Information Infrastructure for Distributed Collaborative Science applied to Earthquake Analysis

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Collaborating Government Organizations: DoE Los Alamos, NASA JPL, USGS
International Collaboration: APEC International Cooperation for Earthquake Simulation (ACES)

Motivation and Project Team

We present a project of the GEM (General Earthquake Models) community involving 11 universities and 3 unfunded government partners, which addresses the computer science issues in building an information infrastructure to support the full range of activities of a modern scientific research field. The importance of and general role of modern information infrastructure for distributed scientific research has been understood for some time and tremendous progress has been made over the last few years. In particular distributed object and web technology has enabled access to and sharing of both data and simulations over time and distance. However there are many fundamental issues to be studied both from computer science (how should we build collaborative scientific environments and what are the needed services) and application science (what changes in the scientific method and what are the application requirements and impact) points of view. The unsolved research issues include the support of real time interactions between people, computer simulations, instruments and other information resources. However perhaps even more importantly we must support fundamental theory which develops over a time period of many years – often longer than the life of today's web on which we build the supporting information infrastructure. This proposal builds an interdisciplinary team where we focus on both the general computer science issues and one particular application area -- that of earthquake analysis and simulation. This application area is both important and needs a rich variety of worldwide services with time scales from seconds to centuries. The computer science research will be generalizable to other application areas using the existing collaborations and broad expertise of the proposal team. The earthquake area will focus on the needs of scientific research but the environments we create will be extensible to support the general needs of earthquake crisis teams with distributed interactions between control rooms, field personnel and experts responding to real time data streams.

1) **Computer Science Research**: We will build an information structure for a full application area from "scratch" using systematically distributed objects and services. We will research the appropriate architecture and base infrastructure for key services: real-time HPCC, multi-sensor scientific data, scientific datamining, visualization and collaboration. We hypothesize that building such an integrated web-based collaborative portal CPW (Collaborative Portal on the Web) will lead to a productive scientific environment with a single infrastructure supporting multiple timeframes. We will iterate short (around 6 month) prototyping efforts with test and evaluation. This modular construction approach fits today's rapid evolution in technology on "Internet Time".

2) **Application Effort**: We have identified three typical timeframes linking distributed scientists, data and simulations and these will be implemented as prototype collaborative environments using both existing and new application codes. With government partners (JPL, USC/SCEC, and USGS), we will link to the major earthquake sensor systems as part of the computational environments. We will include theoretical and observational scientific data analysis in the timeframes in both real-time decision support and more asynchronous collaboration modes.

3) **Outreach**: We will leverage the existing broad and successful outreach program of USC/SCEC, which will link us both to the public (for education), and to the state and federal emergency services. This effort will develop specific educational modules based on GEM work.