filtering modules. Authentication module uses MyProxy, an on-line credential repository for retrieving users' proxy certificates registered in advance. The Authorization module as a policy decision point contacts the Policy Repository to retrieve an attribute certificate corresponding to the users' role. The Data filtering mechanism filters XML data retrieved from the Database to appropriate XML data to the users' role.

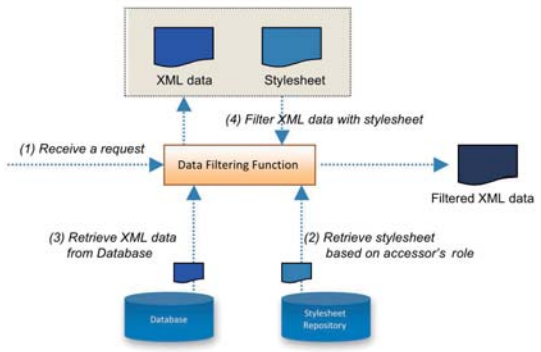

Fig.2: Data Filtering Module (PEP) in Action

The XML data retrieved from the Database is filtered with a stylesheet appropriate to the accessing user's role. The stylesheet is written in XSL.

Application Example: A Clinical Database for Parkinson's Disease Research and Diagnosis

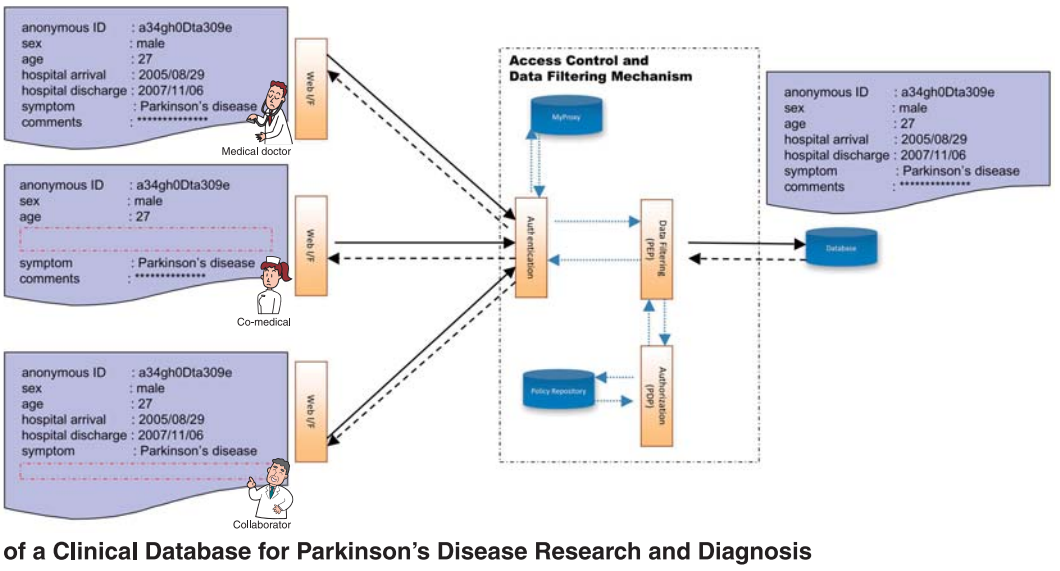

Fig.3: Architecture of a Clinical Database for Parkinson's Disease Research and Diagnosis

The clinical data pertaining to Parkinson's disease is filtered on an XML element level based on the accessing users' role, i.e., medical doctor, co-medical, and/or collaborator and is then delivered to the users. The clinical data is written in Medical Markup Language (MML), which conforms to Health Level 7 (HL7).

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Observation System for Transient Phenomena and Weather Forecast on Sensor Network

