INFORMATION-ANALYTICAL RESOURCES INTEGRATION IN ENVIRONMENTAL EMERGENCY MANAGEMENT

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Decision support systems, environmental, intelligence technologies, resources integration**,** GRID-technology

Abstract

One of the important part of effective emergency management is intelligence decision support systems (DSS). One of such approach is the method of information and analytical resources integration in distributed computing systems. The problems of the dataware of efficiency increasing in the applied studies of safety sciences for information support of decision making systems development have caused need in intelligence methods of decision support.
One of the problems is an information resources increasing. For efficiency of information-analytical resources is necessary usage of all possibilities new information technologies. First of all it is using the modern IT direction of the distributed resources - GRID-technology, intended for ensuring in on-line operation with distributed database and computing resources.

In the paper is considered heterogeneous dynamic distributed information analytical architecture, tracing main trends and principles of the information space update with provision for information flow dynamic.

The results of the studies have found using in investigations on the fundamental studies program of the Russian Academy of Sciences (Electronic Earth: scientific information resources and information-communication technologies) and in studies on Russian Federation program "World ocean".

The important direction of information support efficiency increasing is an intellectual analysis technology use "Data Mining". Possibility of this technology usage intellectual analysis given is researched in the report on example of meteorological information.
Input information are meteorological data, presenting from different regions of the planet/country, in which is kept the summery about type of the phenomena (the wind, storm, etc.), place, where this phenomena existed and organizations, given this information.

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Introduction

The emergency management essential element is fundamental support of decision making at moment or in process of the emergency situations prevention. For this it is necessary integration of all necessary information and analytical resources and use of modern information technology :Web, GIS and Greed technologies.

The important part of effective emergency management is intelligence decision support systems (DSS) (Britkov and Gelovani, 2004). One of such approach is the method of information and analytical resources integration in distributed computing systems. The problems of the dataware of efficiency increasing in the applied studies of safety sciences for information support of decision making systems development have caused need in intelligence methods of decision support.

One of the problems is an information resources increasing (Britkov, 2003).. For efficiency of information-analytical resources is necessary usage of all possibilities new information technologies. First of all it is using the modern IT direction of the distributed resources - GRID-technology, intended for ensuring in on-line operation with distributed database and computing resources.

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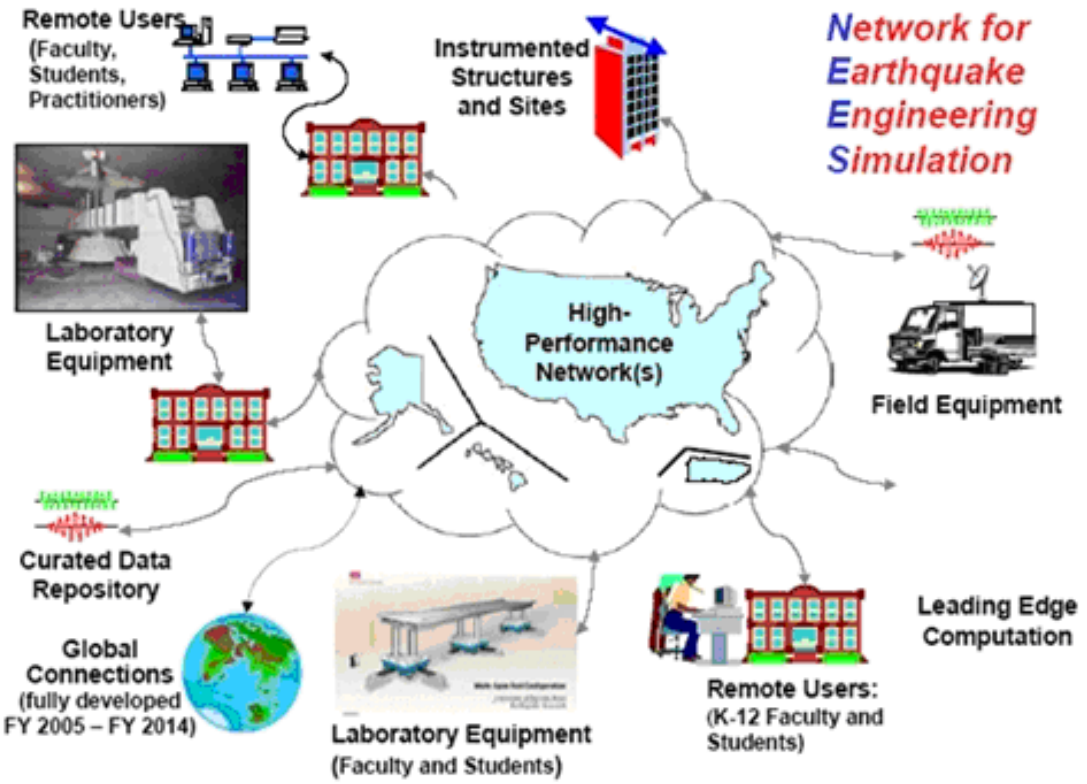
Grid Concept in Earthquake Engineering Simulation

