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Aims and Scope

Global Journal of Computer Graphics & Techniques provides a medium to communicate information concerning interactive CG and CG applications. The journal focuses on interactive computer graphics, visualization and novel input modalities including virtual environments, and, within this scope, on graphical models, data structures, languages, picture manipulation algorithms and related software.

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SOFTWARE PIRACY DOES NOT HURT ANYONE?

Manish Kumar

Abstract

The software piracy has been common nowadays. Many people all over the world seem to involve and used it which thought that it does not that big deal. However, these software companies have been suffered and lose a vast amount of money from illegally distributing their software. This paper will present the background of the software piracy, then this paper will lead to the issues from both side; the people who use software piracy and the software company, and also the social implication.

Keywords- Software Piracy, Reverse Engineering, Software Cracking, Copied Software, illegally distributed, Copyright Infringement

1. Introduction

Recently, the software has been able to distribute all over the world. The people have easily reached them. People do not need to go to a software shop to buy it, they are able to download it on the internet or order it from telephone, and then the software CD will be send via a mail. Moreover, the paying methods has also make people to be more convenient. However, the software has been illegally distributed these days. The illegally distributed or it has been called software piracy. It is using commercial software without paying anything to the software company. The software piracy can also be able to be distributed as the same way as the licensed software, such as buying at the shop or downloading from the internet. This copied software could be a CD Rom, ZIP file or installation file.

2. Background

"Software piracy is the unauthorized copying or distribution of copyrighted software. This can be done by copying,

downloading, sharing, selling, or installing multiple copies onto personal or work computers" as in [1]. Moreover, the software piracy might be caused by installing to more machine than number of permitted machine in the license. This software also includes music, movies, video games and computer software (such as documentation software, operation software or utilities software). In addition, the software piracy seems to be misused of the technology and computer knowledge, such as cracking licenses software for product key by using reverse engineering. The software piracy has been concerned more and more by almost every country all over the world nowadays, as many countries have been increased penalty for software piracy. According to the Designs and Patents Act 1998, the punishment for using software piracy has amended to be with up to 10 years in prison and unlimited fine from up to 6 months in prison and up to 5,000 pound fine [5],[6]. The software piracy has been defined as an unauthorized using or distributing software without license or over permitted of license. Meanwhile, the US laws has defined the software piracy as copyright infringement. This copyright infringement has consisted of two case; civil case and criminal case. The civil case is a case of a person who uses the pirated software. This case, the maximum sentence is a fine up to 150,000 US dollar per infringement.

For an example, if a person has used or installed 2 pirated programmes, then the maximum sentence will be as 300,000 US dollar. The criminal case is a case of a person who cracks or unauthorised copies in order to create unlicensed software. This case, the maximum sentence is a fine up to 250,000 US dollar and a jail up to five years per infringement [2]. These penalties seems to be a strongly punishment, these because of the damage which cause by software piracy has been increasing these days. Example of the software piracy CDs are shown in Fig. 1.

Fig. 1 Example of Software Piracy CD [14]

3. Discussion

The software piracy has become a common nowadays. Many people all over the world have still usual Used, downloaded or bought it, whereas many software companies try to prevent their software to be cracked. This discussion will be divided into 3 sections; for the people who used software piracy, for the Software Company and social implication.

3.1. For the People Who Uses the Software Piracy Even the punishment for software piracy seems to be strongly, many people still uses and cracks it due to it is hardly caught and more reasons as it will be show in the following. This section is divided into technical term (likewise how is the software cracked?) and the common minded of the people who still use software piracy.

1) Technical Term: Nowadays, most of the software has been protect by using product keys. With these product keys, the software seems to be secure enough. However, the crackers have also been able to brake through the protection. The technique that has been common used is called "Reverse Engineering" or "Re-Engineering". This technique is the process of discovering the technological principles of a device, object or system through analysis of its structure, function and operation. The reverse engineering has been used in many fields, such as, reverse engineering of machines, reverse engineering of integrated circuits/ smart cards, reverse engineering for military applications and reverse engineering of software.

"The reverse engineering of software is simply the act of figuring out what software that you have no source code for does in a particular feature or function to the degree that you can either modify this code, or reproduce it in another independent work" [7]. This means the reverse engineering of software allows the crackers to modify the software's code in order to reproduce a cracked executor file or debug the software to get the product keys. As the software piracy normally has cracked files, product keys or CD keys. These are the results of using reverse engineering technique. In addition, the main methodologies of software reverse engineering are:

- Determining Program Behaviour
- Determining Interesting Functions
- Debugging
- Code Modification

The determining program behaviour is to analyse, understand the behaviour of the software in order to know what the software are doing, what functions will be called, and then the interesting functions will be determined in order to understand what the function are doing. After understanding the data flow in the software and functions, the debugging will be examined input and output. The software's product keys will be gained in this state.

Furthermore, the code modification is method to amend the code and function of the software in order to improve or

adjust the software to be suited for each situation. However, this method also allows the cracker to create a cracked program, such as cracked no CD. The reverse engineering of software also can be divided into 3 groups by type of reverse engineering process; analysis through observation of information exchange, disassembly and decompilation. However, the group that has been used for cracking software mostly is disassembly. The disassembly is using a disassembler, this means to reserve engineering by reading and understanding the raw machine language (Assembly). There are a lot of freely commercial tools which provide to perform the disassembly, such as Olly Ddg.

2) Consideration of the people who use software Piracy: there is a vast among of people who still use the software without licensed as show in Table I. This unlicensed software might be downloaded form the internet, bought from the shop or copied from friends.

TABLE I WORLD SOFTWARE PIRACY RANK [3]

World Rank	Country	Piracy Rate
1	America	93%
2	Moldova	92%
2	Azerbaijan	92%
79	Spain	43%
91	Canada	33%
96	Germany	27%
97	The UK	26%
104	Japan	23%
107	The US	20%
	Weighted Average	59.90%

The Table I shows the world ranking and piracy rate of each country. The piracy rate is the total number of units of pirated software deployed divided by the total units of software installed. According to the data, it is highly likely that software piracy is widely accepted and used in developing countries or countries with no serious or poorly enforced intellectual laws and regulation rather than developed countries with strong action against software piracy. Even though the pirate or unlicensed software is risky due to the malicious codes, such as viruses, spywares or back door software, which

may be contained within software, many people risk it owing to the fact that some genuine license software are far more expensive than the pirates [8], or they are not fully aware of the malicious codes hidden in software. Another reason which triggers the high figures in some countries is a dramatic increase in computer sale, along with the accessibility to the internet. [9] A new PC requires several software, for instance operating system software, documentation software, and utility software.

The situation is then worsened as it is implicitly recognized that people are likely to support the illegal software by downloading or purchasing multiple pirate software per one PC. The rate of pirate software is, consequently, exponentially inclined per PC and number of software installed. Furthermore, it could be difficult to locate and apply the copyright infringement law against the individuals.

3.2. For the Software Company

Software companies, for example, Microsoft, Apple, Adobe, IBM, and so on, have directly suffered the effects from people using illegal software. [9] "As broadband growth continues and the IT sector expands, the influx of new users and the increased availability of pirated software means continual efforts are required to reduce and keep software piracy down." [10] The following section will discuss the actions against the violation of copyright software and the outcome of the pirate software in company view.

1) Approaches against the illegal software： There have been several methods which software companies adopt them in both defensive and offensive ways. Firstly, for the defensive approach, most companies have applied the techniques of software product keys to protect their software against the piracy. The software will be unable to be installed or used unless the product key is correctly input. Besides, the activation code required after the installation would bolster the prevention against the illegal use. These methods are not fully effective, and partly mitigate the situation because of the fact that the reverse engineering, as discussed in section A 1) Technical Terms, has eventually overcome these protections. The cracked software would then be available throughout the market or the internet. As a consequence, the additional action has been taken, the online monitoring such as Windows Genuine Advantage

(WGA) Programme. [4] It permits only genuine licensed users to access the update and support features. Another method is related to the economical aspect. Due to the low price of the unlicensed software, they are widely and commonly illegal used in some countries, those with poor enforcement of intellectual property law in particular. Software companies, as a result, have tried to reduce their product price to the affordable level to persuade customers to purchase the legal software where they are offered some additional discounts, ongoing system upgrades, access to updates and other offerings such as software documentations or recovery discs. [4] In view of law enforcement, major well-known software companies have joined the organization called Business Software Alliance (BSA) in order to obtain the bargain power and influence in the international level. BSA, which consists of famous IT companies such as Adobe, Cisco System, IBM, Microsoft, Symantec, and so on, has encourage the government in numerous countries to focus on the Intellectual Property Right and enforce the law in practical way. The law enforcement, the penalties and jail in particular, and the education which increases the awareness of the piracy issue have gradually reduced the rate of piracy. ([9] - [10], [11]) For example, in two decades, starting in 1992, the piracy rate in Europe has decreased from 80 to approximately 35 percent.

2) The effect of unlicensed software: The software companies are evitable to be adversely affected by the pirate software, in both direct and indirect ways. The first is mainly focused on the companies' revenue. Many companies have claimed they have lost large amount of money owing to the illegal software. "Without piracy we could increase revenue by 30 to 50 percent. At the very least, this would mean that there would be fresh funds available for investment to hire 7 to 10 additional staff in research and development," , "Some companies know they are losing 40 percent of their business. If they could recoup that, they could employ more people" [12] Also, some additional budget has been spent in Research and Development for the mitigating solution of the piracy. The companies' profit has consequently been negatively affected by them. As a result, the company's investment and expansion by recruiting more IT staff have been slowly obstructed by these actions. The new products may be

postponed due to the limited workforce. Not only are the revenues affected by the pirated software, but the reputation of company is also affected in the indirect way. According to the Media Surveillance [8], more than 30 percent of Microsoft Windows illegally downloadable from the internet have contained the malicious codes. This means there are possibilities that the computer with these Products will be infected by viruses or back door access, which are risky for confidential information stolen and being utilized as a host for inappropriate purposes such as spamming without the awareness of the computer's owner. The software companies are possibly claimed by incompetent computers owner to responsible for the outcome of misuse of software and consequently lost the reputation. One example of the company attempting to secure their reputation is Microsoft which has launched the WGA programme to distinguish the genuine and suspicious products as a result of this, and only take responsibility for only genuine products.

3.3. Social Implication

The misperceptions of pirated software widely recognized, including "not serious crime", "not harm anyone", or "inexpensive and best deal" [8], have increased the rate of piracy. However, the educations on ethical issues and impacts of malicious software encouraged by the government and institutes have gradually changed these opinions and raised the social awareness of legal issues. The macroeconomic view is one of the major effects of unlicensed software. Nowadays, the number of IT people has increasingly graduated; however, with the limitation of recruitment due to the revenue affected by pirated software, not all of them are hired. The amount of taxation received from software companies is also considered lower than expected; as stated in [13], 10-point drop in piracy rate could raise more than 135 billion US dollars in taxation. This, finally, affects the economic growth and GDP which is supposed to be higher. Keeping in view of microeconomic, ordinary companies have to adapt their ways of business in response to the enforcement of law and social awareness. The legal software is taken into account in term of depreciated assets along with the computers. The PC sale is also the aspect as the cost cutting is one of the market share strategy. The licensed software is unavoidable which adds cost to the PC;

this may be a burden of sales figure,

especially in developed countries which encourage people to use computer and internet. The mitigations of those issues include the use of open-source software and web-based applications, in case high speed internet is fundamental, in order to reduce the cost. This provides opportunities to companies in this segment. Another method is the utilization of virtualization for some medium-sized companies with ability to afford the cost of virtualization software which could positively get the high return in Return on Investment (ROI).

