GRID COMPUTING IN HELP OF MEDICAL ELECTRONICS

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Grid environments are offering new approach for the realization of parallel calculations. Grid environments can be built as hybrid architecture of software and hardware components, which can realize successfully both classical linear and typical parallel algorithms. Important characteristic of Grid calculations is dividing of business logic of the data, under preserving the typical advantages of the distributed environments: increased scaling, improved stability and flawlessness, facilitated multiplication and control of the granularity of the architecture, universal transportation environment.

These qualities are making the Grid environments in very powerful and suitable tool for realizing complexity tasks in the medical electronics. Grid environments are eliminating the limitation a specialized operations to be executed in big distances. In that way is solving not only the task for parallel calculation, but it also offers opportunity for quick, reliable synchronization and summarization of the results under heterogeneous medical researches, analysis, conclusions…

Keywords: grid computing solutions medical electronics

1. INTELLIGRID

IntelliGRID is the code name of a universal system for parallel calculations. The idea of its creation firstly was born in 1998, but its real designing and development started at the end of 2005. IntelliGRID is GRID environment characterizing with typical separation for this type architectures of functionality and data in two independent working subsets.

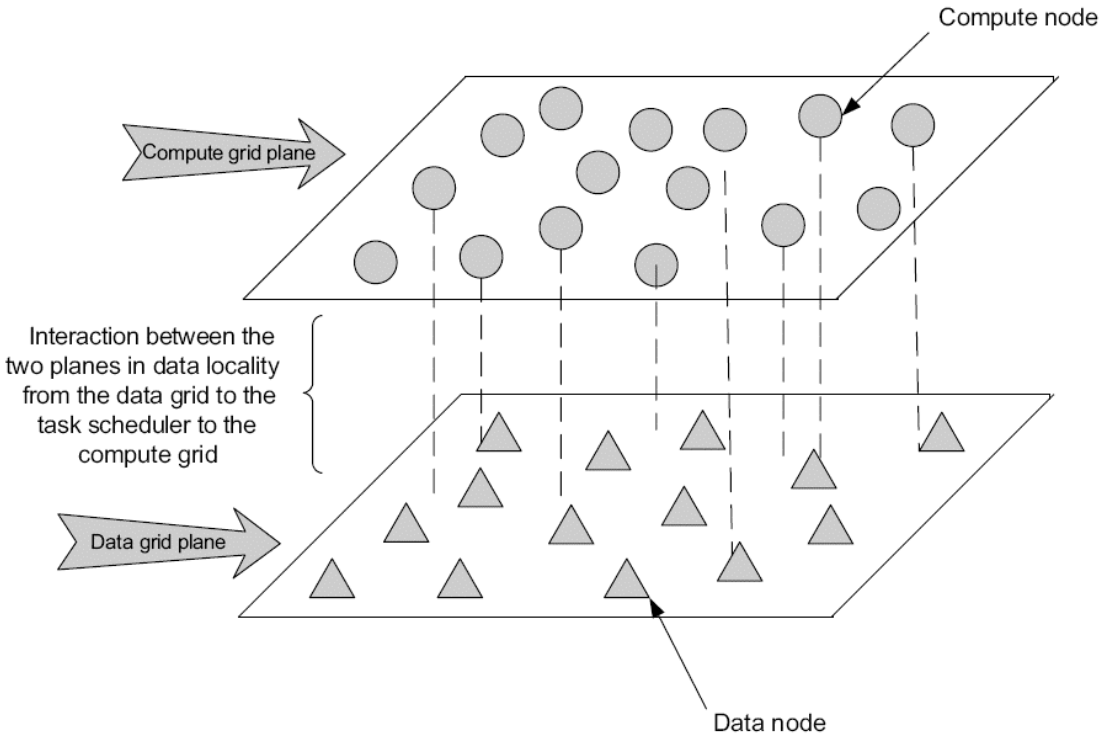
This system consists of the fallowing elements:

- Virtual machine, which executes the parallel programs;
- Agents, special programs which are taking care to start the Virtual machine, or to spread data needed for the functioning of the parallel modules;
- Visual environment for programming of parallel modules and programs;

The Modules of IntelliGRID are linear blocks of program code**,** realized in standard algorithmic procedure language.