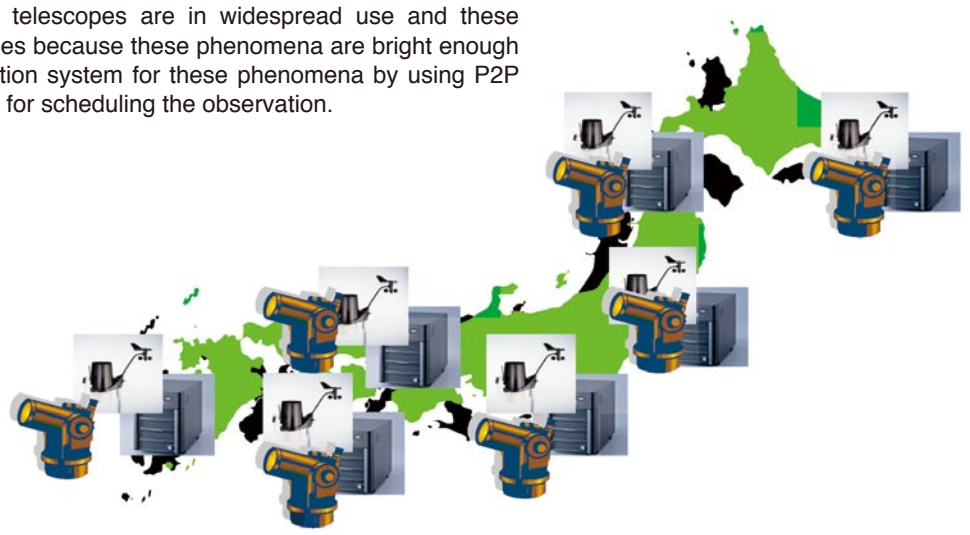
Hyogo University of Health Sciences

Introduction

Transient phenomena such as super novae and gamma-ray bursts often occur in our universe. However, it is difficult to get the first few minutes of data because we cannot predict when these phenomena occur. On the other hand, small telescopes are in widespread use and these phenomena can be observed by these telescopes because these phenomena are bright enough to observe. We present a cooperative observation system for these phenomena by using P2P infrastructure and a weather forecasting system for scheduling the observation.

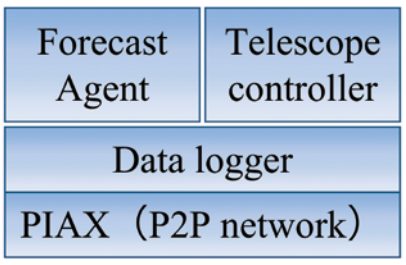
P2P Platform

We adopt the P2P architecture as our application platform for controlling many telescopes, images and weather sensor data. In general, discovering the data effectively is difficult. We use PIAX (P2P InteractiveAgen eXtensions, http://www.piax.org/) as a platform. PIAX, which is developed by Osaka University, can search and get data on the basis of its location information effectively by DHT and LL-Net.

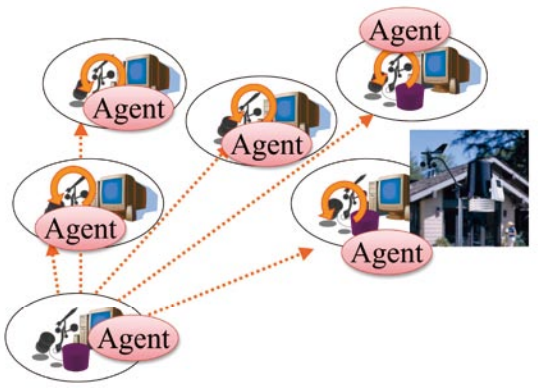


Observation and Weather Forecasting System

We built a system for controlling the telescopes and imaging devices and forecasting the local weather by weather sensor data. In order to schedule observations, knowing the local weather information is necessary. But the local weather changes during 10 minutes order. So we use not only public information but also the local weather sensor data. We collect the weather data by a mobile agent implemented by PIAX and predict the local weather by AR (auto-regressive) model and interpolate the data at certain points. We schedule the observation by these information and get the image data of the phenomena.

