

## DISPLAYING 3-D OBJECTS IN SEISMOLOGY USING PEX LIBRARY

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**ABSTRACT.** Interactive computer program to display Fortran list-directed format data sets with simple graphic primitives (points, lines, areas and texts), which may assemble complex 3-D seismological objects, is described. Powerful tool for 3-D visualizing in the X Window System, graphic library PEX (C language binding), is used.

### 1. INTRODUCTION

The idea of the *pictpe*x program have arisen in the connection to visualize computed results of subroutine packages MODEL for model specification and CRT for complete ray tracing in inhomogeneous geological structures (Červený, Klimeš & Pšenčík, 1988). The utilization of the *pictpe*x program is, however, general. It can be used for arbitrary data set complying the input format.

The names typed in '*italics*' and enclosed in apostrophes are optional and may be replaced by user names.

### 2. PHILOSOPHY

The philosophy of the new *pictpe*x program was originally proposed by Luděk Klimeš and the philosophy has been already used in Fortran computer program *PICTURES* (Konopásková, Bucha, 1996). The main features of the program *PICTURES*, that were used also in the *pictpe*x program are:

- a) The visualization of graphic primitives is managed by '*Control file*'. This is an ASCII Fortran list-directed format data file that includes general graphic attributes, attributes of graphic primitives and names of data files.
- b) '*Data files*' contain data about graphic primitives (points, lines, areas and texts) that we want to visualize. Data also have to comply with Fortran list-directed format in the form described by Klimeš (1994).

The main differences between programs *PICTURES* and *pictpe*x are:

- a) Program *PICTURES* is not interactive and enables visualization of 3-D objects projected to 2-D. Program *pictpe*x is interactive (panning, zooming) and visualizes objects by the use of 3-D space effects.

- b) Program *PICTURES* is written in Fortran language and utilizes 2-D graphic library GKS. Program *pictpez* is written in C language and utilizes 3-D graphic library PEX.
- c) Program *PICTURES* can run on various computer platforms, because GKS graphic library is supported by many software vendors. PEX graphic library, that is much more complex, needs UNIX X Window System.
- d) Program *pictpez* supplements the basic geometrical objects points, lines and texts with facets.

### 3. PROGRAM DESCRIPTION

The source code of the program *pictpez* is split into four smaller code files. Detailed description of input parameters and elementary functions is included in source files. The source code contains also functions that were taken from O'Reilly & Associates example codes (Gaskins, 1992). Appropriate makefile *pictpez.mak* manages the compilation and linking of the resulting *pictpez* program. Program input, interactive viewing and output were tested on Western Bohemia data sets.

#### 3.1. Input

The input Fortran list-directed format ASCII file '*Control file*', which can simply be changed by editing, includes following data (for detailed description of graphic attributes see Gaskins, 1992):

##### A. General graphic attributes

- a) Transform utilities convert modelling coordinates to world coordinates. Transform in *pictpez* includes translation, scaling and rotation. Modifiable parameters are: *fixed point, translation, scaling, rotation*.
- b) Viewing defines a set of parameters indicating our view on the 3-D model. Viewing is defined by two transforms: view orientation and view mapping. Modifiable parameters are: *view reference point, view up vector, view plane normal vector, view window, projection viewport, type of perspective, projection reference point, view plane, back plane, front plane*.
- c) Light in *pictpez* is defined by two light sources: ambient and directional. Modifiable parameters are: *ambient light color RGB, directional light vector, directional light color RGB*.

Program *pictpez* uses Gouraud shading method that calculates reflectance at each vertex of area primitive (linear interpolation). The reflection of the area primitives is set to diffuse.

##### B. Output graphic primitives and their attributes

Attributes have to be set before the primitives are drawn.

- a) Point (marker) attributes are: *marker color, marker type, marker size scale*.
- b) Line (polyline) attributes are: *line color, line type, line width*.
- c) Area (fill area) attributes are: *surface color, surface interior style, surface edges*.
- d) Text attributes are: *character expansion, character height, character spacing, character up vector, text alignment, text color, text font index, text path, text precision*.