The Grid Concept presents the approach on the construction of distributed computing environment and the Grid software toolkit (IARnet) being developed on basis of this approach. The goal of IARnet is to provide Grid users and developers with standard and easy-to-use distributed application development tools, supporting dynamic discovery, remote access and coordination of heterogeneous resources in global networks, connected with Earthquake Engineering Simulation, as an example (Figure1).

Another example of the Grid Concept is the Web-portal of Unified system of information for state in World Ocean (ESIMO, http://www.oceaninfo.ru/) include the enormous amount of information resources, metadata, scientifically - technical, normatively - methodological, legal, socioeconomic, technical documentations. Operation to maintenance ESIMO web portal, with the help of which can be obtained data on marine environment for the acceptance of best decisions making is new stage in the matter of the information servicing of marine activity. In development portal are utilized modern approaches as to the initiation of data systems - dynamical information representation on portal, the use of data-bases and GIS techniques.

Figure 1. Network for Earthquake Engineering Simulation Grid Concept



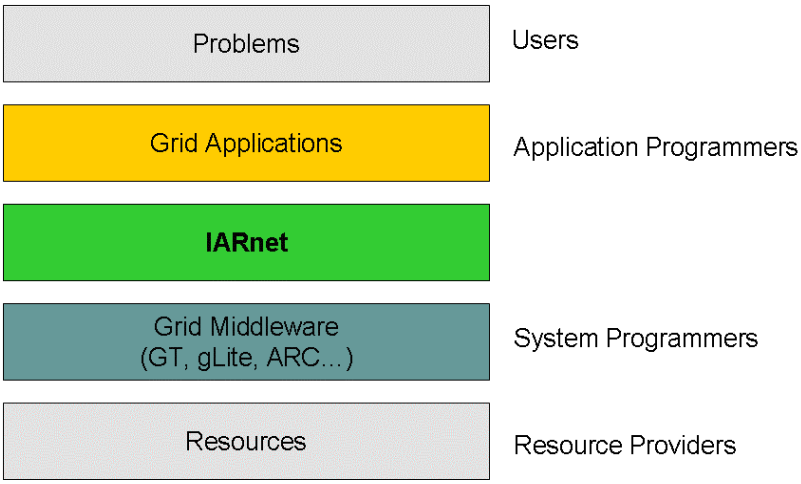
IARnet architecture

The today version IARnet toolbox presents itself set of the libraries, containing facility to resources integration in portioned ambience (the server part, Java and C++ languages) and development of portioned exhibits (client part, Java language), as well as realization several services of the general purpose (Velikhov, 2005).

In base of the architecture IARnet lies the notion information-analytical resource (IAR) as abstractions, allowing describe the general model of the use resource portioned computing ambience for decision of the broad class of the applied problems. If under primary resource to understand any resource, which supports the program access to its functional capacity and can be used for decision of the applied problems then under information-analytical resource shall understand the abstract resource with clearly described functional capacity and program interface of the remote access to this functional capacity, hiding for itself one or several primary resources.

The main principles of the IARnet approach are possible to see in Figure 2.

Figure 2. The main principles of the IARnet approach.



Virtual Data Concept

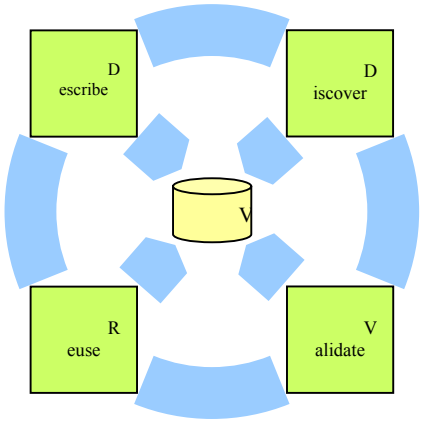
The virtual data concept is motivated by next generation data-intensive applications in which scientists distributed worldwide need to extract scientific information from large collections of data, and would like to share both data products and the resources needed to produce and store them. Virtual data mechanisms seek to enable the declarative specification of the recipes used to derive data, so that requests for data products can be mapped into computation and/or data access across multiple locations. The information recorded to support this reuse of computational results can also be used for other purposes, such as explaining provenance and managing workflows.