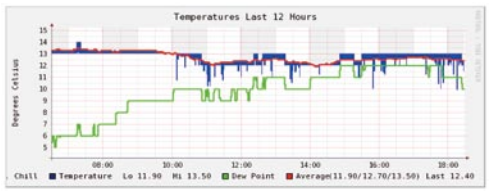


Software architecture of each peer

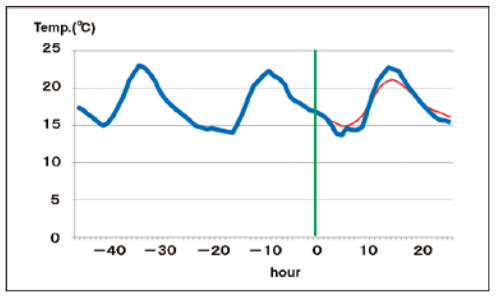


Behavior of mobile agent

Example: multiple weather sensor data

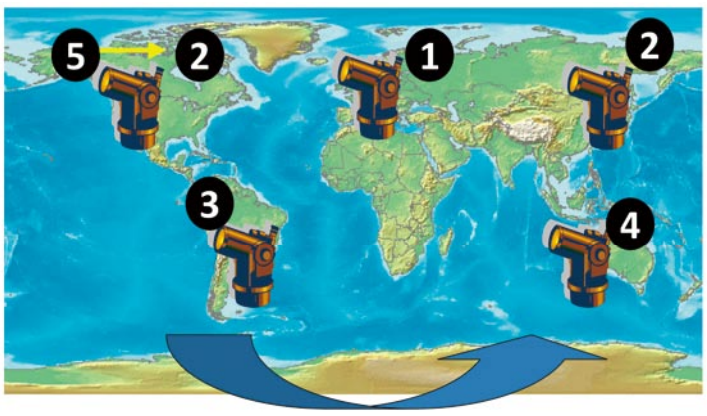


Data collection by P2P agent
The agent predicts the weather by using the historical data



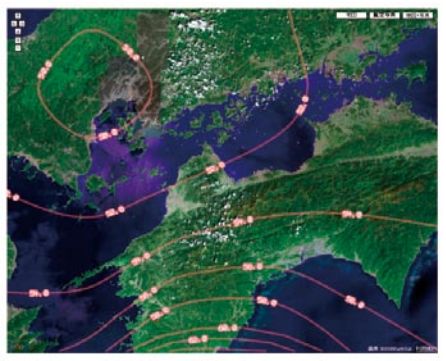
Blue: original data　Red: predicted data

Get forecast information at the any point by interpolation



Case: 24 hours cooperative observation network

Decision of observation schedule in accordance with the weather forecast information



Interpolated map of weather data

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A Data Grid Environment for Research Using Ultra-High Voltage Electron Microscopy

Cybermedia Center, Osaka University, Japan

Background

Recently, remote observation of Ultra-High Voltage Electron Microscopy (UHVEM) at Osaka University has become feasible. However, an infrastructure for easy access to image data is not available. The image data are generated at a CCD (Change Coupled Device) camera-control terminal (Microsoft Windows 2000). To obtain the image data requires a lot of time for the remote user. For remote observation of electron microscopy, remote operation as well as remote access to image data should be enabled. The remote access should be simple and as easy as possible. Remote users will want to share data in research groups and do image processing such as tomographic/3D reconstruction.

Our Approach

As a solution to satisfying the above requirements, we have constructed a data grid environment with NAREGI grid middleware. Figure 1 shows the proposed system.

The Japanese NAREGI (National Research Grid Initiative) project has made fundamental building blocks in the Cyber Science Infrastructure (CSI) project promoted by the National Institute of Informatics (NII), and NAREGI's goal is to provide an integrated grid computing environment for widely distributed research and education. The NAREGI grid middleware has been developed in order to create such an environment, and its platform is the Globus Toolkit version 4.0.

The data flow in the proposed system is as follows. (1) Uploading data. The data created at the CCD camera-control terminal are uploaded semi-automatically to a Gfarm client server. The Gfarm client imports the data into a Gfarm file system (a shared file system). The NAREGI middleware does not provide a function for data transfer from the CCD camera-control terminal to the shared file system. Therefore, we have developed software that links up with the operation of electron microscopy and transfers the data to the shared file system mounted by Samba on the control terminal. (2) File browsing. The user can browse and search the data imported to the shared file system on the NAREGI web portal, and can also do image processing without being conscious of file transfer to worker nodes. (3) Data transfer and downloading. The data in the shared file system are available through the NAREGI portal. The user can copy the data to a local GridFTP server. Those features in (2) and (3) are provided in the NAREGI middleware.

Future Plans

Currently, we are evaluating the function of the file transfer to the GridFTP server provided by NAREGI middleware to give priority to the demands of users who wants to obtain the data. For the next step, we need an evaluation of workflow for image processing such as is used in tomographic/3D construction. Moreover, we will consider providing a command-line interface for the user who does not prefer the Web-user interface.