4. Conclusions

Software is easily purchased through the internet or via market shops. Nonetheless, the pirated software has also increasingly distributed. In spite of the fact that several defensive approaches have been applied to software, for instance, product key and activation code, the prospecting technique known as reverse engineering has overcome this. With the misperceptions of users, the situation of software segment is worsening; software companies have received less revenue and the government has consequently earned less tax. The enforcement of intellectual right could mitigate these; however the increase in awareness of ethical use of software to individual users would be the best approach to eliminate the pirated software industry.

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IMPACT OF DATA MINING ON THE GRID COMPUTING SYSTEM

Amit Kapoor

Abstract

The Grid is a distributed computing infrastructure that enables coordinated resource sharing within dynamic organizations consisting of individuals, institutions, and resources. The Grid extends the distributed and parallel computing paradigms allowing resource negotiation and dynamical allocation, heterogeneity, open protocols and services. Grid environments can be used both for compute intensive tasks and data intensive applications as they offer resources, services, and data access mechanisms. In many industrial, scientific and commercial applications, it is often necessary to analyze large data sets, maintained over geographically distributed sites, by using the computational power of distributed and parallel systems. The grid can play a significant role in providing an effective computational support for knowledge discovery applications. Grid uses the basic grid services such as communication, authentication, information, and resource management to build more specific parallel and distributed knowledge discovery tools and services Data mining algorithms and knowledge discovery processes are both compute and data intensive, therefore the Grid can offers a computing and data management infrastructure for supporting decentralized and parallel data analysis. This paper discusses how Grid computing can be used to support distributed data mining. Grid-based data mining uses Grids as decentralized high-performance platforms where to execute data mining tasks and knowledge discovery algorithms and applications.

Key words: Security Architecture, Security policy, Grid Computing, Data Mining.

Introduction

A. Grid Computing

A parallel processing architecture in which CPU resources are shared across a network, and all machines function as one large supercomputer, it allows unused CPU capacity in all participating machines to be allocated to one application that is extremely computation intensive and programmed for parallel processing. Grid computing is also called peer to peer computing and distributed computing. The grid computing gives us yet another way of sharing the

computer resource and yields us the maximum benefit at the time and speed efficiency. Grid computing enables multiple applications to share computing infrastructure, resulting in much greater flexibility, cost, power efficiency, performance, scalability and availability at the same time.

B. Data Grid

A data grid is a grid computing system that deals with the data controlled sharing and management of large amount of distributed data. A Data Grid can include and provide transparent access to semantically related data.

C. Distributed Data Mining

Distributed data mining deals with the problem of data analysis in environments of distributed computing nodes resources that are different managed by different software systems and are accessible through different protocols and interfaces.

Four Layer Architecture of Grid Computing System

Grid Computing System consist of high speed interconnection network, high performance node, operating system, Grid middleware layer, parallel programming environment and Grid application. The four layer model can be defined as node and interconnection layer, node system software layer, Grid system software layer and application layer.

Node and interconnection layer

This layer is the lowest layer of the Grid Computing System. The node and interconnection layer provides the resources to which shared access is mediated by Grid protocol. It consists of high performance of computer, large-scale database server, largescale file server, computer cluster, large communication equipment and high-speed interconnection network connecting these resources.

Node system software layer

This layer defines core communication and authentication protocol required for Grid specific network transactions. Communication protocols enable the exchange of data between node and interconnection layer. Authentication protocol build on communication services to provide secure mechanism for verifying the identify of users and resources. Nodes system software layer includes operating system software, large-scale database system software, large-scale file system software, cluster system software, network connection protocol large equipment driver etc.

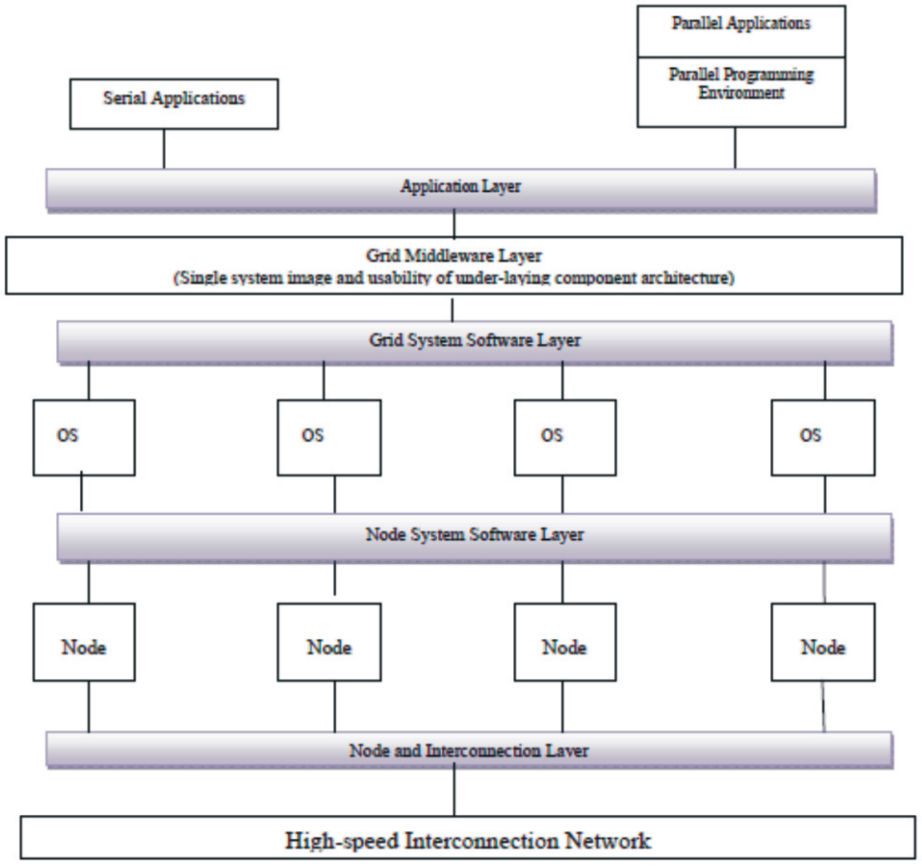
Grid system software layer

This layer is also known as Grid middleware layer. This layer concerned entirely with individual

resources and hence ignores issues of global state and atomic actions across distributed collections. Resource management, data management, user management, task management, information services, authentication and authorization are implemented in this layer.

Application layer

The final layer is our layered Grid architecture comprises the user applications that operate within virtual organization environment .

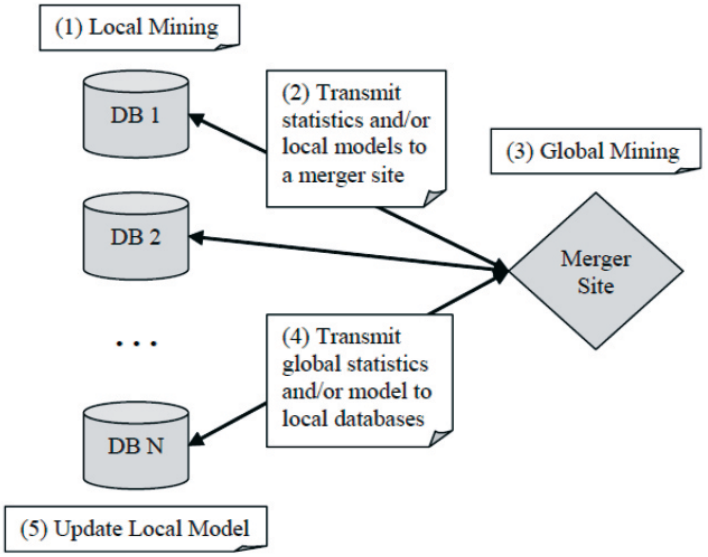


This layer consist of Grid programming environment, other software which support direct access file and database, Grid service portal based web, many kinds of Grid applications.

Distributed Data Mining Data mining evolution has outlined the development of new contributions in any of the following two lines:
(i) New algorithms, theoretical models

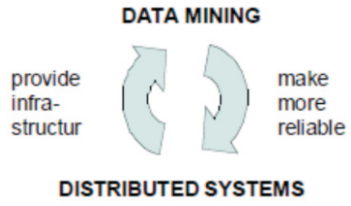
or data mining techniques
(ii) Technological and design research for new data mining systems and architectures .
The same can be asserted for distributed data mining

Figure 1. Typical architecture of Distributed Data Mining approaches



Nowadays, the information overload means big problem, so data mining algorithms working on very large data sets take very long times on conventional computers to get results. One approach to solve this problem is parallel computing parallel data mining algorithms can offer an effective way to mine very large data sets. A primary motivation for Distributed Data Mining (DDM) is that a lot of data is inherently distributed. Merging of remote data at a central site to perform data mining will result in unnecessary communication overhead and algorithmic complexities. For example, consider the NASA Earth Observing System Data and Information System (EOSDIS) which manages data from earth science research satellites and field measurement programs. It provides data archiving, distribution, and information management services and holds more than 1450 datasets that are stored and managed at many sites throughout the United States. It manages extraordinary rates and volumes of scientific data. A centralized data mining system may not be adequate in such a dynamic,

distributed environment. Indeed, the resources required to transfer and merge the data on a centralized site may become implausible at such a rapid rate of data arrival. Data mining techniques that minimize communication between sites are quite valuable.
Some examples are distributed or parallel algorithms for association rules, classification rules, sequence patterns or clustering algorithm.



Challenges Posed by Distributed Data Mining
The shift towards intrinsically distributed complex problem soving environments is prompting a range of new data mining research and development problems. These can be classified into the following broad challenges:

• Distributed data: The data to be mined is stored in distributed computing environments on heterogeneous platforms. Both for technical and for organizational reasons it is impossible to bring all the data to a centralized place. Consequently, development of algorithms, tools, and services is required that facilitate the mining of distributed data.

• Distributed operations: In future more and more data mining operations and algorithms will be available on the grid. To facilitate seamless integration of these resources into distributed data mining systems for complex problem solving, novel algorithms, tools, grid services and other IT infrastructure need to be developed.

• Massive data: Development of algorithms for mining large, massive and high-dimensional data sets (out-of-memory, parallel, and distribute algorithms) is needed.

• Complex data types: Increasingly complex data sources, structures, and types (like natural language text, images, time series, multi-relational and object data types etc.) are emerging. Grid-enabled mining of such data will require the development of new methodologies, algorithms, tools, and grid services.

