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e-Science: the added value for modern discovery.

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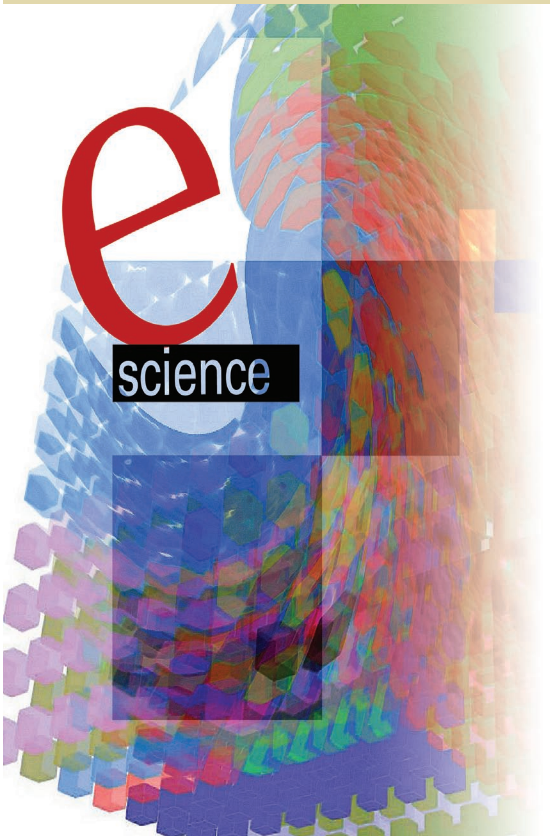

e-Science: The Added Value for Modern Discovery

Vladimir Getov
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e-Science, a new approach based on computer simulation, is increasingly being adopted as one of the most successful modern methods for experimental scientific discovery .

Traditionally, science has been divided into two conceptual branches—theoretical and experimental—which have been the source of scientific discovery and results for many centuries. Since the introduction of electronic digital computing, however, a new approach based on computer simulation has emerged and is increasingly being adopted as one of the most successful modern methods for experimental scientific discovery.

One of the main reasons for the success of e-Science has been the rapid development of novel computer technologies that has led to the creation of complex and powerful distributed systems or computational grids including high-performance computing facilities, fast access to huge datasets, and high-throughput communications. In addition, unique and sophisticated scientific instruments and facilities, such as giant electronic microscopes, nuclear physics accelerators, or complex equipment for medical imaging can be integral parts of grid computing infrastructures.

Originally introduced in 1999 by John Taylor, who at that time was Director General of Research Councils in the UK, the term "e-Science" captured these new revolutionary methods for experimental scientific collaboration and discovery, including computer simulations and virtual environments, that the modern grid computing infrastructures enabled. In 2000, the UK e-Science research program was launched, securing substantial support for this scientific revolution.[1]

Indeed, the field of e-Science opens up vast possibilities for research results on a new scale at quality levels that have been demonstrated by several initiatives all over the world, including the US cyberinfrastructures program,[2] the European grid research infrastructures,[3] the Japanese science grid project,[4] and the Chinese grid computing initiatives[5] among many others.

IN THIS ISSUE

This special issue on e-Science includes contributions that address some of the challenges and give an overview of the latest research results in this area. Unfortunately, we could only include five articles giving a flavor of the research activities in different scientific disciplines as well as the supporting grid infrastructures.

The authors of "TeraGrid Science Gateways and Their Impact on Science" describe one of the world's largest cyberinfrastructures for scientific research. With particular attention to the Science Gateways program, Nancy Wilkins-Diehr and her colleagues offer unique insight into the challenges and opportunities for providing researchers with easy and seamless access to TeraGrid's high-performance computing resources.

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In "Coupled Simulation e-Science Support in the NAREGI Grid," Satoshi Matsuoka, Kazushige Saga, and Mutsumi Aoyagi present their extensive experience in building and using the NAREGI grid in Japan. Focusing on nanoscience, the authors describe several e-Science methodologies that are applicable in different disciplines using complex simulation systems.

Craig Lee and George Percivall address the difficulties in maintaining and using increasingly large geospatial data repositories stored in various formats at different locations. In "Standards-Based Computing Capabilities for Distributed Geospatial Applications," they describe the standardization efforts of two large international organizations: the Open Geospatial Consortium and the Open Grid Forum.

In "e-Science, caGrid, and Translational Biomedical Research," Joel Saltz and his colleagues take the readers into the virtual world of e-Science-enabled biomedical research. The high level of complexity and heterogeneity of information resources in the area of translational research led to several specific challenges that have been addressed by both new experimental approaches and novel domain-specific e-Science technologies.

In their article "e-Science Infrastructure for Digital Media Broadcasting," Ron Perrott, Terry Harmer, and Rhys Lewis apply the e-Science approach to the highly demanding and challenging field of digital media broadcasting. Providing some of the latest results from one of the largest broadcasting infrastructures, this article is an excellent example of interdisciplinary research and results based on e-Science.

With numerous activities worldwide, the e-Science field continues to grow, opening new horizons for interdisciplinary research by virtual organizations on a global scale. Thus, it has become one of the best examples of the current scientific revolution enabled by state-of-the-art computer technologies.

We hope you will enjoy reading the articles in this special issue, which could also become a catalyst for further advances in the exciting new virtual world of e-Science.

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