The Programs of IntelliGRID are using set of modules, connected with *virtual connections*. The Virtual connections are describing the way modules can exchange information. The Connections determine the behavior of the modules, the type and the content of the data, which are exchanged between them

1.1 Architecture



1.2 Transport environment

IntelliGRID design allows a hybrid transport system for distributing of the information to be used. When "firing" a transition between two modules, the *agents* of IntelliGRID are transferring needed meta-information and the true data between the modules:

- In the frames of one virtual machine (*in-process*)
- Between two virtual machines, but in one infrastructure (*out-process*)
- Between two infrastructures (*inter-process*)

Every infrastructure can use specific protocol for communication. *Agents* to be able to communicate with each-other it is used technology XML for description of meta-data. Currently IntelliGRID implementation uses the main protocol for communication via Internet – TCP/IP.

1.3 Parallel Modules and Grid Programs

Virtual links of IntelliGRID are building the classical Petrĭ Network, in which the nodes are represented by parallel modules. Every module has set of parameters which can be *input*, *output* and *transitional*. The transition between two or more modules is fired when the needed and sufficient conditions[1] for starting the module are met. IntelliGRID offers the opportunity freely parameters to be defined and a specific NSC to be tuned. The combination of modules, links and tunes of specific NSC for every module are defining the conception of the *parallel program*. The approach is totally abstract – the programs in IntelliGRID do not contain executable code, as in

[1] NSC – Needed and sufficient conditions

the popular systems. IT may be said that the programs are only managing the behavior of the grid environment, but they can not affect it functional. This "Simple" of first sight decision:

- Uses in optimal way the available resources [2] of the environment;
- Simplifies and standardize the management of functions and data in the environment;
- Protects the environment from importing accidental functionality, by dividing usage requests from the execution of the functionality;

The Modules are the building materials of IntelliGRID. One and the same module (or module version) can be multiplied many times. Under parallel program execution IntelliGRID, based on valuating functions and rules, selects automaticaly which modules to fire.

The Modules are not part of any program. Without program they are elements with passive behavior inside the environment.

1.4 Programming with VisualOrganizer

VisualOrganizer [VO] is unique environment for programming of parallel grid applications. It offers at the same time opportunity to be programmed of пълноценен program language (Pascal and/or Basic) and a visual grid programs to be created by using the mouse and tuning the parameters of modules by *Module Inspector*.

Using VO it can be created, tested locally on the computer and loaded into grid environment modules, necessary for the creation of parallel programs. Similar to standard graphic editor VO allows the modules to be organized by categories in the *Tool Palette*. From there using the mouse, the modules can be easily arranged in projects and to be linked by *virtual visual connections.* Afterwards the projects are automatically transformed in parallel programs and it can be loaded in real work environment of IntelliGRID.

VO has built in functions to protect the copyrights and to control content access and the way of distribution of the modules.

By VO and well developed library of modules, the creation of parallel applications is easy and assessable even for users not very familiar with the usage of program languages or programming techniques.

2. APPLICATION IN THE MEDICINE

IntelliGRID is universal tool for programming and universal environment for performance of GRID applications. Main characteristics of the environment are:

- Easy algorithms coding, by standard program languages;
- Capsulation of the algorithms in modules;
- Random modules combining, by abstract connections to which transport environment does not affect;
- Automatic parallel execution;

[2] Under functional resource it is meant sets of modules and its admissible links between them

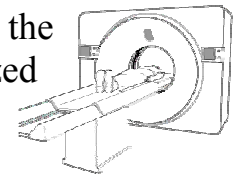
- Automatic and manual control of the behavior of the modules in the different GRID applications;
- Visual programming;
- Use of same module in many applications;
- Use of universal and platform independent virtual machine for execution of the parallel applications;
- Protection of the copyrights, by approved cryptographic methods for symmetric and asymmetric coding;

These qualities of IntelliGRID have given answer at least to 3 fundamental practical questions:

- ❖ Can be easily and quickly created parallel applications without needed special knowledge?
- ❖ Can be created algorithms without limitation in the complexity and in the type of the data, using typical and well known to the scientific community program languages – Pascal, Basic?
- ❖ Can the applications works at standard hardware under the most popular operation systems?

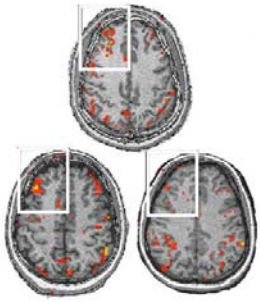
When IntelliGRID was created it searched applicability in four practical areas in the Medicine and the Medical Electronics: basic processing of images, three-dimensional graphical and fluid analysis and building of expert systems.