• Data privacy, security, and governance: Automated data mining in distributed environments raises serious issues in terms of data privacy, security, and governance. Grid-based

data mining technology will need to adress these issues.

• User-friendliness: Ultimately a system must hide technological complexity from the user. To facilitate this, new software, tools, and infrastructure development is needed in the areas of grid-supported workflow management, resource identification, allocation, and scheduling, and user interfaces.

Distributed Data Mining on Grids

• The Grid extends the distributed and parallel computing paradigms allowing resource negotiation, dynamical allocation, heterogeneity, open protocols and services.

• As Grids and Clouds became well accepted computing infrastructures it is necessary to provide data mining services, algorithms, and applications.

Various Grid services for distributed data mining

• Exploiting the SOA model and the Web Services Resource Framework(WSRF) it is possible to define basic services for supporting distributed data mining tasks in Grids

• Those services can address all the aspects that must be considered in data mining and in knowledge discovery processes

• data selection and transport services,

• data analysis services,

• knowledge models representation services, and

• visualization services.

Grid Services for Distributed Data Mining

• It is possible to define services corresponding to

• Allowing developers to program distributed KDD processes as a composition of single and/or aggregated services available over a Grid.

• Those services should exploit other basic Grid services for data transfer and management for data transfer, replica management, data integration and querying.

• By exploiting the Grid services features it is possible to develop data mining services accessible every time and everywhere.

• This approach may result in

• Service -based distributed data mining applications

• Data mining services for virtual organizations.

• Distributed data analysis services on demand.

• A sort of knowledge discovery eco - system formed of a large numbers of decentralized data analysis services.

Data mining grid – mining grid data

From the overview on data mining and grid technology, we see two interesting developments, the concept of a data mining grid and mining grid data. A data mining grid could be viewed as a grid that is specifically designed to facilitate demanding data mining applications. In addition, grid computing environments may motivate a new form of data mining, mining grid data, which is geared towards supporting the efficient operation of a grid by facilitating the analysis of data generated as a by-product of running a grid. These two aspects are now briefly discussed.

Data mining grid: a grid facilitating large-scale data mining

A data mining application is defined as the use of data mining technology to perform data analysis tasks within a particular application domain. Basic elements of a data mining application are the data to be mined, the data mining algorithm(s) and methods used to mine the data, and a user who specifies and controls the data mining process. A data mining process may consist of several data mining algorithms, each addressing a particular data mining task, such as feature selection, clustering or visualization. A given data mining algorithm may have different software implementations. Likewise, the data to be mined may be available in different implementations, for instance as a database in a database management system, a file in a particular file format or a data stream.

A data mining grid is a system whose main function is to facilitate the sharing and use of data, data mining programs (implemented algorithms), processing units and storage devices in order to improve existing, and enable novel, data mining applications (see

Subsection 1.2.2). Such a system should take into account the unique constraints and requirements of data mining applications with respect to the data management and data mining software tools, and the users of these tools (Stankovski et al., 2008). These high-level goals lead to a natural breakdown of some basic requirements for a data mining grid. We distinguish user, application and system requirements. The user requirements are dictated by the need of end users to define and execute data mining tasks, and by developers and administrators who need to evolve and maintain the system. Application program and system requirements are driven by technical factors such as resource type and location, software and hardware architectures, system interfaces, standards and so on. Below we briefly summarize what these requirements may be. Ultimately, a data mining grid system facilitating advanced data mining applications is operated by a human user – an end user wanting to solve a particular data mining task or a system developer or administrator tasked with maintaining or further developing the data mining grid. Some of the main requirements such users may have include the following. Effectiveness and efficiency: A data mining grid should facilitate more effective (solution quality) and/or more efficient (higher throughput, which relates to speed-up) solutions than conventional environments. Novel use/application: A data mining grid should facilitate novel data mining applications currently not possible with conventional environments. Scalability: A data mining grid should facilitate the seamless adding of grid resources to accommodate increasing numbers of users and growing application demands without performance loss. Scope: A data mining grid should support data mining applications from different application domains and should allow the execution of all kinds of data mining task (pre-processing, analysis, post-processing, visualization etc.) Ease of use: A data mining grid should hide grid details from users who do not want to concern themselves with such details, but be flexible enough to facilitate deep, grid-level control to those users wish to operate on this level. Furthermore, mechanisms should be provided by a data mining grid that allows users to search for grid-wide located data mining applications and data sources. Finally, a data mining grid should provide tools that help users to define complex data mining processes. Monitoring and steering: A data mining grid should provide tools that allow users to monitor and steer (e.g. abort, provide new input, change parameters) data mining applications running on the grid. Extensibility, maintenance and integration: Developers should be able to port existing data mining applications to the data mining with little or no modification to the original data mining application program. System developers should be able to

extend the features of the core data mining grid system without major modifications to the main system components.
It should be easy to integrate new data mining applications and core system components with other technology (networks, Web services, grid components, user interfaces etc). To meet the user requirements presented above, a data mining grid should meet additional technical requirements relating to data mining application software (data, programs) and the underlying data mining grid system components. Some basic requirements of this kind are as follows. Resource sharing and interoperation: A data mining grid should facilitate the seamless interoperation and sharing of important data mining resources and components, in particular, data mining application programs (implemented algorithms), data (different standard data file formats, database managements systems, other data-centric systems and tools), storage devices and processing units. Data mining applications: A data mining grid should accommodate a wide range of data mining application programs (algorithms) and should provide mechanisms that take into account the requirements, constraints and user-defined settings associated with these applications. Resource management: A data mining grid system should facilitate resource management to match available grid resources to job requests (resource broker), schedule the execution of the jobs on matched resources (scheduler) and manage and monitor the execution of jobs (job execution and monitoring). In particular, a data mining grid resource manager should facilitate data-oriented scheduling and parameter sweep applications, and take into account the type of data mining task, technique and method or algorithm (implementation) in its management policies.

Mining grid data: analyzing grid systems with data mining techniques

Grid technology provides high availability of resources and services, making it possible to deal with new and more complex problems. But it is also known that a grid is a very heterogeneous and decentralized environment. It presents different kinds of security policy, data and computing characteristic, system administration procedure and so on. Given these complexities, the management of a grid, any grid not just a data mining grid, becomes a very important aspect in running and maintaining grid systems. Grid management is the key to providing high reliability and quality of service. The complexities of grid computing environments make it almost impossible to have a complete understanding of the entire grid. Therefore, a new approach is needed. Such an approach should pool, analyse and interpret all relevant information that could be obtained from a grid. The insights provided should then be used to support resource management and

system administration. Data mining has proved to be a remarkably powerful tool, facilitating the analysis and interpretation of large volumes of complex data. Hence, given the complexities involved in operating and maintaining grid environments efficiently and the ability of data mining to analyse and interpret large volumes of data, it is evident that 'mining grid data' could be a solution to improving the performance, operation and maintenance of grid computing environments.

Nowadays, most management techniques consider the grid as a set of independent, complex systems, building together a huge pool of computational resources. Therefore, the administration procedures are subjected to a specific analysis of each computer system, organizational units, etc. Finally, the decision making is based on a detailed knowledge of each of the elements that make up a grid. However, if we consider how more commonly used systems (such as regular desktop computers or small clusters) are managed, it is easy to realize that resource administration is very often based on more general parameters such as CPU or memory usage, not directly related to the specific architectural characteristics, although it is affected by them. This can be considered as an abstraction method that allows administrators to generalize and apply their knowledge to different systems. This abstraction is possible thanks to a set of underlying procedures, present in almost every modern computer. Nevertheless, in complex systems such as a grid, this level of abstraction is not enough. The heterogeneous and distributed nature of grids implies a new kind of architectural complexity. Data mining techniques can contribute to observe and analyse the environment as a single system, offering a new abstraction layer that reduces grid observation to a set of representative generic parameters. This approach represents a new perspective for management, allowing consideration of aspects regarding the whole system activity, instead of each subsystem's behaviour. The complexity of this formulation makes it hard to face grid understanding directly as a single problem. It is desirable to focus on a limited set of aspects, trying to analyse and improve them first. This can provide insight on how to deal with the abstraction of grid complexity, which can be extended to more complete scenarios. The great variety of elements that can be found in the grid offers a wide range of information to process. Data from multiple sources can be gathered and analysed using data mining techniques to learn new useful information about different grid features. The nature of the information obtained determines what kind of knowledge is going to be obtained. Standard monitoring parameters such as CPU or memory usage of the different grid resources can provide insight on a grid's computational behaviour. A better knowledge of the grid variability makes it possible to

improve the environment performance and reliability. A deep internal analysis of the grid can reveal weak points and other architectural issues. From a different point of view, user behaviour can be analysed, focusing on access patterns, service request, the nature of these requests etc. This would make it possible to refine the environment features and capabilities, trying to effectively fit user needs and requirements. The grid's dynamic evolution can also be analysed. Understanding the grid's present and past behaviour allows us to establish procedures to predict its evolution. This would help the grid management system to anticipate future situations and optimize its operation.

Conclusion

As the demand for automated analysis of large and distributed data grows, new data mining challenges in distributed computing environments emerge. The aim of Data Mining Grid project is to address some important requirements arising from modern data mining scenarios. The technology developed by the project facilitates grid enabling of existing, and the development of novel, data mining applications. Major features of the Data Mining Grid technology include high performance, scalability, flexibility, ease of use, conceptual simplicity, compliance with emerging grid and data mining standards and use of mainstream grid and open technology. As a result, even larger-scale problems are envisaged and in many areas so-called grand challenge problems are being tackled. These problems put an even greater demand on the underlying computing resources. A growing class of applications that need large-scale resources is modern data mining applications in science, engineering and other areas. Grid technology is an answer to the increasing demand for affordable large-scale computing resources. The emergence of grid technology and the increasingly complex nature of data mining applications have led to a new synergy of data mining and grid. On one hand, the concept of a data mining grid is in the process of becoming a reality. A data mining grid facilitates novel data mining applications and provides a comprehensive solution for affordable high performance resources satisfying the needs of large-scale data mining problems. On the other hand, mining grid data is emerging as a new class of data mining application. Mining grid data could be understood as a methodology that could help to address the complex issues involved in running and maintaining large grid computing environments.

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APPLICATION OF PROCESS SIMULATION SOFTWARE METSIM IN METALLURGY

Rakesh Kumar

Abstract

Now the using of process simulation software is more and more widely in many fields especially in chemistry and metallurgy plant designing. The process simulation software provides great convenience for experts and engineers, they can analysis the new process and calculate the heating/material balance by process simulation software, and calculate complex process that the traditional tool EXCEL can not do. The paper introduced the current major process simulation software, includes mainly introducing the application of METSIM and SYSCAD software in metallurgical process, and summary the computational process of them by a few examples, at the same time the application status of the process simulation software was pointed out.

Keywords: process, simulation, software, metallurgy

1. Introduction

Chemical and metallurgical plants design, process design, such as metal and mass balance calculations are both the basis of the entire design work, but also indeed keys to accurate and secure design. Metallurgical calculation is often separated from process design work, and are done under help of excel manual calculations. It is a heavy workload and the work efficiency is very low, at the same time this calculation is not sufficiently sophisticated, especially in face of more complex processes, the demand for raw materials, ″three wastes ″ volume of output are difficult for estimating [1-4].

