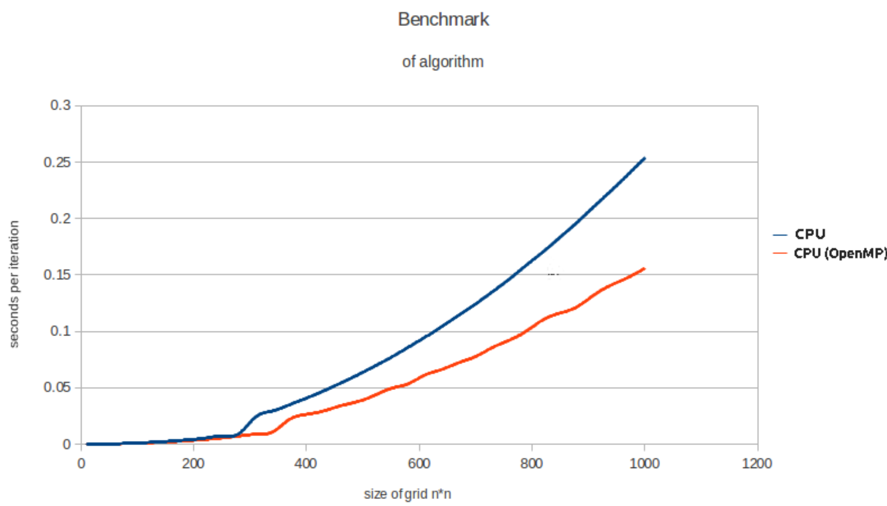
Testing of software

System requirements and benchmarking

The speed of the program depends on the size of the selected field. The amount of computation is directly proportional to the number of grid cells, which need to be processed.

The maximum size of the simulation's field depends on the size of RAM as array data stored therein. For example, for a computer with a RAM of 512 MB theoretical maximum size of the field at the disconnected graphic component of the program is the size of 3000 * 3000 cells. In practice, the serious restrictions imposed the processor, which which may require a large amount of time to process the data of simulation, so for processors with clock rate ranging from 2GHz to 3GHz recommended field size is less than 1000 * 1000.

We have implemented hardware acceleration using *OpenMP*. Below is a graph of the time required to work of one iteration of program on the size of the field.



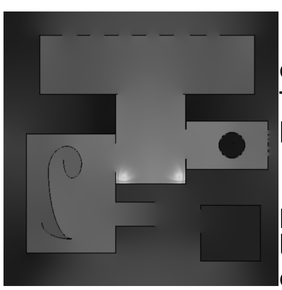
Tests were carried out on a computer with a processor *Intel (R) Core (TM) 2 Duo CPU E8500 3.16GHz.*

The graphical part of the program has been disabled For cleanliness of experiment.

Testing was conducted under the operating system Linux Ubuntu 11.04. Code of our program is cross-platform, that is working under other distributions of Linux and other operating systems, such as Windows.

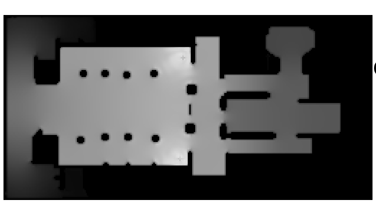
Position of sound source and sound density map

One of the main features of our program - drawing a sound intensity map. Sound intensity map (SIM) describes, in which areas of premises sound has higher or lower volume from acoustic system. This feature is useful for location of sound sources or dock design of premises, because usually there is a problem to achieve a certain sounding from the speaker. For example, it is necessary that volume of sound in all points in the room is equal, or vice versa, it is necessary to ensure that, in some places is silence.

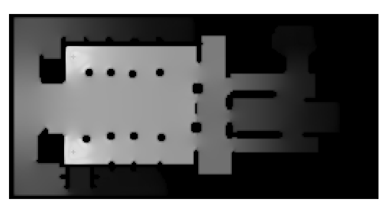


This picture generated by our program. It is sound intensity map. As you can see, there is acoustic system consisting of two acoustic sources (bright spots). The structure of premises has been created by the user. Results a bit predictable, but SIM is able to show it in details.

The next experiment was to find layout of real premises and use it as the object of observation. Here is th layout of some house. We put single acoustic source in corner of one of rooms, and as you can see, the sound volume in every point of this room is almost the same, whereas there are silent areas in house in other rooms.