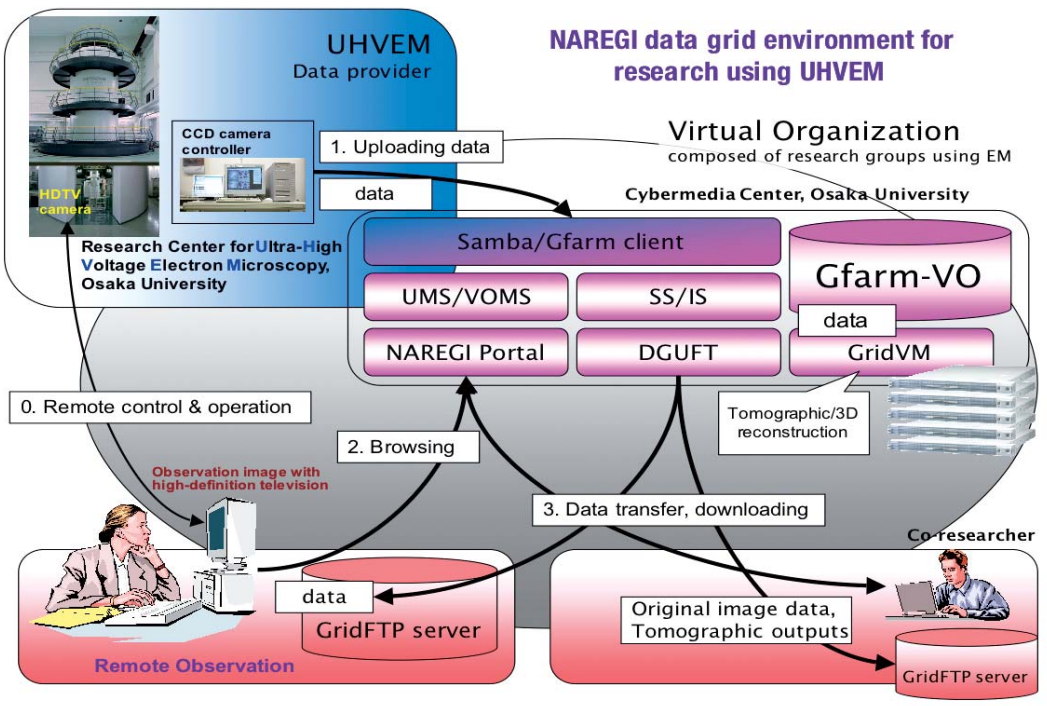

Figure 1. NAREGI data grid environment for research using UHVEM

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Uncompressed HDTV on Tiled Display Wall and 10-Gbps High-Accuracy Distributed Network Monitoring

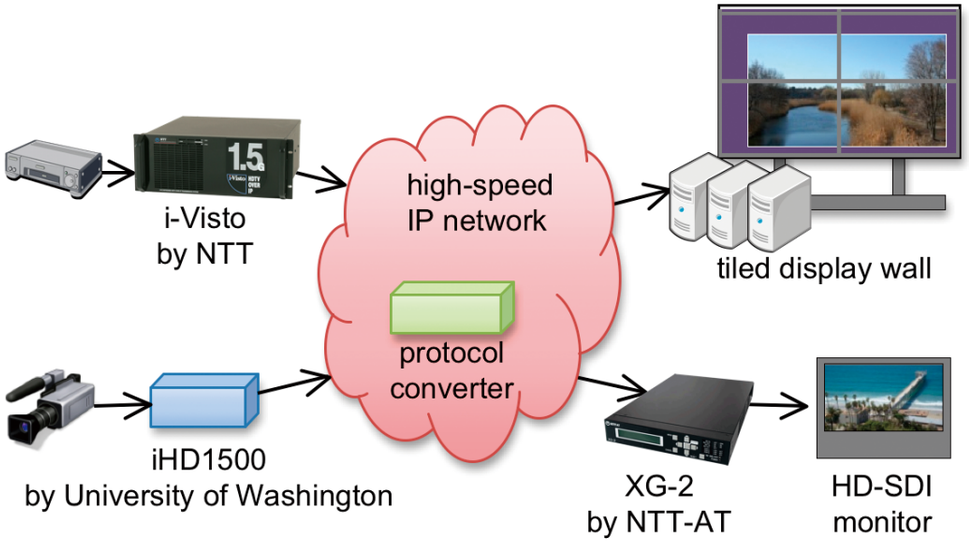
NTT Network Innovation Laboratories
and Cybermedia Center, Osaka University

Uncompressed HDTV on Tiled Display Wall

Osaka University and NTT have developed an uncompressed HDTV streaming system for a tiled display wall. The system can receive HDTV streams from the NTT i-Visto system.