Process simulation technology computes with the help of the establishment of a mathematical model calculated by unit operations, thermodynamic methods. Process simulation technology can calculate material balance, heat balance, estimate equipment size and energy analysis, and make environmental and economic evaluation. It is the combination of chemical engineering, thermodynamics, systems engineering ,

computational methods and computer application technology. It is a new technology developed in recent decades.

Process simulation technology can achieve device tuning, process analysis and process synthesis, so as to realize production optimization, resource conservation, friendly environment and improving economic efficiency, thus helps process development, engineering design and optimizing operations to provide theoretical guidance [5, 6].

Currently, the wider application of process simulation software is show as below: Aspen Plus [7], Chem CAD [8], Hysys, etc. Most of the software is applied in the petrochemical field. There are some process simulation software application in the field of hydro metallurgy, such as SYSCAD and METSIM. This software can be divided into three categories:

(1) Thermo chemical properties of calculation software, such as HSC, OLI, STABCAL, FACTSAGE;

(2) Mineral process simulation and optimization software, such as JKSimMet, JKSimfloat, USIMPAC, etc;

(3) Process simulation softwares, such as. METSIM, SYSCAD, IDEAS, etc; The process simulation software METSIM is highlighted in this paper. The basis for analysis of all chemical and metallurgical processes is the mass and energy balance.

Plant design, capital costs, and technical evaluations are all dependent on such calculations. METSIM is a general-purpose process simulation system designed to assist the engineer in performing mass and energy balances of complex processes. METSIM uses an assortment of computational methods to effect an optimum combination of complexity, user time, and computer resources usage. METSIM originated as a metallurgical process simulation program, written to perform mass balances around the major unit operations of complex process flow sheets. Application of the program proved so successful that it was expanded to include detailed heat balances, chemistry, process controls, equipment sizing, cost estimation, and process analysis. The unique nature of the programming language, APL, allows modification and expansion of the system with minimum effort and permits the incorporation of continuing technological innovations in process simulation. Some have described the application of METSIM to an electrolytic zinc plant circuit[9] and a copper flash smelting plant[10].

2. Research Method

The basic calculation philosophy used in METSIM is that the feed streams is taken to a unit operation module and then a mechanical device handled the

inputing materials according to a module program and outputs the calculation results. Most unit operation modules mix the feed streams first and then the mechanism is applied to deal with it. The mechanism can be preceded by chemical reactions or a phase change and if the result required is not achieved then the mechanism or chemical reaction can be changed or a control is applied as a feed forward or feedback loop. Because of the structure of the program, it is possible to add chemistry to any unit operation and then add controls to simulate any type of reactor without having a specific reactor model. METSIM performs mass and energy balances for chemical processes using the sequential modular approach. This method is used because of its elegance and to simplify divers and complex flow sheets. METSIM can easily be expanded to encompass new processes and techniques. A major advantage of this approach is that intermediate results may be obtained from any stage of the process in an intelligible form. This attribute of METSIM is invaluable when attempting to detect possible modeling or specification errors. If an output stream parameter is to be controlled, a feedback controller must be added to sample the output and adjust an input stream, a reaction extent or another unit operation parameter to achieve the desired results.

In conformance with the sequential modular approach, METSIM comprises modules containing subsets of equations describing the design specifications and performance characteristics for each process step. The system solves the equation subset for each module, allowing for an individual analysis of each unit operation in the flow-sheet. Given data on design variables and input stream composition, each module calculates all of the output stream variables, which can then be used as input stream values for the next process step. The modules access data on all independent stream variables from the data arrays contained within the APL global workspace. Additional input data required to solve the equations in each module are requested by the program and are stored as global variables. The user may supply actual data obtained from operating or pilot plants, from similar processes, or from estimates supplied by the engineer.

Creating METSIM model must have a plan and the entire modeling process can be divided into eight main steps:

(1) Enter the basic information of the project and select parameters such as quality and time units;

(2) Select the elements and draw up system phase table that lists each of the elements and compounds system contains , and select phase of each compound;

(3) Draw process flow sheet including all operations units and logistics;

(4) Input the name , flow and composition of the inflow stream;

(5) Enter chemical reaction of each operating unit and set the necessary parameters;

(6) Add the process controllerinput function command in order to achieve the expected results; (7) Check the results , check input values and process mechanism debugging model until the display shows no error ; (8)Display the

3. Results and Analysis

3.1. practical procedures of METSIM in alumina production process

According to above eight steps the basic information of the project and parameters will be input and the dialog box is shown as below:

The new alumina production process was simulated by METSIM as below. The process involves compounds as Table 1.

The related reactions are shown as below:

$$AlO(OH)(s)+NaOH(a)\rightarrow NaAl(OH)4(a)$$
$$Al_2O_3\bullet 2SiO_2\bullet 2H_2O(s)+AlO(OH)(s)+Ca(OH)_2(a)+H_2O\ (a)\rightarrow 3CaO\bullet Al_2O_3\bullet 0.64SiO_2\bullet 4.72H_2O(s)$$
$$3CaO\bullet Al_2O_3\bullet 0.64SiO_2\bullet 4.72H_2O(s)+CO_2(g)\rightarrow CaCO_3(s)+Ca_2SiO_4(s)+Al(OH)_3(s)+H_2O(a)$$
$$Al(OH)_3(s)+NaOH(a)\rightarrow NaAl(OH)_4(a)$$
$$NaAl(OH)_4(a)\rightarrow Al(OH)_3(s)+NaOH(a)$$

So the next is establishing elements and compounds database based on reactions. The table list show as Figure 2.

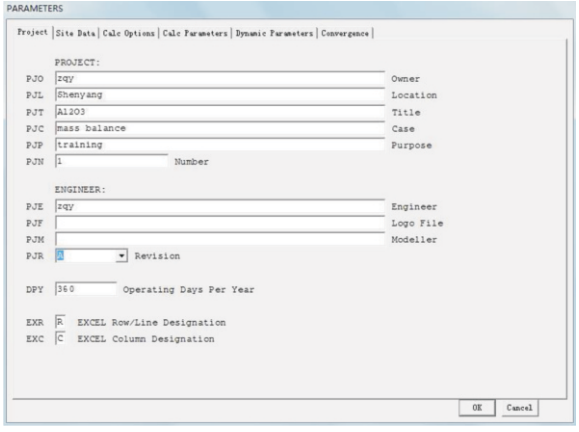

Figure 1 Input dialog box of the project and parameters

Table 1 Compounds

Solid	Aqueous	Gas
AlO(OH)	NaOH	CO2
Al2O3•2SiO2•2H2O	NaAl(OH)4	H2O
3CaO•Al2O3•0.64SiO2•4.72H2O	Ca(OH)2	Steam
CaCO3	H2O	
Ca2SiO4		
Fe2O3		
CaO		

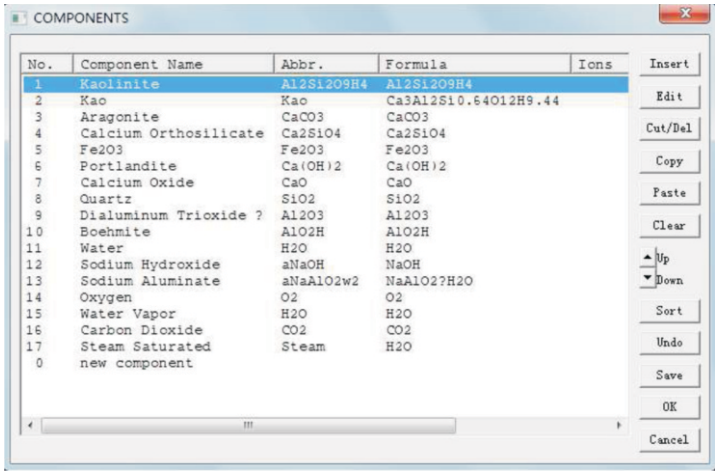

Figure 2 Elements and compounds database

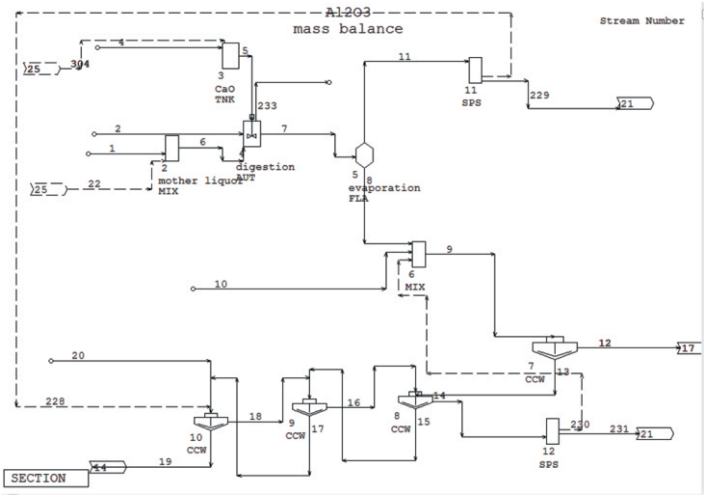

Figure 3 Process flow sheet of section 1

After proper elements and compounds are selected the process flow sheet is drawn as Figure 3-5.

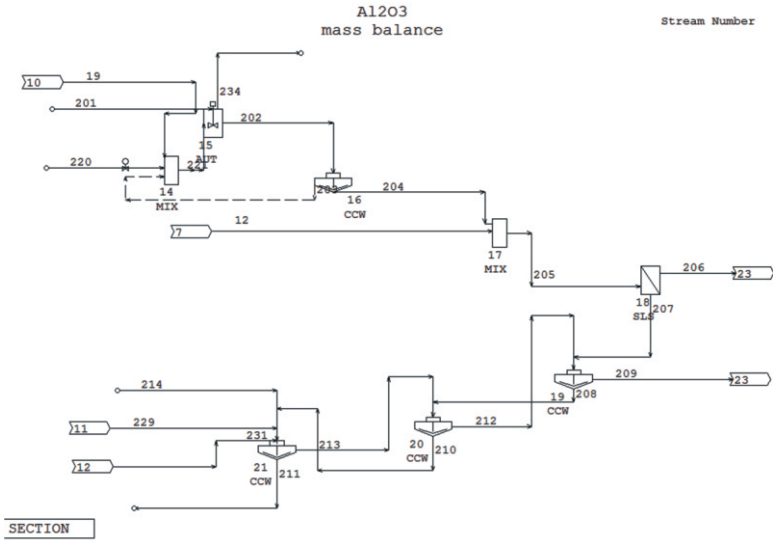

Figure 4 Process flow sheet of section 2

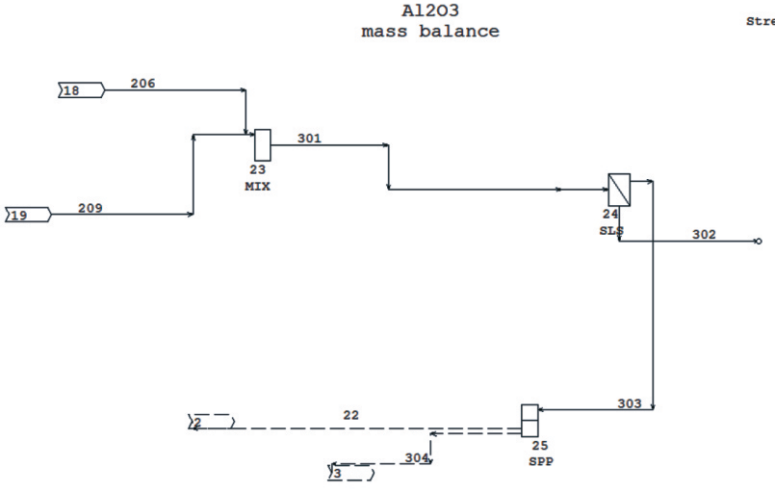

Figure 5 Process flow sheet of section 3

METSIM was originally developed to calculate mass and energy balances around any type of flow sheet in a timely manner. To facilitate this task several generic unit operation modules were used. Chemistry and heat balance data may be added to any of these units. The general unit operations are adopted in this alumina production process. This operation concludes all we needs,what shows as Table 2.

