PAPER P

TIMS SOFTWARE

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ABSTRACT

TIMS, the Tomography Imaging and Modeling System, is an on-going software development effort designed to provide end-to-end travel time processing of cross-well seismic data. This paper provides a brief overview of the system, with an emphasis on the most recent developments. It also describes how the processing ties in with software written under the ProMAX software development environment, from Advance Geophysical. A list of TIMS programs is given in Appendix A.

INTRODUCTION

The successful application of cross-well tomography requires integrating acquisition, processing, and interpretation just as surface seismology has over the years. As acquisition capability expands, it will not be unusual to record tens of thousands of traces for tomographic processing. Eventually, a good travel time processing system will have (1) picking, (2) 3D geometry, (3) inversion, and (4) imaging and display tools. It will be capable of handling 50,000 traces or more efficiently on desktop workstations. With this in mind, the Seismic Tomography Project at Stanford University developed TIMS* - Tomography Imaging and Modeling System. TIMS provides a prototype system for complete end-to-end travel time processing of cross-well seismic data. It will accommodate large pick data sets and runs on modern Unix workstations. TIMS was initially developed on a Sun4 workstation, but recent development efforts have been on DECstation 5000's, running Ultrix.

TIMS

What is TIMS? TIMS is a collection of software applications and tools that can be assembled to form a processing flow (see Appendix A for a complete list of programs). It

