IEEE Visualization Design Contest 2006

See What's Shaking

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1 Introduction

This two page report is intended as a guide for the video submitted for the IEEE 2006 visualization design contest "See what's shaking".

The report is divided into three sections: first, a description of the different components of the video is made; secondly, a brief description of how different sections of the video help answer specific seismology questions is presented; finally, some of the details regarding the coding, implementation and final production of the video are presented. The end of the report also includes some conclusions about the work done and considerations on how to extend it.

2 Video description

The first intention of the video is to provide the viewer with a reference frame in terms of the location of the volume of study. With this in mind, the viewer is presented with a map of the state of California (made available through the contest's website). After presenting the map in its more common orientation, it is aligned with the volume of study by means of rotating it counter-clockwise.

Once the viewer has California as reference point, the location of the volume together with the sedimentary basins it includes is presented. By changing the camera position, it is possible to later focus on the area of interest. At this point, the whole volume is rotated to show the viewer the depth at which sedimentary basins are located.

Once the volume is back to its initial position (centered and viewed from the top), a color map of the speed at surface level through time is presented. At an intermediate point, i.e. time step 90, time animation is stopped to present a displacement of the slice in depth, thus switching from time animation to spatial animation.

Finally, the camera position is modified to allow the viewer to have a zoomed perspective of the surface speed and how to understand this is related to the presence of sedimentary basins. Once more, an animation in time is made to present the evolution of the earthquake. Images are used to keep the viewer aware of the whole speed range at critical points. These images are also included in the submission.

3 Addressing seismology through visualization

This final section of the report is intended to help the viewer identify the relation of the video to particular seismology questions.

Do waves follow a particular sedimentary channel? When looking at the evolution in the speed induced by the earthquake through time, it is clear that the waves tend to concentrate in the sedimentary basins in the Whittier-Narrows area. This effect can be observed specially when looking at the surface speed magnitudes between time steps 70 - 100.

Do waves concentrate in the center of basins? Better seen when zooming into the volume, it is possible to notice that, even within the basins, the maximum speed values tend to concentrate in the center of them. This effect is more clearly appreciated between time steps 70 - 100. The relation between increased speed and the presence of sedimentary basins can also be observed when looking at the depth displaced slice for time step 90.

Do strongly shaken basins act as wave sources? This effect can be clearly seen when focusing on the sedimentary basins in the Whittier-Narrows area. Starting from time step 130 and after the basins were strongly shaken, they clearly appear as secondary wave sources. This effect can be seen both, when looking at the whole volume from the top and when looking at the zoomed interaction between basins and the surface speed.

Though efforts were done to improve the final solution, for a non-specialist such as the author, it was impossible to clearly visually address the remaining questions.

4 Coding process and technical aspects

First, as a review of the pre-processing stages, the velocity vector field provided by the organizers was integrated into a single file representing the speed at each point in the volume. The calculated speed, together with the provided velocity mesh data (stiffness) are the main scalar values used for the visualization.

Secondly, the solution was made using only one in ten of the provided time steps. This reduction in the size of the data allows us to experiment more with different visualizations, and thus allowing to have a better final result.

In terms of software, the submitted video was produced using Microsoft Visual Studio 6 in addition to VTK 5.0 and edited using VirtualDubMod 1.5.10.2.

On the other hand, the hardware used for the production of the submitted video consisted of a Mobile Pc Dell Inspiron 600m with a 1.50GHz Intel Pentium M processor and 512 Mb ram running Windows XP Home Edition.

5 Conclusions

From the work presented, it can be concluded that it is possible to produce meaningful scientific visualization of seismic datasets. More specifically, evidence for answering three of the proposed questions can be found in the visualization.

- It can be observed that earthquake waves do follow a sedimentary channel in the Whittier-Narrows
- It can be observed that waves concentrate at the center of basins, thus making these areas the more strongly shaken areas in the volume of study.
- And finally, it is also clear from the visualization that sedimentary basins in the area act as a secondary wave sources.

More work is needed if the video is to address the remaining questions. Other possibilities could include processing the data in search for areas that include drastic changes in velocity (or negative acceleration) that could represent border areas for wave-type conversion.

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