Table 2 General unit operation

Sect ion	Pump, Sump
Stream	Pump, Vacuum
Recycle Stream Links	Pipe
Stream Mixer	Pipe Connection
Solid/Liquid Separator	Pipe Header
Stream Distributor	Tank –agitated tank with internal coils for heating or cooling
Component Splitter	Tank –agitated tank with external jackets for heating or cooling
Phase Splitter	Tank –agitated storage tank
Stream Splitter	Tank –with internal coils for heating or cooling
Sump	Tank –with external jackets for heating or cooling Tank – simulates a storage tank
Launder	Tank –decant tank for separating organic from aqueous Tank – electrolyte or compartmented tank
Pump, Centrifugal	Tank –process tank wit h agitation
Pump, Positive Displacement	Tank –storage tank without agitation or heating
Pump, Verticle	
Pump, Metering	

When above works have been done the information about streams and operations should be input and FBC control should be set up. The content of compounds in raw materials is shown as Table 3.

Table 3.Content of compounds

Compounds	Boehite (%)	Lime (%)
Al_2O_3	54.41	1.17
SiO_2	16.55	2.38
Fe_2O_3	7.16	0.58
TiO_2	2	0
Na_2O	0.15	0
CaO	0.5	86.5
crystal water	12.89	0
other	5.85	2.58

So we can draw conclusion from calculations the flow rate of washing water needed is about 6000 kg and flash water is about1373 kg for producing one ton alumina. For the same process we can set different forms of flow sheetFigure 6 is other form for alumina producing process.

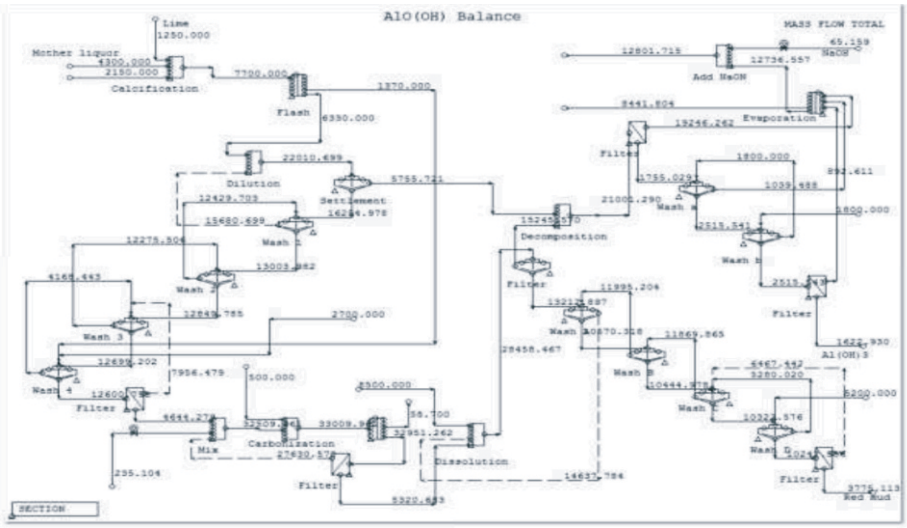

Figure 6 Process flowsheet in one section

All of the operations are arranged in one section in figure 6, it is more directly and easy for reading but when the process is more complex it can not be achieved.The results are similar for the two schemes and we should study furthermore to get the best scheme. There are other applications for METSIM. Ming. Wang [12] calculated metal/material balance of separation of ionic rare earth. The annual equivalent processing capacity of REO is 1500t (5000 kg/d) rare earth raw materials , 25% is the rare earth oxide containing 92% REO , 75% is rare earth carbonate with 40% REO , the process is acid dissolution-extraction -precipitation - burning for preparation of single rare earth oxide. Only acid-soluble process is selected as example using METSIM.Total of rare earth elements are 17 species and all of the 15 kinds of elements are need to be addressed except Sc and Pm. because these elements exist with the form of oxygen compounds, carbonates and chlorides, the corresponding compounds of primary metal are as many as 45 kinds. If using existing method of Excel to calculate

Metal / material balance, it will be difficult to achieve balance of the main metal material.

METSIM is reliable for these calculations no matter how many kinds of elements and compounds. Acidsoluble process and towards of streams using METSIM software are shown as figure 7. The figure shows that the acid dissolution process is mainly including acid-soluble oxidation rare earth raw (operating unit) , acid-soluble rare earth carbonate raw (operation unit 3) , aging (operation unit 4) , and Plate-frame Pressure of supernatant (operation unit 5) ,the viscous liquid natural filtering (operation unit 6) . The Component of oxygen rare earth and rare earth carbonate are input to steam 1 and stream 4. The industrial hydrochloric acid (stream 2 and stream 5) is added for decomposition reaction. (For convenience , the rare earth ions are carried as trivalent).

$$RE_2O_3+6HCl=2RECl_3+3H_2$$

$$RE_2(CO_3)_3+6HCl=2RECl_3+3H_2O+3CO_2$$

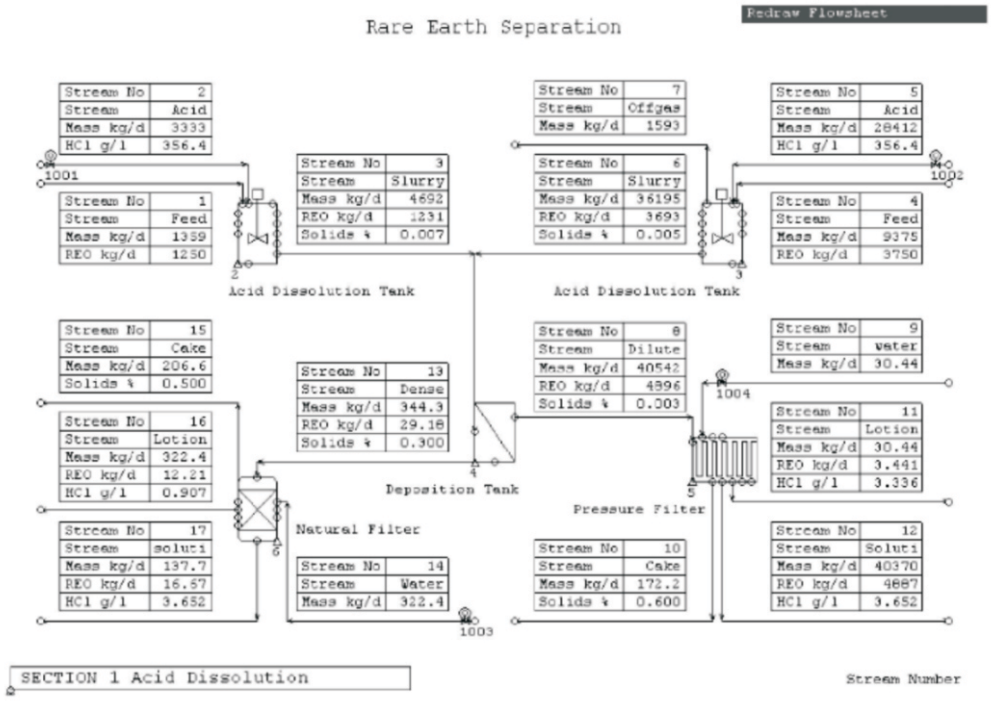

Figure 7 Process flow sheet of acid dissolution in rare earth separation [11]

The amount of hydrochloric acid was controlled by the controller 1001 and the controller 1002,which ensure that the pH value is1 after acid-soluble. The acid soluble slurry（stream 3 and stream 6）flow into the aging tank, after aging for 24 h supernatant（stream 8）flow into the plate-frame pressure filtration, viscous liquid（ stream 13）flow into the natural filtration tank for filter and is washed by water（stream 9 and stream ,14e）amount of washing water is controlled by the controller 1003 and the controller 1004 , so that the metal content of the residue reached a certain low value . Filtered feed solution（stream 12 and stream 17 ）enter the next step of extraction process , the lotion (stream 11 and stream 16) return to the main flow , filter residue (stream 10 and stream 15) are sent to the residue field storage .

The whole process needs oxidized rare earth materials 1 359 kg / d, rare earth carbonate raw materials 9 375 kg / d, acid consumption 31 745 kg / d. filtrate Output 40507.7 kg/d, the containing main metal equivalent REO 4 903.7kg / d, 98% yield ; the output of wet residue to 378.8 kg / d , producing slag was 3.5%. The total input streams and total output streams are both 42 831.9kg / d, the material balance is achieved.

4.Conclusion

Chemistry and metallurgy process simulation software is convenient for calculate heat/balance of material. The soft ware METSIM and SYSCAD are better software among numerous process soft wares.

The calculations examples for alumina production process, acid dissolution in rare earth separation process, the desilverising of lead by the reagent zinc and Nickel laterite acid leaching process are all successful by using the simulation software.

Study on the process simulation software in China is later and is not widespread, more and more people can to master the process simulation software and be able to develop our own software.

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A SURVEY OF NEXT GENERATION INTERNET PROTOCOL VERSION 6

Mr. Jayesh Kumar

Abstract:

This paper highlights the upgraded features, addressing methods, transition techniques of next generation Internet Protocol version 6 after performing a detailed survey.