The virtual data system implements such virtual data mechanisms. Definition and query operations are expressed in a virtual data language (VDL), and information about data and computation procedures are stored in a virtual data catalog (VDC). We illustrate in Figure3 the lifecycle of virtual data within the virtual data system.

The lifecycle begins when a virtual data definition, described in VDL, is entered in the VDC. This definition can then be discovered by virtual data query operations, and the scientific analysis procedures associated with it can be executed and validated. New algorithms and procedures can be derived from the knowledge gathered, and another round of the lifecycle starts when the derived virtual data is published into the VDC or recorded by the virtual data system.

This approach has been applied to a variety of data-intensive applications, such as the information servicing for marine activity on basis of the web – technologies. However, while command-line interfaces may be appropriate for experts, end users need an interactive environment within which they can easily discover and share virtual data products, compose workflows, and monitor workflow executions across multiple grid sites. Ideally, they should also be able to integrate virtual data capabilities into their specific user communities and science applications, and obtain help with the nontrivial tasks of setting up and configuring the virtual data system and its associated grid compute and storage resources.

Figure 3. Lifecycle of Virtual Data



These considerations have led us to develop, apply, and evaluate, "Grid portal" designed to allow for convenient interaction with the virtual data system. The virtual data portal is an integrated environment that provides a single access point to virtual data and grid resources.
One of the very important problems for emergency management is to increase the capacity by building an enlarged set of risk-management decision support tools and procedures for standardized evaluation and mitigation of the consequences (Britkov, 2002).. The first point is emphasize:
1) the use of a Geographic Information System (GIS) to create a notional port city with air, rail and marine transportation facilities and demonstrate the notional relative proximity of critical infrastructure;
2) identification of hazard simulation and modeling tools to both superpose damage footprints across critical infrastructure and demonstrate potential consequences to the community;
3) demonstration and econometric model evaluation of alternative mitigation and causal chain intervention strategies that are proposed by various economies (Gelovani and Britkov, 2003).
To facilitate collaboration among a maximal number of economies, high bandwidth video teleconferencing with streaming video will be used to minimize transportation costs of participants and mutually demonstrate web-accessible mapping, simulation and modeling techniques currently used by various economies (Britkov, 2001).

The task is to assemble a web-accessible toolbox of hazard models and decision support simulations with using of GIS notional port communities with critical infrastructure and cross-linked hazards. It is very important to develop econometric models that can be used as decision-support tools in evaluating the relative merit of alternative strategies of mitigation, response and recovery from various types of terrorist attacks.

Next feature for this case study is collaboration over a high-bandwidth video-teleconference system. As an overall objective, analysis tools and procedures would be exportable and adaptable for mutual use by any individual economy in assessing their own economy's vulnerabilities, conducting their own terrorist attack consequence mitigation program and increasing the abilities of their own communities to survive and recover from terrorist attack. A list would also be compiled of sources for GIS hazard mapping products and video-telecommunication sites among the various economies, encouraging mutual assistance and continued collaboration (Britkov, 2002).

Intelligence Approach in Emergency Management

One of the main factor in emergency management is an operative taking the efficient decisions. Practically, the database execute the function to memories, access of the user to vault data provides only extraction of the small part from preliminary stored information in response to clearly assigned questions. But, when we have an enormous flow to information, we will get up the task greatly reasonable to use this information to extract hidden in data knowledge for the reason optimize control a process emergency management. This task can be not solved only power of the person on the strength of gigantic volume of given economic inefficacy of such decision. Besides, not always got analyst results are objective since people follow some considerations, a priori beliefs about under study subject that is reflected on objectivity got result (Britkov, 2003).

The methods “data mining” allow reducing the quip of the problem. Using promoted analytical methods in the field of mining the knowledge from source, "damp", data, many organizations enlarge profit, raise power, shorten the expenses and enlarge complacency a client. They already are actively used at analysis market, marketing, forecast of the stock quoting and other business-applications. But in the first place these methods today must interest the commercial enterprises, unfolding projects on base information vault given (Data Warehousing).