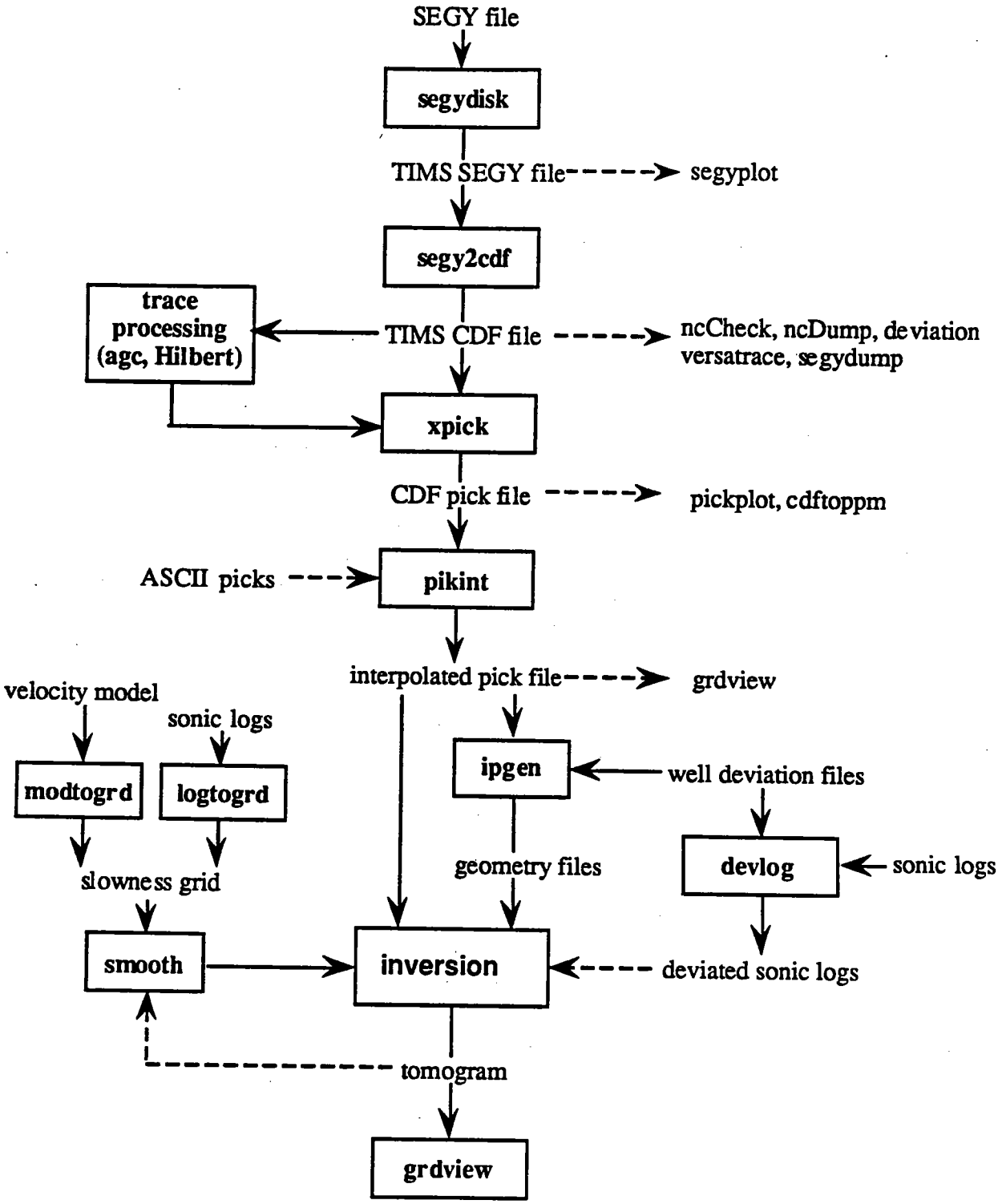

Figure 1. TIMS processing flow chart

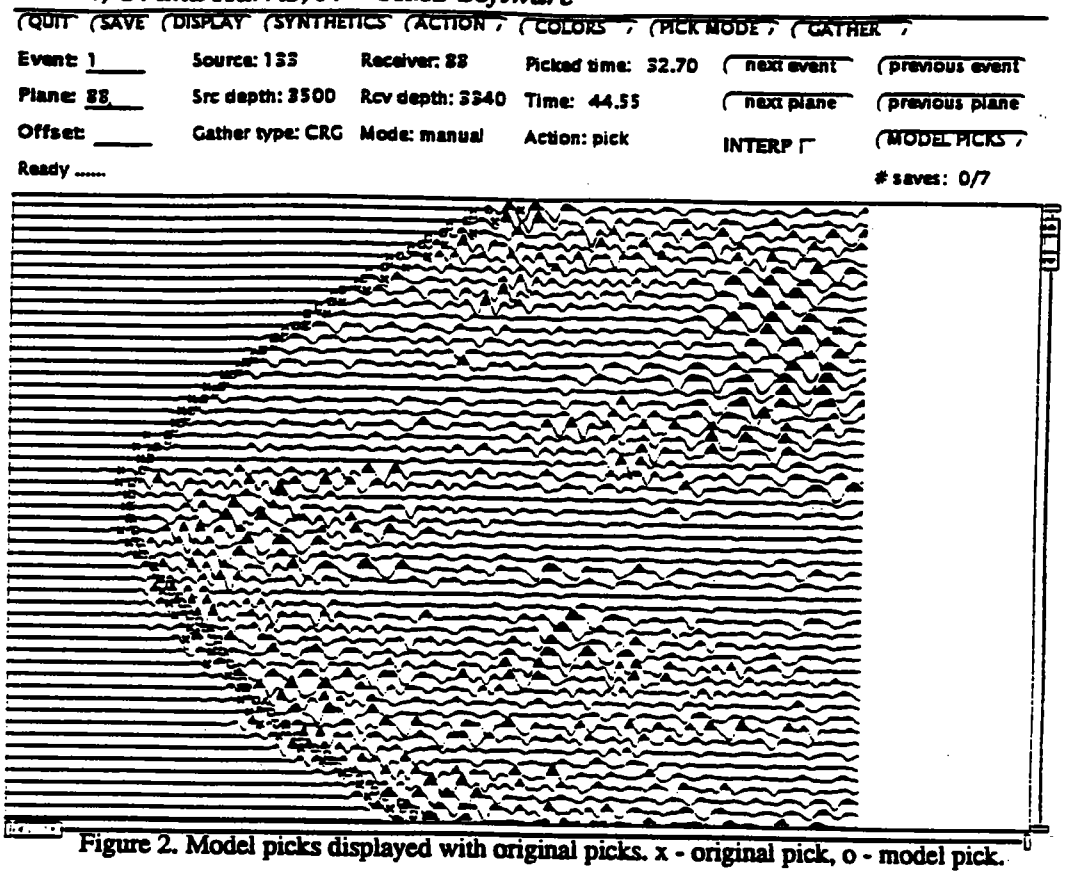

Figure 2. Model picks displayed with original picks. x - original pick, o - model pick.