Keywords: internet protocol, address space, routing, IP sec, transition

I. INTRODUCTION

Internet Protocol Version6 is introduced due to the depletion of all internet protocol version4 addresses.IPV4 uses 32-bit addresses that allows 232 unique addresses worldwide where as IPv6 uses 128-bit addresses, allowing for 2128 unique addresses that is 340 trillion (or 340,000,000,000,000,000,000,000,000,000,000,000,000) addresses assuring that ipv6 will never run out of addresses in future. Apart from large address space in ipv6, other features are included in this version which enhances better QoS, security, extensibility, mobility, routing capabilities etc.,

II.IPV6 Addressing

A. Hexadecimal Notation

128-bit IPv6 addresses are represented by splitting them up into eight 16-bit segments. Each segment is written in hexadecimal between 0000 and FFFF, separated by colon. Ex: 2001:0000:130F:0000:0000:09C0:876A:130B

B. Address Compaction

Leading zeroes in a segment can be compacted. All zeroes in one or more segments can be represented with a double colon (::). Double colons can be used only once. IPv4 Embedded in IPv6 addresses are represented with dotted decimal.

C. Prefix Representation

CIDR notation can be used to specify prefix length. ex:2001:CB8E:2A::/64

is network.,2001:3F0E:102A::/48., 2001:10C2:43EE:D0C:F::C14/126.,2001:3F03:102A:3010:20::/75

D. Address Allocation

Internet Assigned Numbers Authority(IANA) allots IPv6 address space to Regional Internet Registries (RIRs). ISPs get address space from the RIRs. Enterprises get their IPv6 address space from their ISP. The allocation process is as follows. The IANA has allocated 2001::/16 for initial IPv6 unicast use. Each registry gets /23 prefixes from the IANA. Registry allocates a /32 prefix to an IPv6 ISP. An ISP allocates a /48 prefix to each end customer.

E. Address Scope

IPv6 addresses are denoted with scope value. The packets cannot be sent beyond a specified scope.
1) Interface-local:The scope of this address spans for its own interface. The loopback address of unicast type isan example for Interface-local scope.
2) Link-local:The scope of Link-Local address spans within the link. The destination node must exist withinthe same link.
3) Subnet-local:The scope of Subnet-Local address spans within the subnet of multiple links.
4)Admin-local:The scope of this address is configured by the admin.
5) Site-local:The scope of the Site-Local address spans across multiple links connected within the same site.
6) Organization-local:The scope of the organization-local address spans across multiple sites within anorganization.
7) Global: The scope of this address spans across entire internet.

F. Address Types

The IPv6 addresses are categorized in to three types. They are Unicast, Multicast, Anycast.
1) *Unicast:*The Unicast address is used to send a packet to a single interface in a network. The types of Unicast addresses are as follows.

- Unspecified 00..0 (128 bits) ::/128
- Loopback 00..1 (128 bits) ::1/128
- Link Local Unicast 1111 1110 10 FE80::/10
- Site-Local Unicast fec0::/10
- IPv4-mapped IPv6 address ::FFFF: a.b.c.d
- IPv4-compatible IPv6 address ::a.b.c.d
- Aggregatable global unicast address 2000::/3

2) *Multicast:* The Multicast address is used to send a packet to multiple interfaces in a network. Multicast address is denoted by Multicast 1111 1111 FF00::/8.
3) *Anycast:* The Anycast address is used to send a packet to multiple interfaces in a network and the one nearest will be the destination node.

G. Interface ID

The last 64 bits of the IPv6 address is represented by interface id. The interface id is unique to link and used to identify a particular interface in a link. This ID can be generated by different methods. It can be configured automatically from a 64-bit EUI-64 or by expanding 48-bit MAC address or by automatically generating a pseudo-random number or by manually configured via DHCP.

III.IPV6 HEADER

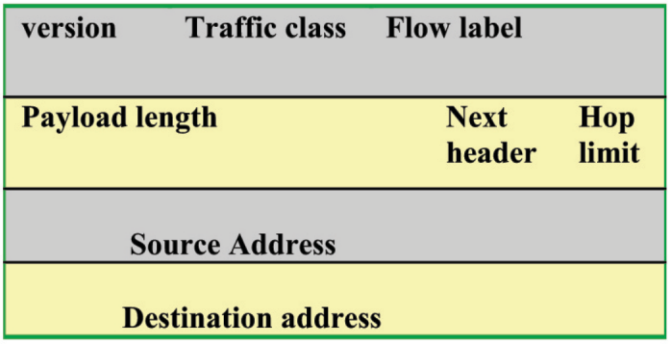

Fig 1: IPv6 Header Format

A. Version (4 bits)

This field indicates the internet protocol version which is 6 and denoted with binary value 0110.

B. Traffic Class (8 bits)

The Traffic class field holds 8 bits that indicates the priority in which a packet must be routed in a network and packet priority value is assigned by the source node.

C. Flow label (20 bits)

This 20-bit is used to indicate packets with same flow and all the ipv6 routers handles all the packets with same flow in a similar way to ensure Quality of Service.

D. Payload length (16 bits)

This field indicates the length ofvcdgvbfryjh65j payload. It also includes length of extension header if present.

E. Next Header (8-bits)

This field identifies the transport layer protocol used by the next header and ipv6 provides an extension header for a packet to do specific task and this detail is also added as option in this field.

F. Hop limit (8 bits)

This field is used to denote the number of hops that the packets are limited to travel. When a packet undergone the

number of hops denoted, it is dropped. The packets cannot travel not more hops than specified in this filed.

G. Source Address (128 bits)
This is the 128-bit IP address of the node where the packet first originated.

H. Destination Address (128 bits)
This is the 128-bit IP address of the node where the packet finally has to reach.

IV. ICMPV6

Internet Control Message Protocol version 6 (ICMPv6) is the upgraded version of ICMP for Internet Protocol Version6.The ICMPv6 combines the activities of three main protocols ICMP (Internet Control Message Protocol version), IGMP (Internet Group Membership Protocol), and ARP (Address Resolution Protocol).Hence it becomes a multipurpose protocol performs various tasks that includes error diagnostics and error reporting, neighbor discovery, reporting multicast memberships.

A. ICMPV6 HEADER

Type	Code	Chechsum
ICMPv6 Message		

Fig 2: ICMPv6 Header Format

1) Type (8 bits):The Type field indicates the type of message and the value determines which type of erroror information message.
2) Code (8 bits):The value of the code depends on the type of message and its value gives additional precise information about the message.
3) Checksum (16 bits):This field is used for the error detection purpose.
4) ICMPv6 Message (32 bits):ICMPv6 messages are categorized in to Error messages and Information messages. Information message includes two of icmpv6 messages, Neighbor discovery messages, and Group membership messages.

Error Message includes Destination-Unreachable Message, Packet-Too-Big Message, Time-Exceeded Message, and Parameter-Problem Message

Type	Meaning
1	Destination Unreachable
2	Time Exceeded
3	Packet Too Big
4	Parameter Problems

Information message includes two of icmpv6 messages. They are Echo-Request Message and Echo-Reply Message. Neighbor Discovery Messages includes Router-Solicitation Message, Router-Advertisement Message, Neighbor-Solicitation Message, Neighbor-Advertisement Message, Redirection Message, Inverse-Neighbor-Solicitation Message, and Inverse-Neighbor-

Advertisement Message.Group membership messages includes Group Membership Query, Group Membership Report, Group Membership Reduction

Type	Meaning
128	Echo Request
129	Echo Reply
130	Group Membership Query
131	Group Membership Report
132	Group Membership Reduction
133	Router Solicitation
134	Router Advertisement
135	Neighbor Solicitation
136	Neighbor Advertisement
137	Redirect

V. NEIGHBOR DISCOVERY PROTOCOL

Neighbor Discovery Protocol is introduced in the internet protocol version6. It has following functions. Router discovery, Prefix discovery, Parameter discovery, Address auto configuration, Address resolution, Next-hop determination, Neighborun reachability detection, Duplicate address detection (DAD), Redirection.
It makes use of ICMPv6 neighbor discovery messages such as Router-Solicitation Message, Router-Advertisement Message, Neighbor-Solicitation Message, Neighbor-Advertisement Message, Redirection Message, Inverse-Neighbor-Solicitation Message, and Inverse-Neighbor-Advertisement Message.

A. *Neighbor Discovery Functions*

1)Router discovery: The host automatically locates the router with the help of icmpv6 information messages such as Router Solicitation and Router Advertisement. During Router solicitation, the host afterallotted to a certain network multicast router solicitation message to all routers in that network. The routerin turn responds by advertising with its address.

2) Prefix discovery: The host can get all reachable prefix information during router advertisements so that all the traffic can directly be sent to destination without forwarding to router.

3) Parameter discovery: The router advertisement also includes the maximum transmission unit (MTU) and the default hop limit values for the host to send packets accordingly.

4) Address auto configuration: The host can automatically generate a stateless address by combining the EUI-64 of the interface with the prefix learned from prefix discovery method.

5) Address resolution: The host makes use Neighbor-Solicitation and Neighbor-Advertisement Messages to discover neighbor's link layer address. The host multicasts a neighbor solicitation and the neighbor respond with link layer address during neighbor advertisement.

6)Next-hop determination: When the destination does not come under local link, the host determines which router it must take to reach destination. Once the next hop is found it is stored in destination cache. This destination cache maintains information about recent device's next hop, destination address and interface identifier.

7) Neighbor unreachability detection: Here the neighbor node is checked for its reachability using neighbor solicitation message. When a neighbor advertisement is got from the desired node, the node is reachable else unreachable. Its entry is then removed from neighbor cache.

8) Duplicate Address Detection (DAD): The host ensures that the address assigned

by it does not exist to other node in the same link. So it sends a neighbor solicitation and gets back neighbor advertisement. When the same address is found, the host changes its own assumed address.

9) Redirection: In this process, the router sends a redirection message to the host to take up the most preferable hop.

Vi. Multicast Listener Discovery Mld

The Multicast Listener Discovery protocol is introduced for the multicast transmission in IPV6 network. MLD protocol uses ICMPv6 information messages such as Group Membership Query, Group Membership Report, and Group Membership Reduction for managing multicast function. Multicast router can send either general query to all multicast listener's addresses with Maximum Response Delay unit or a specific query for a particular group of multicast listeners. The router uses general query message to discover multicast listeners in the network. The multicast nodes respond by sending report message to the multicast router. When the multicast node decides not to receive multicast packets, acknowledge the multicast router by MLD done message and can leave the group.

VII.IPV6 Routing

The Routing types in IPv6 are similar to that of the IPv4 but with slight upgradation in the protocols used for routing. The protocols used in IPv6 routing are RIPv6, OSPFv6, IDRPv2, EIGRP and Dual IS-IS. These protocols are upgraded for the purpose of supporting the 128-bit address of IPv6 with slight modifications done in their functionalities. For instance, RIPv6 is similar to the previous version of RIP but it is modified to support 128-bit address and provide integrated routing that supports simultaneously both ipv4 and ipv6 routing. It is used to get information about the route or any changes in route. OSPFv6 or OSPFv3 are same and modified to support 128-bit address type as well as removed authentication function, since it is carried out by security features of IPv6. It is used to determine the cost of each route. Whereas IDRPv2 and EIGRP are modified to allow multiprotocol routing.

VIII.IPV6 Security

The IPsec feature is widely adopted in IPv4 as an optional thing. Whereas in IPv6, IPsec feature is inbuilt in it. The IPsec features includes authentication to ensure the data got from an original node using shared keys and digital certificates. The data sent is encrypted and hence they are decrypted only in the destination node with the help of shared keys. Hence confidentiality is maintained. Further Data integrity is maintained by comparing checksums.

