Laser-Scan Ltd.

Software Product Specification

TVES package

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Package TVES Software Product Specification

1 **DESCRIPTION**

The TVES package is one of 6 Laser-Scan DTM production and manipulation packages:

- DTMCREATE - the DTM creation package,
- DTMPREPARE - prepares IFF format vector data for DTM construction using package DTMCREATE
- IMAGEPROCESS - (was SATMAP) prepares satellite raster data for use with DTM manipulation utilities
- DTMCONVERT - conversion of model data between DTI format and external formats
- TVES - **T**errain **V**isualisation and **E**xploitation **S**oftware
- MATRIX - raster manipulation utilities, 3-D viewing and applications library

2 **Package TVES - input**

The TVES Package is designed to exploit a grid based Digital Terrain Matrix (DTM) held within Laser-Scan's Digital Terrain Image (DTI) format. It allows a customer to derive additional geographic measures such as slope, aspect and visibility information from the elevation data. The package also contains facilities to display grid based data in combination with vector geographic data in both 2 and 3 dimensional representations, and modules to allow conversion between grid (raster) and vector formats.

3 **INPUT**

The TVES Package requires grid based data to be held in Laser-Scan's Digital Terrain Image (DTI) format, and vector data to be held in Laser-Scan's Internal Feature Format (IFF).

4 **OUTPUT**

Data output and data conversion is to either the DTI format as grid representation or to IFF as vector representation.

5 **FACILITIES**

Package TVES offers the following features:

- exploitation of grid based elevation data for multi-disciplinary applications
- combined exploitation of grid and vector based geographic data to meet Geographic Information System (GIS) requirements
- flexible vector to raster and raster to vector conversion utilities
- use of standard VAX and popular graphic displays in combination with flexible data visualisation mechanisms
- input and interaction with the display via a digitising table
- user friendly command interface; all routines contain interactive help facility and where appropriate input via table menus

6 **HARDWARE PREREQUISITES**

The following computer hardware requirements are needed to run TVES.

- Any DEC VAX, MicroVAX or VAXstation computer supported by the current version of VAX/VMS.
- At least 10MB available disc space for software, plus sufficient for data files.
- At least a 4096 page working set per process, and a virtual page count of 30000 pages is needed for efficient operation of the larger utilities.
- Any LSL-supported graphics device or electrostatic plotter, currently one of:
  - A VAX workstation with 8 bit planes running UIS or the DECwindows/Motif windowing systems
  - Calcomp 5800 series colour electrostatic plotter
  - Benson 3000 series colour electrostatic plotter
  - Sigmex ARGS 7000 series colour display (with minimum of 8 bit planes)
  - Sigmex 6100 series, 6200 series and 6300 series intelligent GKS workstation
  - Versatec colour electrostatic plotter

- Precision Image C448 colour electrostatic plotter

- o A high resolution Altek Datatab Digitising Table (or similar LSL approved digitising table), 16 button puck, and associated Laser-Scan Table Monitor System, are required for source document registration and command menu input
- o Any DEC-compatible alphanumeric terminal (optional if the graphics device has alphanumeric terminal capability).

7 **SOFTWARE PREREQUISITES**

TVES modules run under VAX VMS V5.4-3 (or later version, assuming continued upward compatibility by DEC), concurrently with other interactive and batch processes.

For the use of Motif on a VAXstation, the "DECwindows Motif" layered product from DEC is required. The "VMS DECwindows Developers Kit for Motif" is not adequate.

For the use of UIS on a VAXstation, VAX VMS Workstation Software (VWS) version 4.3 or later is required.

A minimum working set of at least 4000 pages is recommended. Larger working sets will help performance, particularly with large matrix files.

Laser-Scan's **I**FF **M**ap **P**rocessing package (IMP) and the MATRIX raster data processing package are essential. Laser-Scan's LITES2 interactive digitising and editing software running on the same workstation is recommended for digitising vector input data. LASERTRAK automated digitising is recommended for large numbers of input documents.

8 **GROWTH CONSIDERATIONS**

The minimum hardware and software requirements for any future version of this product may be different from the minimum hardware requirements for the current version.

9 **SUPPORT LEVEL**

TVES is a fully supported Laser-Scan standard software product.

10 **COMPONENT MODULES**

Package TVES consists of the following component modules:

MODULE COVER

COVER determines which areas of the terrain surface are visible or hidden from the view of an observer. The observer may be positioned on or above the terrain surface, and may represent either a human observer, or a device such as a radio transmitter.

The input to the module is a Digital Terrain Model (DTM) and optionally a file with information on the heights of surface features. The output is a grid based intervisibility or cover map, that may be displayed in colour coded form on a graphics device, or manipulated using other TVES modules.