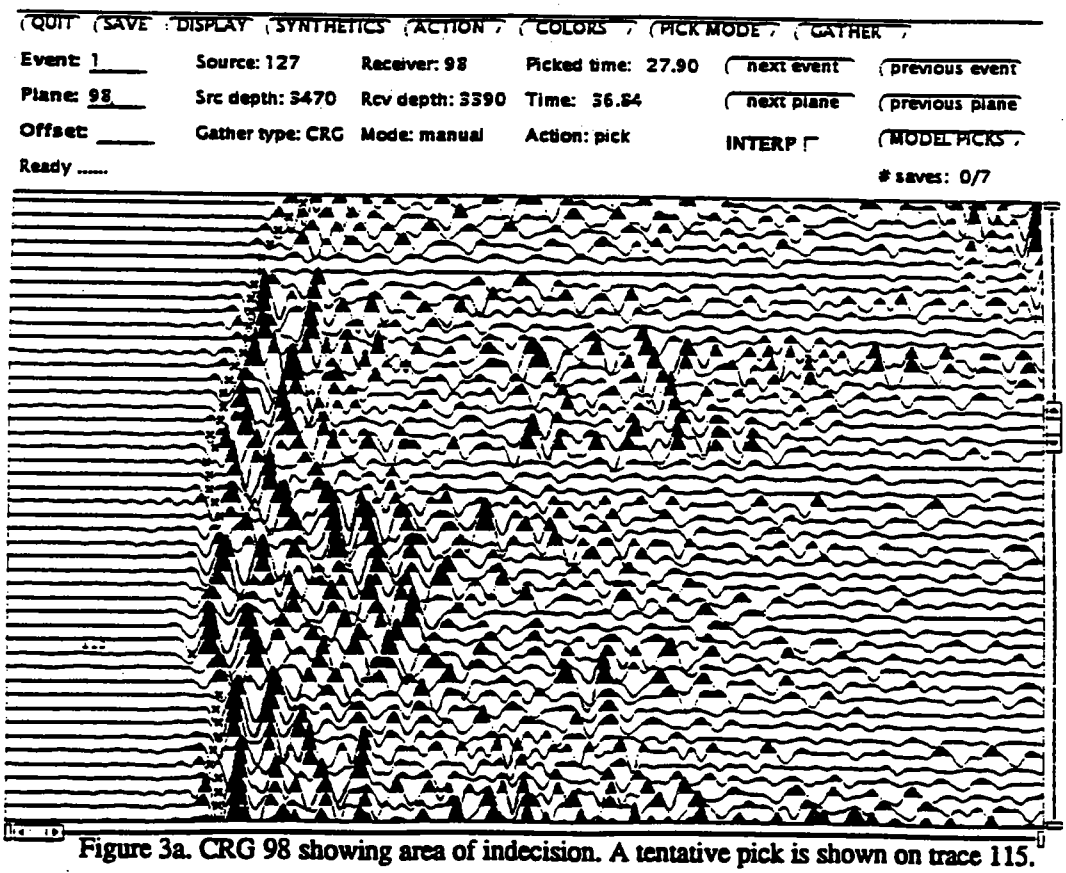

Figure 3a. CRG 98 showing area of indecision. A tentative pick is shown on trace 115.

Geometry Files and Inversion

On output from xpick, the picks are stored in a netCDF file. The first step in preparing for the inversion is to interpolate the picks to a regularly sampled grid, which is output as a compact binary file. All image files of this type (except the tomogram itself) will have measured wireline depth as axes. The pick interpolation program can read in picks in ASCII format as well, so picks from other sources can be processed.

The last step before inversion is to create geometry coordinates for converting the 3D well geometry to the 2D image geometry. Six geometry images are created; one x, y, and z plane for each of the source and receiver wells. The axes for these files are the source and receiver measured wireline depths, just like the picks.

The final processing step is the inversion. Besides the pick image and geometry images, the inversion program requires an initial starting model. Log data, which provide constraints at the wells, may also be input. Currently only the string inversion program has been used in this processing sequence. Some other type of inversion, such as anisotropic inversion, could be used instead. These other types of inversions are expected to be included as TIMS modules as they become available.

TIMS and ProMAX

The seismic processing package ProMAX, from Advance Geophysical, has been adopted by the STP group for processing cross-well seismic data. Although the functionality of ProMAX and TIMS overlaps in some areas, such as picking, they are largely independent systems. ProMAX is used mostly for initial trace processing; TIMS for tomography. The ProMAX picker contains features that xpick does not have, but xpick has features that ProMAX does not have. Figure 4 shows the relationship between the two systems. In addition, some of the software development in the STP group is being done exclusively with ProMAX, such as the reflection processing. The direction of future development is an open issue.

APPENDIX A - TIMS PROGRAMS

Program	Description	Author(s)
Data Formatting		
cdf2segy	convert seismic data from netCDF format to SEGY format	CL
cdftoppm	convert grid in netCDF format to ppm format	CL
field2tims	convert seismic data from field format to SEGY format	WW/CL
grd2segy	convert grid to pseudo-SEGY format for ProMAX display	CL
grdtocdf	convert binary grid to grid in netCDF format	CL
grdtoppm	convert binary grid to ppm format	CL
ppmtogrd	convert from ppm format to binary grid	CL
segy2cdf	convert SEGY data to TIMS netCDF format	MF/CL
segy2grd	convert pseudo-SEGY data from ProMAX to binary grid	CL
segydisk	convert SEGY to SEGY; read SEGY from tape	MF/WW/CL
synpkcdf	convert ASCII picks to picks in netCDF format	CL
Trace Processing		
agc1	perform AGC on seismic traces	GM
bpf1	bandpass filter	GM
fkf1	time domain filter	GM
fks1	2D spectral estimation	GM
hil1	Hilbert transform	GM
med1	minimum phase deconvolution	GM
Picking Tools		
xpick	X window based interactive picker	CL
Inversion Programs		
pikint	interpolate picks on a regular grid	JH
ipgen	create image plane geometry files	JH
string	string inversion	JH
Inversion Utilities		
convert	convert between ASCII and binary grid format	CL
deviation	add deviation information to data in netCDF format	JH/CL
devlog	convert log wireline depths to XYZ well coordinates	JH
invert	invert grids between slowness and velocity	JH
logtogrd	create slowness grid from sonic log data	JH
modtogrd	create slowness model from velocity nodes	JH
pikreg	register gridded picks to wireline depths	CL
pikshift	add a constant to interpolated picks	CL
smooth	smooth a binary grid	JH