IX. Transition Methods

Internet Protocol version 4 and Internet Protocol version 6 are not compatible with each other which means they cannot communicate with each other. It takes some time to convert all the nodes and devices related to a network from internet protocol version 4 to version 6. In order not to disturb the data transmission in the ipv6 deployment process, both the protocols ipv4 and ipv6 must co-exist in the same node. Several transition mechanisms are proposed to act with both versions of protocols simultaneously. The transition mechanisms come under three categories. They are Dual Stack, Tunnelling, and Translation. There are two mechanisms in which packets can be sent they are IPv4 over IPv6 and IPv6 over IPv4. Dual Stack technique comes under IPv4 over IPv6 mechanism and Tunnelling techniques comes under IPv6 over IPv4 mechanism.

A. Dual Stack

It is the simple and flexible transition technique in which all the nodes, routers, switches are made compatible with both IPv4 and IPv6 protocols. The IPv4 and IPv6 functionalities co-exist in same node as dual IP layer. When IPv4 packet approaches the host it is accessed by the IPv4 part of the stack and when IPv6 packet is to be accessed, it is dealt by the IPv6 part of the stack. Dual stack method is widely used by IPv6 network to access the IPv4 hosts. Dual stack method requires all the network devices to support both the versions of internet protocols 4 and 6. Hence the resource requirements doubles and when some devices not compatible with both versions ipv4 and ipv6 some other techniques can be used. But Dual stack technique is widely preferred for immediate and easy transition in big enterprises.

B. Tunnelling

Tunnelling is the process of sending an ipv6 packet by encapsulating it in to an ipv4 packet. When an IPv4 host does not support dual stack architecture and when such host needs to communicate with the IPv6 network, tunnelling method can be used. Then IPv6 packets are encapsulated in IPv4 packets and sent to the desired IPv4 nodes. Tunnelling can be limited up to certain distances such as router-to-router, host-to-router, host-to-host, and router-to-host. Tunnelling can be implemented either as automatic tunnelling or configured tunnelling. In automatic tunnelling, connection is automatically established between an IPv6 and IPv4 network. The embedded IPv6 address gives all the necessary information about destination IPv4 network for which packets are to be sent. Whereas in configured tunnels the destination address is manually assigned. They are also called automated tunnels. The tunnelling types includes 6 to 4, IPv6 Tunnel brokers, Teredo, ISATAP

1) 6 to 4:In this technique, the two IPv6 hosts can communicate with each other through an IPv4 network. This is possible by embedding ipv4 destination address in the ipv6 address. This comes under automatic tunnelling technique.
2) Tunnel brokers: In this technique, the two IPv6 hosts can communicate with each other through an IPv4 network by a service called tunnel broker. An encapsulated path established in existing network that carries ipv6 packets within the ipv4 packets over ipv4 network to an ipv6 destination.
3) Teredo: This technique is mainly used to send ipv6 packets to a host behind an ipv4 NAT. The host that sends ipv6 packets is considered as teredo client and the packets are sent as ipv4 UDP message to NAT ipv4 to reach ipv6 host. The NAT must support UDP port translation.
4) ISATAP: Intra-Site Automatic Tunnel Addressing Protocol which is used to automatically configure a tunnel and to send ipv6 packets encapsulated within ipv4 packet over an ipv4 network trough an ISATAP router to another ipv6 node. The ISATAP router must have a dual stack.

C. Translation

When there exists a network that support only IPv4 transmission and a network that support only IPv6 transmission, a packet from IPv4 only network can be sent to ipv6 only network by a technique called Translation. In this technique IPv4 address can be translated to IPv6 address and IPv6 address in to IPv4 address. There are two kinds of translations possible they are NAT-PT (Network Address Translation-Protocol Translation) and NAT64. Since NAT-PT technique makes use of Application level Gateways for the protocol translation, there occur a delay in inspecting each packets and translating them. So, other method NAT64 is widely used. In this method, IPv6 embeds the ipv4 address of a destination node and in NAT64, address mapping is done. Then the packets are sent to the desired node.

X. Conclusions

The next generation Internet Protocol version 6 has come up with a huge address space that never come to extinction. Many upgraded features will give added benefitsin terms of reliability security and management etc. There are so many ongoing researches in the area of transition and deployment of IPv6. This paper gives an overview of all the features modified in the IPv6.

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NUMERICAL METHODS FOR SOLVING TURBULENT FLOWS BY USING PARALLEL TECHNOLOGIES

Ms. Sunita Singh

Abstract

Parallel implementation of algorithm of numerical solution of Navier-Stokes equations for large eddy simulation (LES) of turbulence is presented in this research. The Dynamic Smagorinsky model is applied for sub-grid simulation of tur-bulence. The numerical algorithm was worked out using a scheme of splitting on physical parameters. At the first stage it is supposed that carrying over movement amount takes place only due to convection and diffusion. Intermediate field of velocity is determined by method of fractional steps by using Thomas algorithm (tridiaginal matrix algorithm). At the second stage found intermediate field of velocity is used for determination of the field of pressure. Three dimensional Poisson equation for the field of pressure is solved using upper relaxation method. Moreover various ways of geome-trical decomposition for parallel numerical solution of three dimensional Poisson equations are investigated.

Keywords: Domain Decomposition; Parallel Computations; Dynamic Smagorinsky Model; LES Approach

1.Introduction

Most flows occurring in nature and in engineering appli-cations are turbulent. Turbulent flow is a fluid motion that possesses complex and seemingly random structure at some macroscopic scale of dynamical importance. The most important physical consequence of turbulence is the enhancement of transport processes. In turbulent flow, momentum, energy and particle transport rates greatly exceed the corresponding molecular transport rates. Turbulent flow exhibit much more small-scale structure than their non-turbulent counterparts. In fact, this small-scale structure is correlated with enhanced turbu-lent transport phenomena. Small-scale structure itself is evidence of enhanced transport in the sense that small scale develop from the degradation of large-scale excita-tions and are maintained by energy transport from one scale to another. Another important characteristic of tur-bulent flows is

their apparent randomness and instability to small perturbations. Currently, there are three basic and commonly used approaches for simulation of turbulent flows. First approach is direct numerical simulation (DNS) which applies to solve Navier – Stokes equations, resolving all the scales of motion, with initial and boundary conditions appropriate to the considered flow. Each simulation produces a single realization of the flow. The DNS approach was infeasible until the 1970s when computers of sufficient power became available. In DNS whole range of spatial and temporal scales of the turbulence must be resolved. All the spatial scales of the turbulence must be resolved in the computational mesh, from the smallest dissipative scales (Kolmogorov micro-scales), up to the integral scale L, associated with the motions containing most of the kinetic energy. Second approach is large eddy simulation (LES), the larger three –dimensional unsteady turbulent motions are directly represented, whereas the effects of the smaller-scale mo-tions are modelled. In computational expense, LES lies between Reynolds-stress models and DNS. Because the large-scale unsteady motions are represented explicitly, LES can be expected to be more accurate and reliable than Reynolds-stress models for flows in which large- scale unsteadiness is significant – such as the flow over bluff bodies, which involves unsteady separation and vortex shedding. The computational cost of DNS is high, and it increases as the cube of the Reynolds number, so that DNS is inapplicable to high Reynolds number flows. Nearly all of the computational effort in DNS is ex-pended on the smallest, dissipative motions, whereas the energy and anisotropy are contained predominantly in the larger scales of motion. In LES, the dynamics of the large-scale motions are computed explicitly, the influence of the smaller scales being represented by simple models. Third approach is the Reynolds-averaged Navier–Stokes equations (or RANS equations) are time-averaged equations of motion for fluid flow. The idea behind the equations is Reynolds decomposition, whereby an instantaneous quantity is decomposed into its time-averaged and fluctuating quantities, an idea was first proposed by Osborne Reynolds. The RANS equations are primarily used to describe turbulent flows. These equations can be used with approximations based on knowledge of the properties of flow turbulence to give approximate time-averaged solutions to the Navi-er–Stokes equations.

2.Mathematical Model

Under the assumption of incompressible flow, the di-mensionless governing equations are as follows [1,2,7]:

$$\frac{\partial u_i}{\partial t}+\frac{\partial u_j u_i}{\partial x_j}=-\frac{\partial p}{\partial x_i}+\frac{1}{\mathrm{Re}}\frac{\partial}{\partial x_j}\left(\frac{\partial u_i}{\partial x_j}\right)-\frac{\partial \tau_{ij}}{\partial x_j} \quad (1)$$

$$\frac{\partial u_j}{\partial x_j} = 0 \quad (i = 1,2,3). \qquad (2)$$

where $\tau_{ij} = \overline{u_i u_j} - \overline{u_i u_j}$

The solution of spread of flow in three dimensional areas were considered in this work. Re =*DV/ ν* (*ν* dynamic viscosity). Fur-thermore Cartesian coordinate system is employed, in which z is stream wise direction, x, y are in the lateral directions. As for constructing model of turbulence we used dy-namic model of Smagorinsky, the following is the un-derlying principle of the dynamic model for extracting information concerning a given eddy-viscosity model via a double filtering in physical space. It is worth to admit that the most of the historical developments have been done with Smagorinsky's model [6,9]

$$\tau_{ij} - \frac{1}{3}\delta_{ij}\tau_{kk} = -2\nu_{sgs}\overline{s_{ij}} \qquad (3)$$

$$\delta_{ij} = \begin{cases} 1, i = j \\ 0, i \neq j \end{cases} \quad \text{Kroneker symbol}$$

where

$$\nu_{sgs} = (C_s\Delta)^2\sqrt{2\overline{s_{ij}}\,\overline{s_{ij}}},$$

$$\overline{s_{ij}} = \frac{1}{2}\left(\frac{\partial\overline{u_i}}{\partial x_j} + \frac{\partial\overline{u_j}}{\partial x_i}\right), \quad \Delta = (\Delta x\Delta y\Delta z)^{1/3} \qquad (4)$$

$$C_s = \frac{1}{\pi}\left(\frac{3C_k}{2}\right)^{-3/4},$$

C_S= 0.18 for a Kolmogorov constant of 1,4. But the dynamic procedure applies in fact to the types of eddy viscosities such as those used in the structure-function model. We start with regular LES corresponding to a "bar-filter" of width Δx, an operator associating an function $\bar{f}(\bar{x},t)$.Then we define a second "test filter" tilde of large width $2\Delta x$ associating $\tilde{\bar{f}}(\bar{x},t)$. So let us first apply this filter product to the Navier-Stokes equation. The subgrid-scale tensor of the field $\tilde{\bar{u}}_i$ is ob-tained from equation (4) with the replacement of the fil-ter bar by the double filter and tilde filter:

$$\tau_{ij} = \overline{\tilde{u}_i\tilde{u}_j} - \overline{\tilde{u}_i u_j} \qquad (5)$$

$$l_{ij} = \overline{\tilde{u}_i\tilde{u}_j} - \overline{\tilde{u}_i u_j} \qquad (6)$$

