

COLLABORATIVE VISUALISATION USING ACCESS GRID

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Key Objectives: To raise awareness of the state-of-the-art hardware and software technologies and practices for collaborative visualisation using Access Grid and to discuss the technological issues surrounding the effective deployment of Access Grid technology for collaborative scientific and engineering visualisation.

Motivation for the work (problems addressed): The need to adopt co-operative, collaborative problem solving methodologies among geographically distributed multi-disciplinary teams of scientists with complementary skills is recognised as essential to unravel the “grand challenges” of modern scientific research. Visualisation is a key component of scientific problem solving, and recently existing dataflow visualisation systems have been extended to allow collaborative working. A powerful and flexible paradigm in which individual users link their dataflows into a global inter-connected pipeline allows sophisticated collaborative programming – at the cost of complexity. Thus human issues in collaborative visualisation are now as challenging as the technological issues. The Access Grid (AG), a complement of the Grid, is an ensemble of resources that consists of multimedia display, presentation and interaction environments, where interfaces to grid middleware and to visualisation environments can be used to support dynamic, larger “group access” to the Grid. The hypothesis is that the bringing together of these technologies and tools for collaborative working raises the quality of interaction. The AG extends the existing collaborative visualisation systems to add the ‘human’ element: rather than simply receiving data along a wire, the collaborators now see how that data was generated, and can discuss how the collaboration might be programmed differently. Scientists ‘enter’ the collaboration, rather than being on the edge looking in. This is a new concept, however, and solutions are evolving and are far from generic. It is proposed that a Birds Of Feather session at All Hands2002 Conference is organised under the Chairmanship of Professor K. W. Brodlie. The purpose of the session is to bring practitioners and other interested researchers to raise the awareness of the case studies, and the availability of state-of-the-art software tools for collaborative visualisation using Access Grid, and to discuss technical issues in how to take the work further.

The scale and complexity of modern scientific research requires the collaborative efforts of teams of scientists with complementary skills to unravel the problem at hand. Collaborative research mostly consists of the simulation of complex physical processes and experiments and analysis of the huge amount of data generated using modern visualisation techniques. Thus visualisation is a key component of successful computational modelling. Although most visualisation systems are designed for use by the individual scientist, recent research has focussed on extending these to allow multi-user operation. The collaboration-aware modules of IRIS Explorer, developed under the EPSRC- and NAG-funded COVISA (Co-Operative working in Visualisation and Scientific Analysis) project, are an example of the genre that support “same time, different locations” collaborative visualisation. This allows a group of users to individually create visualisation pipelines, but to link these together into a ‘global’ pipeline by sharing raw data, geometry or images. This ‘programming’ of collaborative visualization is extremely flexible and powerful: data can be shared at different points along the pipeline to

accommodate different network bandwidths; and users can keep some data private and make other data public. This flexibility comes at the price of complexity, particularly as individual users only ‘see’ their own pipelines.

Apart from visualisation, another associated computing “grand challenge” is to provide appropriate software tools and techniques that support the scientists to carry through effective collaboration. Software tools for scheduling mechanisms to synchronise activities across the network, good quality high resolution, scalable, functionally rich networked audio and video streams etc. are needed for effective multimedia communication between geographically distributed participants. The Access Grid (AG), a complement of the Grid, is an ensemble of resources that consists of multimedia display, presentation and interaction environments. The AG has been widely used for group conferencing and delivery of remote seminars to group audiences, but more generally AG has the capability to support dynamic, larger “group access” to the Grid. The designated, designed spaces of

individual Access Grid facility provide the larger group of participants with a more flexible, richer collaboration experience than video conferencing.

Current interest centres on the hypothesis that the bringing together of these technologies and tools for collaborative working raises the quality of interaction among geographically distributed teams of co-operating scientists exploring their data together at the same time. Assuming that a data flow visual paradigm is used for the visualisation pipeline, this will involve the seamless integration of:

- **Visualisation display:** high resolution, large projection tiled display so all participants can easily view video and visualisation outputs of theirs as well as those of other sites.
- **Visualisation construction:** sharing of inter-linked visualisation pipelines while providing privacy within individual, non-linked pipeline modules.
- **Direct human communication:** through high fidelity multimedia audio and video facility.

We have carried out some early trials of this idea in an experiment linking AG nodes at Caltech and RAL, with IRIS Explorer used for collaborative visualisation. The visualisation display was generated locally at each site, using local rendering of geometry – the geometry perhaps being generated remotely and shared using COVISA. The visualisation construction was done locally but to support the linking of pipelines, we used the VNC desktop sharing tool so that each participant could see each individual pipeline. Direct human communication was achieved by the usual AG facilities.

Early results are extremely exciting. Experienced users of COVISA find that, suddenly, ‘blindfolds’ are removed so that they can not only see the faces of their collaborators, they can also see how they are programming their pipelines. A view of the ‘global’ interconnected pipeline is suddenly visible, on the large AG display wall, not just their own ‘local’ pipeline. Novice users can learn much faster, as they can be taught remotely by experienced users who can see the current state of their pipeline. The ‘group’ nature of the AG extends the collaboration to collaboration between teams, rather than between individuals. The AG itself becomes a workspace, not just a meeting room.

Overall, the methodology holds much promise for increasing the effectiveness of collaborative research and indeed the training of scientists in the use of scientific visualisation.

Birds of Feather session at All Hands 2002:

Raising community wide awareness of early results is a necessary next step towards wider participation and use of Access Grids for collaborative visualisation. This in turn is necessary towards addressing the many technical issues relating to this new and evolving technology. The challenge of transmitting large amounts of visualisation data is likely to focus the minds of researchers for some time. The Birds of Feather session will also invite current practitioners to share their experiences, and highlight and discuss the technical aspects.

The Access Grid technology is developed in the United States of America but has been taken up and effectively put to use in the United Kingdom academic community via the regional e-Science Centres. It is expected that issues relating to network flow engine and extensible routing technologies and tools to enable researchers to prioritise and route video and audio streams will be addressed by the originators of the AG technology in future releases of the software. Issues, such as the integration of remote Grid based applications and generic visualisation tools, and interfaces that support interoperability between such tools, can be raised and addressed more widely and effectively. The authors propose the holding of the BOF session for these purposes.

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