Let us try to solve the problem: how to determine the most suitable locations of



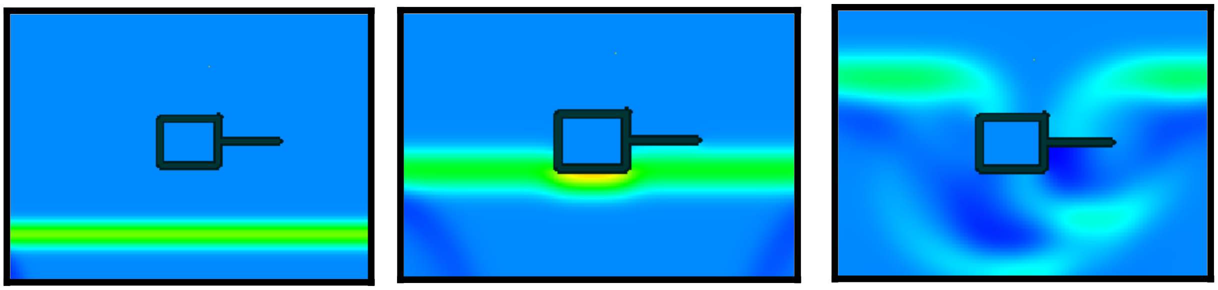
the two sound sources in the cathedral for a loud sound in the main hall and the silence behind the altar.

Here you can see two different sound intensity maps. Based on the results, it can be argued that in this case, a suitable location of sound sources is their location closer to the exit.

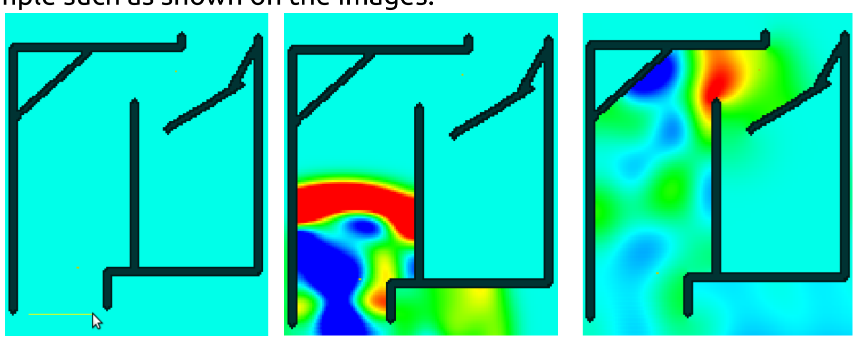
Wave behavior

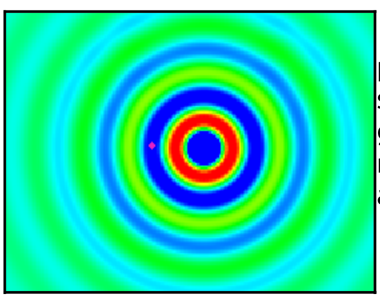
The main advantage of LBM is dynamic visualization of acoustic wave behavior. It is useful for tracking the passage of a certain wave in a certain premise.

These images show the passage the obstacle by sound wave. Part of the wave reflected from the object, another one rounded obstacle, showing by it phenomena diffraction.

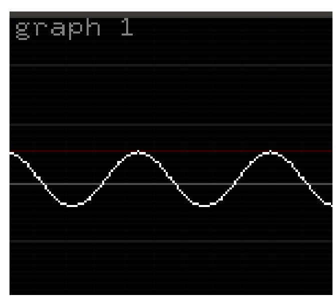


LBM allows you to visualize the behavior of acoustic waves in a labyrinthine structure. For example such as shown on the images.





In our program, it is possible to observe the behavior of sound waves using graphs. This is graph of values obtained by the receiver located near the sinusoidal acoustic source.



Experiments with WAV files

As the LBM simulates the behavior of sound approached to a reality, one of the ideas was to simulate the passage of sound waves in the form of a WAV file through created field, but unfortunately the result was far from ideal: the sound output file was too distorted and had defects relative to the input file.

Also there was an attempt to use s sin-wave emitter of WAV file. The result was better. In the spectrogram observed fact that the file consists of a single frequency (with slight defects). The volume of the output file depends on the distance to the sound source.