NTT has also developed a protocol converter, which enables interoperation between i-Visto and iHD1500 developed by the University of Washington.

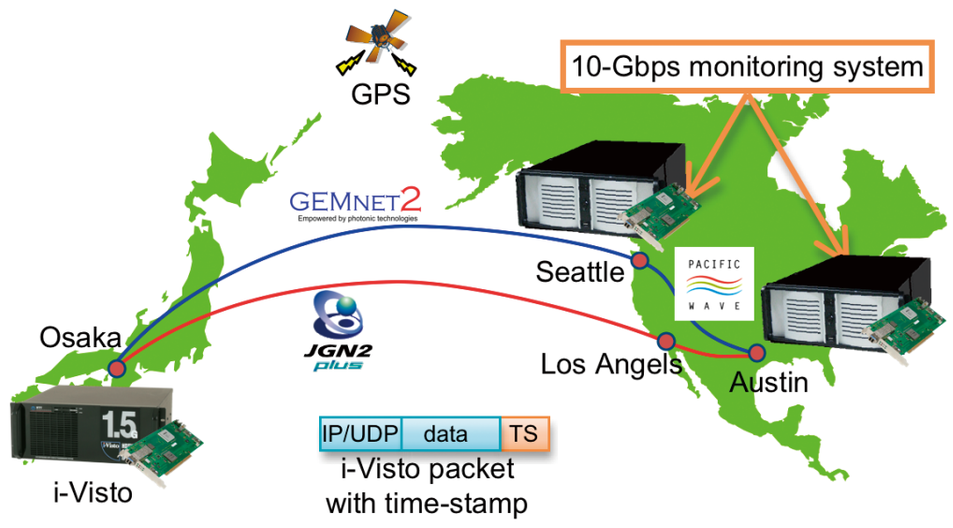
NTT promotes standardization of the protocol to facilitate the wide-ranging use of uncompressed HDTV transmission.



10-Gbps High-Accuracy Distributed Network Monitoring

NTT has developed a 10-Gbps network interface card with high-accuracy traffic-measurement capabilities, which enables distributed network monitoring systems using an application-coexistent monitoring scheme.

In this booth, we demonstrate the measurement of traffic burstiness and delays using 100-ns fine-resolution packet time-stamps appended to i-Visto streams. The characteristic differences are shown on two different networks from Japan to the United States using deployed systems in Seattle and Austin.



This work was partially supported by the National Institute of Information and Communications Technology.

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The Massive Scale Visualization and Simulation for Unstructured Hexahedron Mesh Data on TDW

Osaka University, Kyoto University and KGT Inc.

Background

Noise predictions combined with the computational fluid dynamics (CFD) method are growing popular, because advance of CFD enable the time series analyses of vortex. This improvements of simulation technologies enable engineers and scientists to explore the effective and theoretical design of not only industrial materials but also medical materials.

In our own body, there are growing expectations of the researching and developing the fundamental treatment methods of speech disorders, which are directly linked to Quality Of Life (QOL). In particular, the dental fricative voice has different characteristics of its sound production with the one of the vowel. The sound source of the dental fricative is downstream obstacle in the oral airflow field, where turbulence is dominant, although the vowel's sound source is the vibration of vocal cords by airflow thorough them. That is to say, frontal teeth are thought to be the obstacles against the turbulence and sound source so far. In oral therapies, the modification of oral morphological features is often happened on changing spatial positioning of jaws on the purpose of maxillofacial orthodontic therapies, prosthetic treatments of superstructures after dental implant surgeries and inserting sports mouthguards. Those alterations of oral morphologies may affect the characteristics of the resonance, and the magnitudes and region of the sound sources.

Therefore CFD and an acoustical simulation may predict the influence to the voice quality by such alteration of human oral geometries. To realize the prediction, huge amount of computational, storage and visualization resources are needed, which should be given in distributed environments. In order to understand the total view of oral air flow, the volumetric visualization are appropriate. As the oral air tract has very complicated morphological geometries, an unstructured mesh need to be taken and huge size of computational mesh are required to capture the vortex attitude. However, the volume rendering of unstructured mesh is not possible so far.

