

Dynamic plotting of model surface and body waves

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ABSTRACT

Dynamic plots (movies) of surface and body waves have been made using Matlab finite difference modelling code. They show how waves of different types propagate, and how they are altered by a variation of properties within the medium. To understand the nature of the waves, it is important to know the direction in which the particles move. If the nature of the wave can be shown in a small detailed area, the best display is the Matlab quiver plot. A surface wave has been displayed in this way. If a broader view is required, an excellent display codes the azimuth of displacement to a colour spectrum and uses intensity to indicate amplitude. Several types of body wave plots have been made in this way.

MOVIE REVIEWS

Copies of the following movies will be available on the sponsor's CD.

Explosive near surface source movie

This shows the interrelated chain of events from an explosive source near the earth's surface. Figure 1 labels the type of events:

P – primary and ghost P wave.

S – shear wave ghost from the surface.

PS – shear head wave converted from P wave energy as it progresses against the surface.

R – Rayleigh or surface wave.

This Figure and Figure 2 are the right half of a model which is symmetric about the Z axis.

Figure 2 is the last frame of the dynamic plot which is clipped at one half of the maximum amplitude. This presentation is most effective for showing subtle effects in motion. One notable effect is the relative build up of the surface wave with time.

P to S conversion on reflection movie

Figure 3 is the last frame of the clipped version of the movie. It begins as a pure explosive source P wave which is about to hit the interface.

The interface has a strong S wave contrast (2.0) and a weak P wave contrast (1.2) to get a comparatively strong converted wave.

Surface wave quiver plot movie

Figure 4 shows the first frame of this movie. It is most useful for showing the detailed ground motion: retrograde at the surface and prograde below 7.

Surface wave colour movie

Figure 5 shows the first frame of this movie. It is most useful for showing subtle effects which require greater dynamic range. The most interesting subtle effect here is the shear wave energy which spins off the initial surface wave. This happens as the imperfect initial surface wave assumes its propagating form and the unconforming displacement energy is carried off as body waves.

ACKNOWLEDGEMENTS

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FIGURES

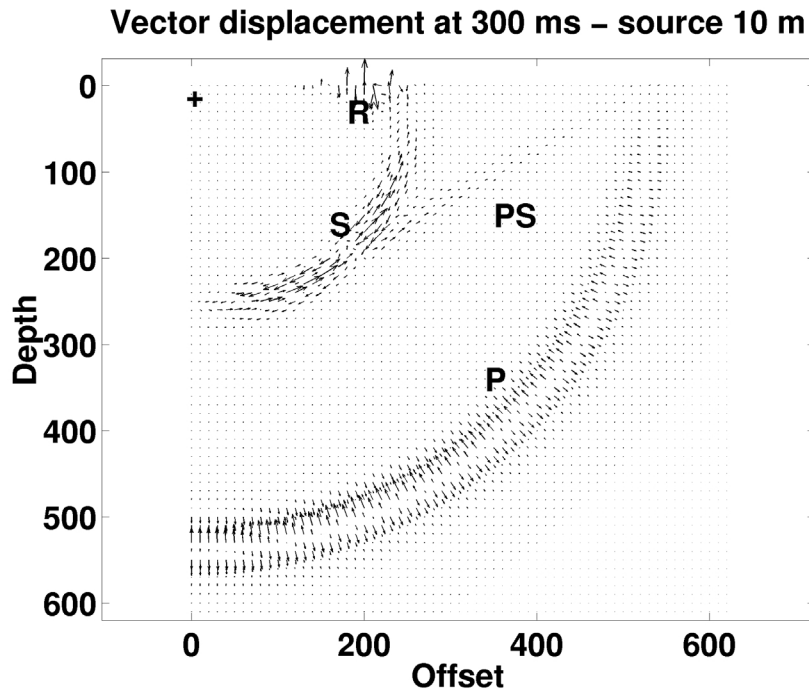


Figure 1. Static exploding source quiver plot. This is a more conventional way to display the dynamic displacement plot of Figure 2.