Now we apply the tilde filter to equation (4), which leads to

$$\tilde{\tau}_{ij} = \overline{\tilde{u}_i u_j} - \overline{\tilde{u}_i u_j} \qquad (7)$$

Adding equations (6) and (7) and using equation (5), we obtain

$$l_{ij} = \tau_{ij} - \tilde{\tau}_{ij}$$

Further we use Smagorinsky's model expression for the subgrid stresses related to the bar filter and tilde-filter

to get

$$\tilde{\tau}_{ij} - \frac{1}{3}\delta_{ij}\,\tilde{\tau}_{kk} = -2C\,\tilde{A}_{ij}$$

where

$$A_{ij} = (\Delta x)^2 \left|\overline{S}\right| \overline{S_{ij}} \qquad (8)$$

We have to determine τ_{ij} the stress resulting from the filter product. This is again obtained using the Smagorinsky model, which yields

$$\tau_{ij} - \frac{1}{3}\delta_{ij}\tau_{kk} = -2CB_{ij} \quad \text{where} \quad B_{ij} = (2\Delta x)^2 \left|\tilde{\overline{S}}\right| \tilde{\overline{S}_{ij}}$$

Subtracting (8) from (9) with the aid of Germano's identity we get the following

$$l_{ij} - \frac{1}{3}\delta_{ij} l_{kk} = 2CB_{ij} - 2C\,\tilde{A}_{ij}$$

$$l_{ij} - \frac{1}{3}\delta_{ij} l_{kk} = 2CM_{ij}$$

where

$$M_{ij} = B_{ij} - \tilde{A}_{ij} \qquad (10)$$

All the terms of equation (10) may now be determined by means of u Unfortunately, there are five independent equations for only one variable C, and thus the problem is over determined. The first solution was pro-posed by Germano to multiply (10) tensorially by $\overline{S_{ij}}$ to get

$$C = \frac{1}{2}\frac{l_{ij}\overline{S_{ij}}}{M_{ij}\overline{S_{ij}}}$$

3.Numerical Simulation

The numerical solution of system is built on the stag-gered grid with the usage of the compact scheme for convective terms and scheme against a stream of the second type [5]. The scheme of splitting on physical parameters is used for the solution of turbulence problem [9-12,14]:

I. $$\frac{\vec{u}^* - \vec{u}^n}{\tau} = -\left(\vec{u}^n \nabla \vec{u}^* - \nu\Delta\vec{u}^*\right),$$

II. $$\Delta p = \frac{\nabla \vec{u}^*}{\tau},$$

III. $$\frac{\vec{u}^{n+1} - \vec{u}^*}{\tau} = -\nabla p.$$

The first stage is solved by fractional step method in combination of Thomas algorithm (tridiaginal matrix algorithm) [8, 11,13].Three dimensional Poisson equation for pressure field using an over - relaxation method is handled at the second stage. Three dimensional Poisson equation is parallelized by using various geometrical decomposition (1D, 2D and 3D). Geometric decomposition of the grid area is selected as the basic approach of parallelization. In this case, there are three different ways of sharing the values of the grid function on the compute nodes one-dimensional, two-dimensional and three-dimensional of the grid computing nodes [3,4].

After a stage of decomposition, when performed on separate data blocks for the construction of a parallel algorithm, we proceed to relation between the blocks, the calculations which will be run parallel. Because of we used an explicit difference scheme for computing the next approximation in the border nodes of each subdomain is necessary to know the value of the grid function with bordering neighboring processor elements. To accomplish this, in each compute node a fake edge for storing data from a neighboring computational node and arranged shipment of these boundary values needed to ensure the homogeneity of the calculations by explicit formulas. Sending data is done using the procedures library MPI. Let us turn to a preliminary theoretical analysis of the effectiveness of various methods of decomposition of the computational domain for this case. We will estimate the time of the parallel program as the time of consistent program T $_{calc}$ divided by the number of processors used, plus the time shipments $T_p = T_{calc} / p + T_{com}$. While shipments to different ways of decomposition can be approximately expressed in terms of the amount of bandwidth:

$$T_{com}^{1D} = t_{send} 2N^2 x2$$

$$T_{com}^{2D} = t_{send} 2N^2 x4 / p^{1/2} \quad (11)$$

$$T_{com}^{3D} = t_{send} 2N^2 x6 / p^{2/3}$$

where N ^{3} dimension of finite-difference problems, p –number of computing nodes, t_{send} shipping time of one number. Calculations were performed on a cluster system URSA KazNU after al-Farabi on grids of 128 × 128 × 128 and 256 × 256 × 256 by using up to 64 processors. Results of computational experiment showed the presence of a good speed in solving problems of this class. They are mainly focused on over-time shipments and time calculations for various methods of decomposition. In the first stage we used one overall program, the size of arrays from run to run have not changed, each pro-cessor element numbering of the array elements starting from scratch. Despite the fact that, in accordance with the theoretical analysis of the 3D decomposition is the best option for parallelization (**Figure 1**), computational ex-periments have shown that better results can be achieved using 2D decomposition when the number of processes from 25 to 144 (**Figure 2**)

On the basis of preliminary theoretical analysis of the graphs it must have the following pattern. Computation time without interprocessor communication costs at dif-ferent ways of decomposition should be approximately the same for the same number of processors and shrink as T_{calc} /P. In reality, the calculated data (**Figure 4**) indicate that the use of 2D decomposition on different grids gives the minimum cost for computation and

payment schedules depending on the computation time on the number of processors which placed much higher than T_{calc}/P.

To explain these results there is a need to pay attention to the assumptions that were made during the preliminary theoretical analysis of the problem. Firstly, it was assumed that regardless of how the dis-tribution of data on a single processor element executed the same amount of computational work, which should lead to identical time-consuming. Secondly, we assumed that the time spent on interprocessor shipping any order of the same amount of data that does not depend on their selection from memory. To understand what happens in reality, the next set of test calculations was held. To assess the consistency of first admission was considered when the program is run in a single-processor version, and thus simulates different ways of geometric data decomposition for the same amount of computation performed by each processor. Thus, for explicit difference methods for solving three dimensional Poisson equation can be applied one-dimensional, two and three-dimensional decomposition, but the results of testing programs have shown that the 3D decomposition does not gain in time compared with the 2D decomposition, at least for the number of processors does not exceed 250, and the 3D decomposition has a more time-consuming software implementation and the use of 2D decomposition is sufficient for the scale of the problem at the present number of compute nodes.

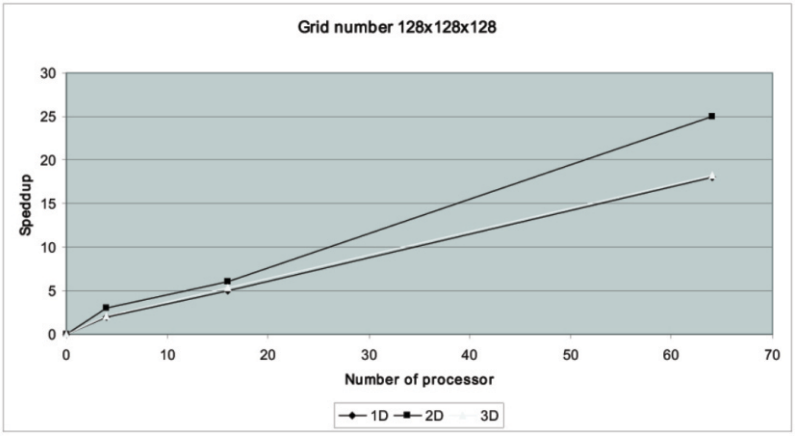


Figure 1 Speed up for different ways to decompose the computational domain

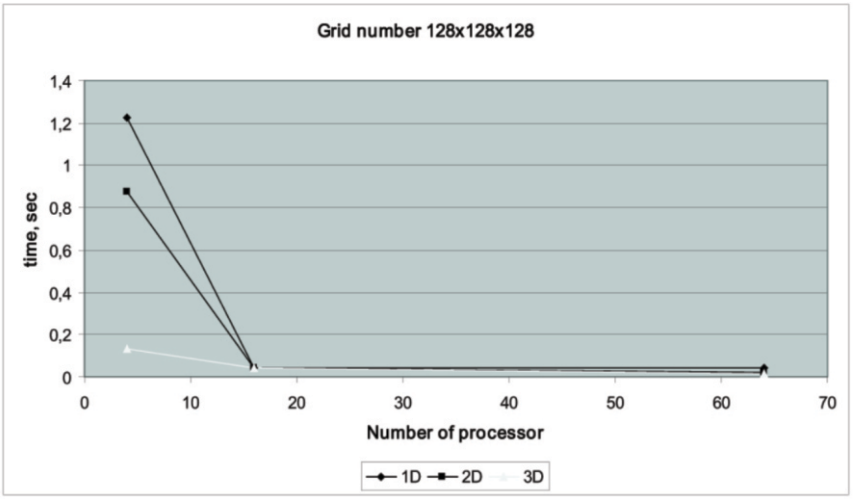
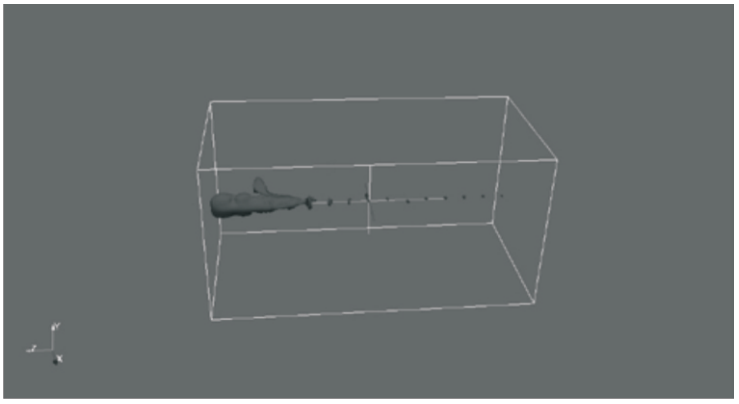


Figure 2 Computation time without considering the cost of data transfer for various methods of decomposition sec1D2D3D

4.Testing results of the numerical method

Consideration of a turbulent flow, which is located in the channel (**Figure 1**). Computations were performed for the Reynolds number Re $UmD/v=$ equal to 8000 de-fined based on the jet axis velocity. Also the following grid $N_x x N_y x N_z = 80x80x160$ is taken in the calculations. The spread of flow in three dimensional areas is de-scribed in numerical solution. **Figure 6** shows isosurface of spread flow in three dimensional areas at different time scale.



5.Conclusions

The results of numerical experiments showed that the constructed mathematical model of turbulence is able to reproduce the characteristic features of turbulent flow. The usage of dynamic Smagorinsky model allowed us to obtain good data for the study area. Application in the calculation of 2D decomposition gives 65% efficiency in the use of 25 compute nodes. With further increase in the number of compute nodes and 100 for the chosen mesh size, a characteristic was obtained for problems of this class efficiency value is around 45%.

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