In this project, we've developed three components, the volume rendering software for massively huge data size complicated geometry data, middleware to achieve the data sharing, parallel processing and network monitoring, and an interactive human interface for visualization control in the design lab or etc.

Particle Based Volume Rendering

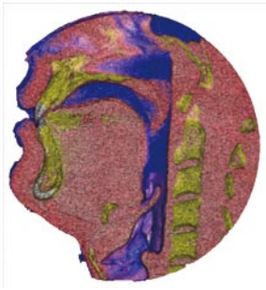
In this project, we will develop a system to visualize a large scale irregular volume dataset on a tiled display wall (TDW). The accomplishment of this project will be expected to become a visualization foundation for our national peta-scale computing facility which will be developed in 2011.The development of techniques for processing irregular volumes has remained a major challenge for the visualization community. Such datasets consist mainly of scalar data defined on collections of irregularly ordered cells whose shapes are not necessarily orthogonal cubic. In irregular volume rendering, one of the most major issues is to relax the processing requirement for the visibility sorting or to develop a technique without the sorting. To address the latter, we developed a particle-based volume rendering (PBVR) technique. In general, a volume rendering technique utilizes an illumination model in which the 3D scalar field is characterized as a varying density emitter with a single level of scattering. Our rendering technique represents the 3D scalar fields as a set of particles. The particle density is derived from a user-specified transfer function, and describes the number of particles in a unit volume at any given point.

Since the particles can be considered fully opaque, no visibility sorting processing is required during rendering process, and this is advantageous from a distributed processing perspective.

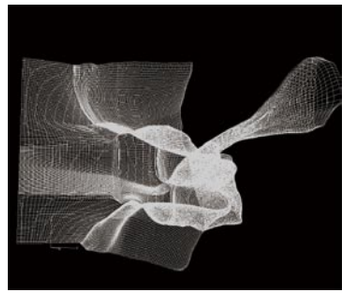
Currently, we confirmed that the technique can generate an image which is equivalent to the volume ray-casting's and deal with large irregular volume datasets in which the maximum number of tetrahedral cells exceeded one billion. In 2008, we will develop the remote visualization system in which a set of particles are transmitted through a high speed network. The next year, we will develop an integrated renderer which can process particles generated from geometric datasets such as polygons, polylines. In the final year, we will develop a streaming system which renders time-varying irregular volume datasets.

Interactive Human Interface

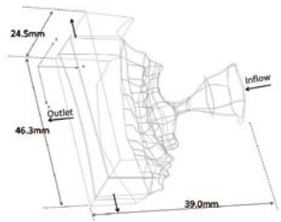
In this three-year project, the user interface team aims to develop a set of novel 3D interaction techniques for investigation and exploration of volumetric data. As opposed to a typical polygon-based virtual environment, interactive examination of volumetric data of interest exhibits a number of technical challenges to tackle; e.g. huge data size hinders its rendering at an interactive frame rate at the highest pixel resolution of the tiled display, self-occlusion prevents observation of an internal structure of interest. The user interface team will propose and validate new solutions to these problems by exploiting levels-of-detail techniques, interactive space-warping, multi-view rendering, and a diverse range of 3D interaction techniques.



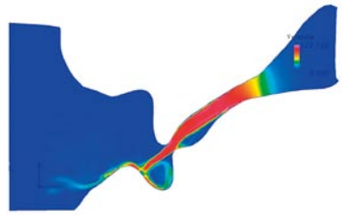
Human Vocal tract



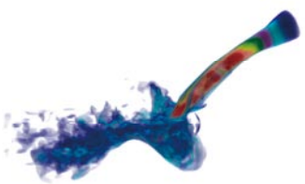
Unstructured Hexahedron Mesh



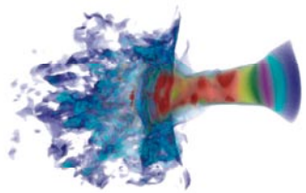
CFD Boundary Conditions



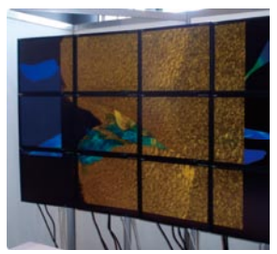
Conventional Visualization



PBVR for Velocity Field 1



PBVR for Velocity Field 2



Portable CMC TDW

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