Both input and output data are held in a Laser-Scan Digital Terrain Image file. The main features of the program are:

- Use of the whole or part of a Digital Terrain Model (DTM)
- Registration of the DTM to a source document positioned on a digitising table
- Optional use of information on the height of surface features, such as woodland, when determining visibility
- Optional compensation for the effect of earth curvature and terrestrial refraction
- Immediate calculation of visibility along a simple single line of sight
- Selection of up to 8 observers
- Full user control over the position (x,y,z) and cone of view of each observer, as well as target distance and direction
- Coordinate input in grid, metres, or latlong units
- Display of cover information relating to a selected observer or observers
- User definable colour look-up-table
- On-line help and full user documentation

MODULE DTICHECK

The module DTICHECK is used to validate the data values in a DTI file. It is generally used to detect possible problems in a Digital Terrain Model (DTM). Checks are made for:

- critical slopes defined by a user supplied threshold Z difference
- DTM posts having a zero Z value
- DTM posts having a negative Z value
- DTM posts having a null Z value

The checks may be carried out singly or in any combination.

Error output may be directed to either an IFF file, LITES2 command file, or ROVER command file. The two command files may be used to aid the interactive correction of height errors in the DTM.

MODULE DTICONTOUR (recontouring from DTM)

DTICONTOUR is a grid bilinear contouring program, using DTMs contained in DTI (**D**igital **T**errain **I**mage) files. Contour output is to a Laser-Scan IFF format file.

DTICONTOUR offers the following features:

- DTM recontouring for DTM validation or for measurement system/contour interval changing.
- change of measurement system from current DTM system, eg metric to imperial or vice-versa, (or to any user defined system).
- tags output IFF contour features with a real or integer contour height.
- allocates a different IFF feature code for single point output strings (spot heights), contours and index contours.
- performs a simple linear contour interpolation, often preferred by Government departments for DTM validation purposes.
- has an optional contour smoothing routine.
- optionally outputs contour labels as IFF strings for quality check plotting.
- will break contours to insert contour labels.
- will always place contour labels such that they read "uphill".
- enables the user to specify the contour and index contour interval.
- enables the user to change defaults for labelling frequency along lines, proximity to adjacent contours, label size and the maximum line curvature acceptable for labelling.
- "most often required" default settings for all options.
- is command driven.
- command file operation to reduce operator error rate and use of "guidance files" for training, demonstrations and semi/fully-automated operation.
- on-line help and full user documentation.

MODULE DTIVIEWEXTRA

The module DTIVIEWEXTRA enables the IFF vector overlay options in DTIVIEW. These options allow data describing surface features (eg. rivers and woodland) to be drawn on a 3-D perspective or isometric terrain image.

The primary use for the option is for data verification, enhancement of the model, and for Geographical Information System applications which involve the combined presentation of vector and raster data.

Overlay facilities within DTIVIEW allow:

- Selection of features on the basis of feature code, feature serial number or layer
- FRT and SRI control over the colour and symbolic representation of the IFF features
- Automatic or user control over the registration of the vector data and the DTM
- Separate manipulation of the Graphics Device planes allocated to the terrain base and to the vector overlay

MODULE I2GRID

I2GRID is a module to convert data from Laser-Scan's Internal Feature Format (IFF) to Laser-Scan's Digital Terrain Image (DTI) format. In so doing the data is converted from a VECTOR to a GRID (raster) form; ie. the data in the input IFF file is rasterised.

In its rasterised form, the data may be manipulated and displayed using many of the modules that form part of the Laser-Scan TVES and MATRIX packages.

The module does not require a graphics device.

The main features of I2GRID are:

- Vector to raster conversion of the whole or part of an IFF file
- Output of converted data to a new or existing grid file
- Selection of which feature attribute is stored in the output grid file (eg. feature code, height)
- Output of the data at any grid resolution (dependent on the application of the imagery)
- Conversion of point, line and area information
- Selection of which IFF features are converted on the basis of feature code, FSN or layer
- User control over the order in which features are converted
- Mechanism to allow preset attribute values to be associated with selected features
- On-line help, and friendly command interface using user defined lookup and feature representation tables.

MODULE PROFILE

The module PROFILE is used to construct a series of path profile lines through a Digital Terrain Model (DTM). Typically, the origin of the profiles will be a base station, and the profile data will be used for radio frequency propagation analysis. Profiles are constructed either radially around the base station, or between each DTM node and the base station. Options are provided in the program to restrict profile generation to a rectangular area of interest, or to a sector of interest.

Input is a DTM, and optionally a series of clutter grid files, held in a Laser-Scan Digital Terrain Image (DTI) format. The DTM defines the elevation of the terrain surface, while the clutter grid file contains height information relating to surface features such as buildings, vegetation or water. Output is to a Laser-Scan vector Internal Feature Format (IFF) file.

