Active Spaces -
Computational Laboratories the Future of Collaboration

Mark Hereld, Michael E. Papka, Rick Stevens
Argonne National Laboratory

ActiveSpaces are the workspaces of the future, places that combine existing workspace infrastructure with high-tech information technology. The goal is to be able to construct a workspace that enhances the work experience, which enables the user to be more productive, and does not intimidate the user. The construction of ActiveSpaces is a cross-cutting research agenda that combines research in display technology, collaboration environments, networking, and many other areas into a seamless environment. The key point when discussing the development of ActiveSpaces is not the construction or integration of any one technology into the workspace, but the integration of many diverse components. Components that are individually developed to address a certain research goals or problem but are then incorporated into the larger picture of the workspace to become an ActiveSpace. Our premise is simple: in order for advanced visualization and collaboration technology to succeed it must be widely used and used in a variety of application and interaction domains, and that this wide use will happen only when the technology is empowering and the environments compelling. This means that the technology needs to be integrated into the places and modalities that characterize modern intellectual work. Our experience has indicated that a considerable number of research activities require people to work in loosely coupled collections of small groups. This multiple level group structure is the target of our technology work. We are interested in developing working environments that enabled groups to visually and interactively investigate large scientific datasets using large-format and immersive visualization technologies in the context of shared collaborative spaces. These shared collaborative spaces focus on creating the illusion of being in an shared workspace that is permanently connected to a set of other workspaces, via multiple cameras, large-format displays, and full-duplex “ambient audio” enabling natural conversations between participants as if they were in the same work room.

Our goal in this work is to understand how to engineer into future workspaces the technology that can support high-performance collaboration and scientific visualization. We believe that the following areas of work are needed to pursue this goal:

- Group workspaces need to be designed to be comfortable, flexible, attractive and compelling environments that encourage users to congregate and naturally express themselves,
- Computing, and communications technologies needed to support collaboration (e.g. cameras, displays, microphones, interfaces, and controls) should be tightly integrated into the physical design of the space,
- The user interface should support a natural set of interaction modalities (e.g. for collaboration this means hand free full-duplex high-quality audio, multi-perspective video streams, for visualization this means that for 3D datasets they should be experienced in 3D, with direct interaction interfaces of virtual reality devices),
- User owned and managed resources should be easily and temporarily integrated into the active scope of the workspace (e.g. user's laptop, phones, PDAs, etc. should have a simple mechanism enabling it to become part of the collective resource set for the time the user is participating in the activity of the workspace),
- Interconnecting collaboration and visualization provides a uniquely challenging set of requirements for both the systems design, physical and software integration, and use of high-performance networking and communications for enabling shared interactions,

Comprehensive sets of middleware services are needed to provide a high-level set of abstractions for multimodal communication, security, scheduling and resource management on which the ActiveSpace environments can be layered.

* Hot challenges: what are the key problems at the frontier of the NC program?
* Future tech: what are the emerging technologies that may solve them?
* Killer apps: what are the next round of science applications for NCs?
* Are the needs of specific disciplines really different?

* What kind of NC program is needed to meet the challenges?
* How should we integrate the program to gain optimal leverage from the projects?
* What will the signature elements of DOE's NC program be, that distinguish it from other agency Grid, middleware and collaboratory efforts?