The correlations of the volume and speeds to memories and define possible use the artificial intelligence, systems KDD (Knowledge Discovery in Databases) - a systems of the extraction of the knowledge from database.

Using the systems KDD requires the known art of the director of the exploratory tasks since their decision finally must match with logic his intuitive analysis. The Key to successful using the methods KDD serves not simply choice one or several algorithms KDD, but skill of the analyst. Data Mining does not exclude need of the knowledge of specifics of the application domain and understanding themselves data or analytical methods.

Knowledge discovery in databases is an analytical process of the study of the person of the big volume to information with attraction of the facilities of the automatic study given for the reason finding hidden in structure data or dependencies. It is expected full or partial absence of the a priori beliefs about nature of the hidden structures and dependencies. KDD includes the preliminary comprehension and incomplete wording of the task (in term target variable), transformation given to available to automated analysis format and their preprocessing, finding facility automatic study given (data mining) hidden structures or dependencies, approbation of the discovered models on new, not used for building of the models data and interpreting the person of the discovered models.

Data mining - a study and finding "machine" (algorithm, facility of the artificial intelligence) in damp given hidden structures or dependencies, which earlier were not known, not trivial, practically useful, available to interpreting the person (Arseniev, 1997).

As a whole technology data mining it is enough exactly defines as a process of the finding in damp given earlier unknown, nontrivial, practically useful and available interpreting the knowledge required for decision making in different sphere of emergency management Any cognition presents itself modeling of emergency situations. The Model - artificially created system, in which is reflected resemblance of the structure and functions with system-original. Exist two types of the models: prediction and descriptive. The First use one set given with the known result for building of the models, which obviously predict the results for the other set data, but the second describe the dependencies in existing data. The revealed model will not be able to pretend on absolute knowledge, but will give the analyst certain advantage already fact of the finding itself to alternative statistical significant model.

The task of the models building it is possible to divide into two important sub ranges. First, this tasks to categorizations - a referring the new object to some class from their ensemble on base already available given about the other object of these classes. The other sub range form the tasks of the forecast of some unceasing numeric parameter.

One of the key issues of information modeling approach is system integration of all possible relevant tools and systems, including GDIN (The Global Disaster Information Network) is a public-private partnership with the primary objective of getting the *Right Information, to the Right People, On Time* in order to make the Right Decision, so as to help mitigate and effectively respond to the toll of natural and man-made disasters around the world.

Conclusion

The development of the modern information technology tools (Grid and Web approaches) of the analysis environmental information and use geographic information intellectual systems is bound with expansion of the spectrum of the taken into account problems in the first place, comprising of the first queue need forecasting of the development technical and software programs, which can be used for analysis environmental situations. For this necessary use the extended possibilities managerial system data, facilities of the analysis and presentations to information, cut-in in systems of the programs of the statistical analysis, categorization and recognitions, methods of the artificial intelligence for analysis and interpretation result processing. There is basis to expect that the most further development will come of one sides by spreading universal tools and Internet , but on the other hand use the knowledge-based tools for the processing and analysis of environmental data.

The basic accent in researches is done on creation of integration tools is information analytical resources. Integration is considered in following directions: a program-technological level which allows to obtain spatially distributed data; semantic integration with use of means of the artificial intellect, allowing in common to analyze and process the heterogeneous data received with use various methodologies.

To creation of system integration of heterogeneous processes of processing and the analysis of the information approaches have been developed for support of acceptance of operative decisions in extreme situations. One of stages is development of means of access to bases of metadata, to data on the information production represented on Web sites and portals, the integrated database - uniting various types of data (numerical, text, spatial, graphic, etc.).

Have been carried out researches on intellectualization of methods of support of decision-making as by one of the basic directions of increase of efficiency of application of modern information technologies. In particular approaches methods of integration of information and analytical resources in the distributed computing environment were used are.

Realization of technology of integration of information-analytical resources (in the form of the heterogeneous information space) has been carried out.

For an effective utilization of the distributed information resources use of various opportunities and first of all new a field of information technologies - the GRID-technologies intended for maintenance in a mode on-line of work with distributed databases and computing resources has been considered.

It is considered heterogeneous dynamic distributed it is information - the analytical environment tracing the basic directions and principles of updating of environment in view of dynamics of information streams.

The results of the studies have found using in investigations on the fundamental studies program of the Russian Academy of Sciences (Electronic Earth: scientific information resources and information-communication technologies) and in studies on Russian Federation program "World ocean".

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