2.1 Basic processing of images



The basic sources of graphical images in the Medicine are the scanners. The different types of scanners are giving specialized information to the doctors, but often complete and more precise diagnostic to be performed is needed the fallowing:

- To improve the quality of the images created by the scanners;
- To be performed additional scanning with another type of scanner for receiving more information, and then the result from both scanners to be summarized in one image;



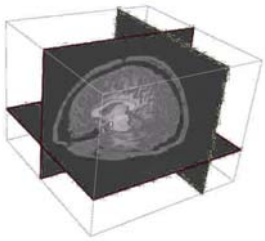
IntelliGRID has its own well developed modules library, which allows loading of different type of graphical files, image filtering by linear and non-linear algorithms, as well as to apply the basic arithmetic operations on two or more images aiming improvement and summarization of the final result. In addition the graphical library operates with 24 bites and 32 bits color images with opportunity for correction of the transparency and the way of their "flatten" in the so called "graphical layers".

So as the IntelliGRID is a parallel environment for calculation of every each of these functions, so it can perform independently or parallel in accordance with the rest of the functionality.

2.2 Three-dimensional graphical analysis

One of the applications of the Three-dimensional graphic analysis in the Medicine is the processing of bundle (series) of images, which are produced automatically by the so called three-dimensional scanners. The process can be described in the fallowing steps:

- Delivering of the bundle of images as a set of images;
- Performing of primary processing – filtering, coloring etc.;
- Normalizing of the images;
- Separating borders and edges, defining of characteristic points;
- Building of tree-dimensional body of the result image, by interpolation over the external characteristic points;



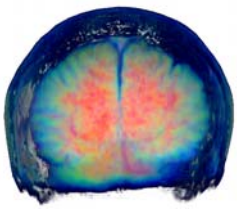
The task can be complicated also by interpolation over internal characteristic points, if body volume analysis is necessary to be made.

The modern scanners operate with high resolution and can produce big sizes graphical files. This raises two generic problems: it isn't possible to process many files at the same time and the main processing may take significant processing time according to filtering algorithms. Both problems are rising of insufficient microprocessor resource. In practice it's about thousands files in one series, which means that the time for processing most probably will increase significantly.

IntelliGRID is the tool, by such sort of tasks can be conducted parallel, according the specific algorithmic realization. For example, series of image can be divided in equal parts and the basic processing to be performed on a several computers.

2.3 Fluid analysis

The option IntelliGRID to combine one module in different applications allows to be measured some specific topological areas in the received tree-dimensional bodies, after conducting of tree-dimensional analysis. In practice this can be achieved by two approaches:



- By physical injection of special colorized fluid in the tree-dimensional body and comparing the results with the not-colored body;
- By simulating of fluid spreading in already built tree-dimensional model;

First approach demands reproducing of the tree-dimensional body with the fluid anew and its comparing, by interpolation in reasonable borders with the original. After this, some classical sets operations for underlining or contour separation of the areas affected by the fluid are made. The performing of tree-dimensional graphical analysis of the two bodies can be started parallel, as the fluid coloring to be conducted in specialized laboratory, and the results and the final counter separation to finish at the home computer of the doctor.

The second approach is significantly more complicated for execution, because it is necessary availability of additional information of the type and the density of the matter that the tree-dimensional body is built of. Often templates are used for

comparison. In this situation IntelliGRID will help by automatically to start the calculation on faster machine in the parallel environment and will deliver the appropriate templates.

2.4 Building knowledge database – expert systems

IntelliGRID is a typical grid environment, in which the business logic is separated from the data. The granularity of the environment is measured by set of functions and set of data. Every function is represented by module and can be used needed data, without knowing where exactly this data are placed.

IntelliGRID is designed in a way that when an application is started, by valuating functions the environment delivers most accurately, most quickly and most securely those modules needed for the execution of the grid program. The modules are delivering those data needed.

Intersection of the tree sets: functions, data and virtual links are building the classical *Decision Cube,* needed per expert system. In this matter the IntelliGRID architecture can be used not only for parallel calculations.

An interesting and ambitious challenge is ahead with the implementation of IntelliGRID. This challenge is dynamical creation of virtual links between atoms of two sets. This will be the first step in the creating of *Artificial Intelligence* in GRID architecture.

3. REFERENCES

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