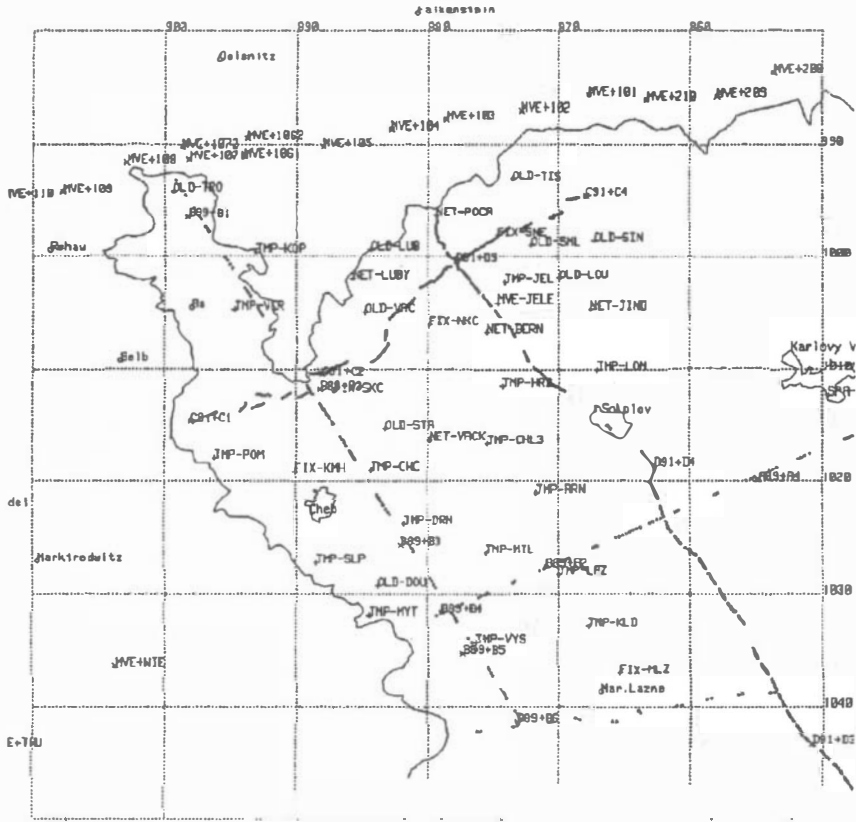


FIG. 1. Map representing the test data set from Western Bohemia

e) Names of data files

### 3.2. Interactive Viewing

Program *pictpex* offers three tools for interactive viewing:

- a) *Panning around* the model is accomplished by changing the view plane normal in response to mouse movement that is controlled by holding the first mouse button and moving the mouse in the desired direction.
- b) *Panning over* the model is carried out by moving the view reference point. The interaction is performed by holding the second mouse button and moving the mouse in the direction where we want to shift the model.
- c) *Zooming* is accomplished by varying the size of the view volume. The projection viewport is fixed. Holding the third mouse button and moving the mouse in vertical direction causes continuous zooming.

### 3.3. Program Output

Figures 1–3 show *pictpex* output. Presented figures were originally coloured. The greyscale (scanned) copies are thus not quite clear, especially figure 3. Figures 1



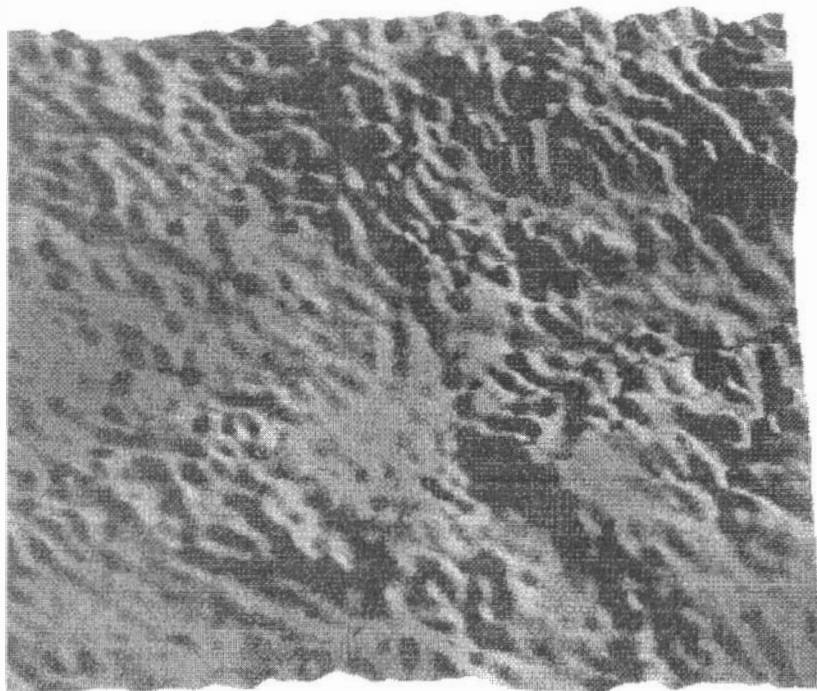


FIG. 3. Surface P wave velocities of Western Bohemia a priori model

#### REFERENCES

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