Each profile is written to the IFF file as a separate feature. The bearing and length of the profile is stored in the IFF file, along with the x, y and z coordinates of the profile sample points. Additionally a clutter index value is stored for each sample point. The main features of the program are:

- Registration of the DTM to a source document positioned on a digitising table, and command input from the table puck
- Optional use of information on the height of surface features such as buildings and vegetation
- Construction of profiles either radially around the base station, or between the base station and each DTM node
- Use of a constant sample interval or sample interval that varies with the distance of the sample point from the base station
- Restriction of profile generation to a rectangular area of interest, or to a sector of interest in the DTM
- Coordinate input in matrix, metres or latlong units.
- On-line help and full user documentation

MODULE ROVER

ROVER displays both grid based and vector geographic data. Output is to a Laser-Scan supported graphics device or colour electrostatic plotter. When using a graphics device the user may interactively interrogate and edit the grid data. The grid data may take the form of a DTI (Digital Terrain Image) file containing elevation, slope or aspect information, shaded overlay, or remotely-sensed data (eg. satellite imagery) data.

The grid and vector data may be displayed independently, but more importantly they may also be displayed together using the program. The user is able to derive considerable benefits from this integrated display:

1. in the areas of data validation and visualisation
2. when editing the grid data
3. through the derivation of other geographic information from the combined datasets

Using a digitising table the user is able to move around and edit matrix values. Editing facilities within ROVER offer the option of editing a single data value, a line of values or all values within a defined area. The grid data may be edited with reference to any overlaid vector information.

ROVER provides a display link between Laser-Scan programs that manipulate and display grid and vector datasets. The Laser-Scan programs that either generate or utilise digital terrain matrices (See the SPS for Packages DTMCREATE, MATRIX and TVES) are of particular relevance, along with Laser-Scan's vector cartographic editor (LITES2) and plotting program (FPP). The modules I2GRID (vector to raster conversion) and VECTORISE (raster to vector conversion) are also significant for preparing data for display within ROVER.

The main features of ROVER are:

- Full or quartered screen display
- Image zoom and roam under cursor control
- User control over allocation of device bit-planes between the raster and vector pictures
- Selective manipulation and display of raster and vector pictures
- A range of interactive raster edit capabilities
- User control over colour tables (defining nature of raster display colours and vector overlay colours)
- Ability to annotate the display with legend and user specified text
- Source document registration to grid or vector data
- Ability to digitise to an output IFF file, using the displayed information as a guide

- Command input via keyboard or puck button
- On-line help and full user documentation

Raster Display Facilities:

- Manipulation and display of 4 grid files
- Definition of area of interest in matrix units, metres or latitude and longitude values
- User definition of data range and step values
- User control over the number of raster display colours
- Rotation of the grid file
- Rapid display of satellite imagery held in a byte format

Vector Display Facilities:

- Scaling of the vector data to register to the displayed raster information
- Selection of area of interest in the IFF file
- Selective display and erasure of IFF features
- User control over the graphical representation of linear, point symbol, areal and text features (including pattern lines)
- User control over the colour representation of overlaid features

Raster Edit Faciltiies:

- Readout of the coordinates and value at the current cursor position
- Editing of a single point, line of points or all points within a user defined area
- Editing using interpolation algorithms

MODULE SLOPES

SLOPES generates slope or aspect information from elevation data held in the form of a grid based DTM. The module may also be used to produce a shaded overlay. The derived information may be displayed as a classified image on a suitable colour graphics device, or may be output to a disk grid file for subsequent manipulation or fast display using modules within the TVES package.

The information derived from the elevation data on slope and aspect represents a valuable end product in itself, but more importantly may be an input into a Geographic Information System (GIS).

SLOPES features are:

- Use of the whole or part of a digital terrain matrix
- Input of an area of interest in lat/long, metres or grid units
- Registration of the DTM to a source document positioned on a digitising table
- Output of the derived information to a disk grid file
- Output of the derived information as a classified colour display
- Selection of colour look-up-table
- Annotation of the display with user information
- Command input via the keyboard or table menu
- On-line help and full user documentation
- Generation of a slope map with:
  - Choice of 4 gradient algorithms (including maximum or average slope algorithms)
  - Selection of gradient step intervals
  - Allocation of gradient step to selected colour
  - Display of slopes lying between a specified gradient range
  - Display of slopes between a specified height range
  - Display of a height difference map
- Generation of an aspect map with:
  - Selection of angular step interval
  - Choice of colour or grey-scale display

- Generation of a shaded overlay
  - Display using 128 grey levels
  - Variable light source (sun) position and angle
  - Choice of 3 reflectance algorithms

MODULE VECTORISE

The module VECTORISE allows grid based data (raster) to be converted into a vector IFF representation. Lines generated from the raster image by VECTORISE are the boundaries between areas in the grid file whose pixel values fall into user defined ranges. The input grid file may contain a variety of geographic information ranging from elevation or slope data to remotely-sensed satellite imagery.

The main features of VECTORISE are:

- Use of the whole or part of a DTM
- Selection of data value range or series of ranges (real or integer)
- Output into a link-node structured IFF file
- Vector boundary generation
- Optional smoothing of the vector boundary data
- Progress and diagnostic display
- On-line help and full user documentation