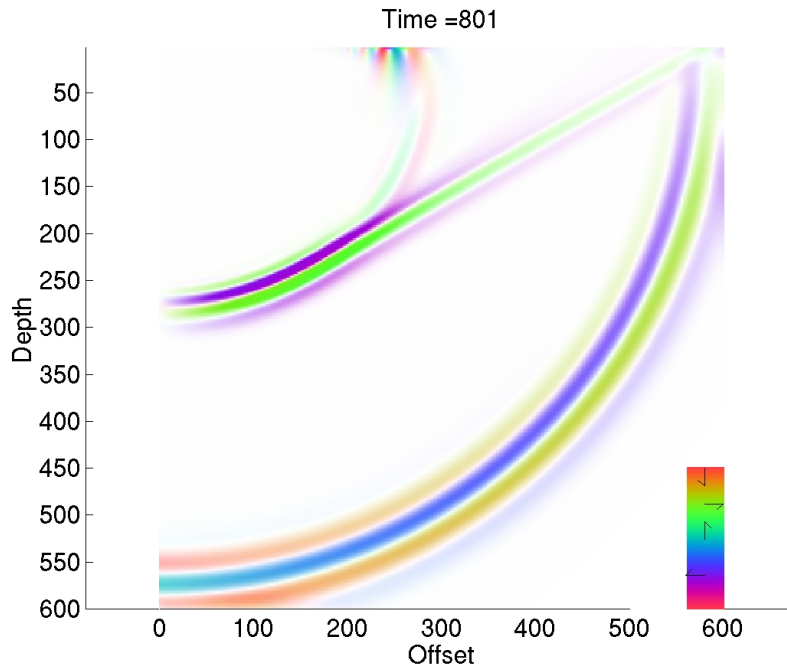


Figure 2. The last frame of the dynamic plot from the near surface exploding source. This version is clipped at half the maximum amplitude.

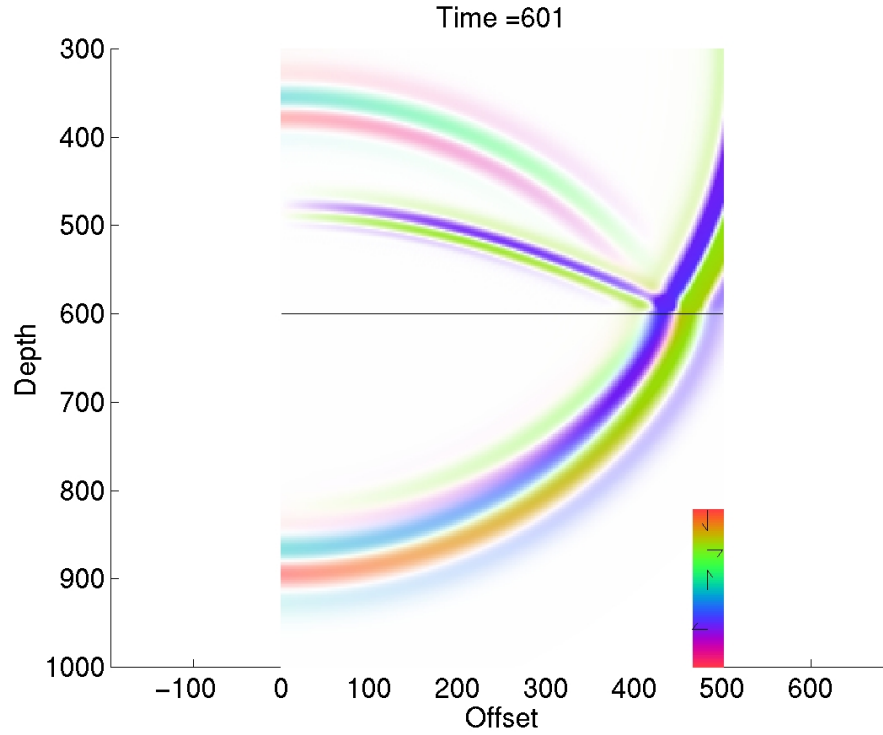


Figure 3: The last frame of the dynamic plot showing P to S conversion on reflection.

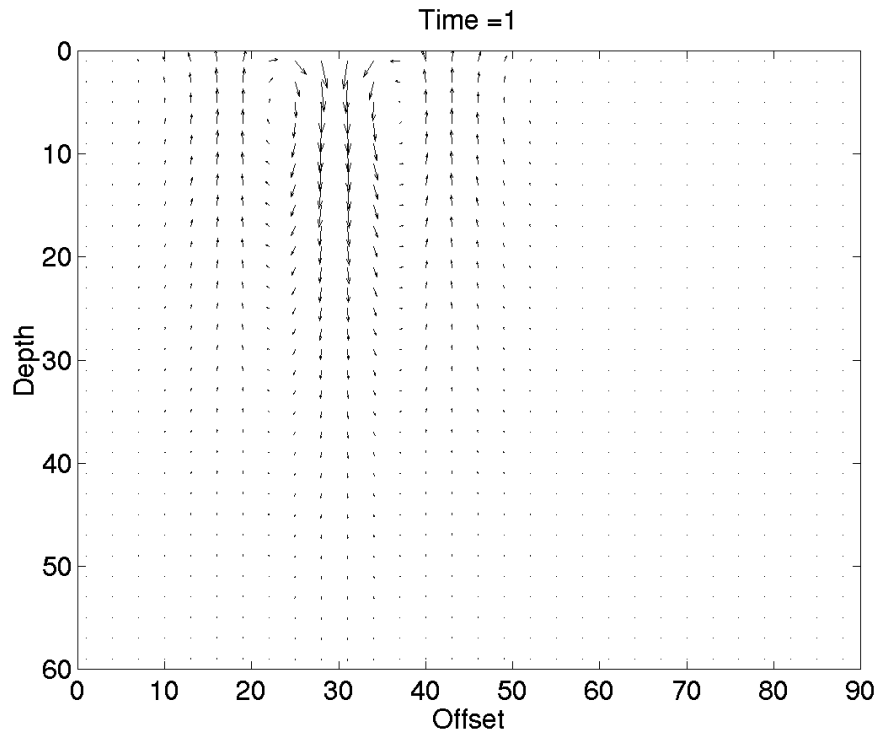


Figure 4: The first frame of the dynamic vector plot showing surface waves. It shows retrograde motion at the surface and prograde motion below 7 units.

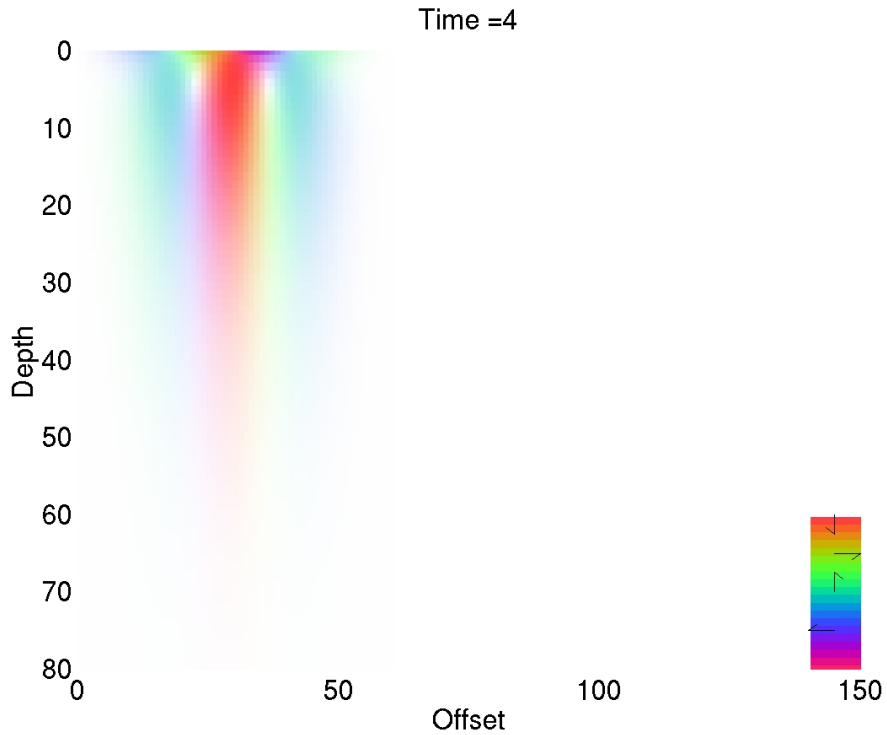


Figure 5: The dynamic colour plot of the surface wave. It is more difficult to interpret, but has greater dynamic range.