Newsletter – February 2019

GPR-SLICE Subscribers,

We would like to welcome the following organizations to the GPR-SLICE community:

- United Nations Development Program - Damascus, Syria
- Brian Whiting, PhD LEG, Seattle, Washington
- RMBaker LLC, Orlando, Florida
- Dept of Natural Resources, Washington State
- Dept of Earth Sciences, The Hebrew University, Israel
- Maek Consulting PTE LTD, Singapore
- Delta Marking BV, Netherlands
- GeoSense, Bogota, Colombia
- Masarykova Univerzita, Czech Republic
- Foshan University, China
- Opdida SL, Spain
- Florida Bureau of Archaeological Research, Tallahassee
- Soil Testing Siam Co Ltd., Bangkok, Thailand
- John Wood Group PLC, British Columbia, Canada
- GeoView Inc, Florida
- Faculty of Engineering, University of J. J. Stotamayer, Croatia
- Fred W. Birmingham, Jackson, TN
- Diamond Concrete Sawing, Michigan
- Technics Group, Guildford, United Kingdom
- Ingenieria Agustin Omar Jaque La, Chile
- Texas Cemetery Restoration, Dallas

- Geosurveys, Angola, Africa
- DSTL, UK
- AF Consult, Sweden
- Byram Archaeological Consulting, LLC, California
- Department of Geology, University of Peshawar, Pakistan
- SIA Smart Engineering, Latvia
- Birlik Build, Izmir, Turkey
- American Geotech Inc, Wyomissing, Pennsylvania
- American Engineering, USA
- Aero 360 Solutions, Manila, Philippines
- Alpha Geosurvey Ltd, Aberdeen, United Kingdom
- Astellog, France
- Universidade Federal Rio Grande do Norte, Brazil
- Department of Geosciences, University of Massachusetts, Amherst
- Proceq Trading Shanghai Co, Limited, China
- Belgian Army, Belgium
- Virtual Wonders, Delafield, Wisconsin
- Department of Geography, Texas A&M University

- Central Florida Locators, Wessex Archaeology and Geoscan expanded their GPR-SLICE licenses to include multichannel options
- Geoview ordered a 2nd GPR-SLICE license
- Our newest user from Aero 360 took 4 licenses initially

GPRSIM Software licenses were delivered to following organizations:

- Foshan University, China
- Soil Testing Siam Company, Thailand
- DSTL, UK
- Proceq Trading Shanghai Co, Limited, China
- Virtual Wonders, Wisconsin

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Mala Guideline Geo is is now independently marketing and providing software support and delivered GPR-SLICE licenses to 7 new organizations with a total of 9 new subscriptions since the last August newsletter. Their recent client, the Belgian Army, started with 3 licenses.

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Several other GPR manufacturers and organizations including RadarTeam of Sweden, Impulse Radar of Sweden, and Allied Geophysical in the UK have also expressed an interest to begin marketing GPR-SLICE Software and provide full support.

Software Updates - Release of GPR-SLICE v7.MT

If you have not been following the updates on the website or our FB group page then the biggest news since OpenGL was added to the software some 10 years ago is that GPR-SLICE v7.0 is now GPR-SLICE v7.MT!   So, what's new? Well the MT of course!   GPR-SLICE 2019 is now a MultiThreaded – MT - application! If you have multiple cores on your computer, you can speed up processing by almost N times – where N is the number of logical cores!   On many computers one can send 2 threads per core for processing - where the number of logical cores can be 2 times the number of actual cores.   When one processes a set of radargrams, GPR-SLICE will send out each radargram process as a separate thread to be executed in Windows and to be run simultaneously on as many cores as exist on a computer.   All-in-all, the speed of processing a set of radargrams can be increased almost by the number of logical cores one has on their computer!
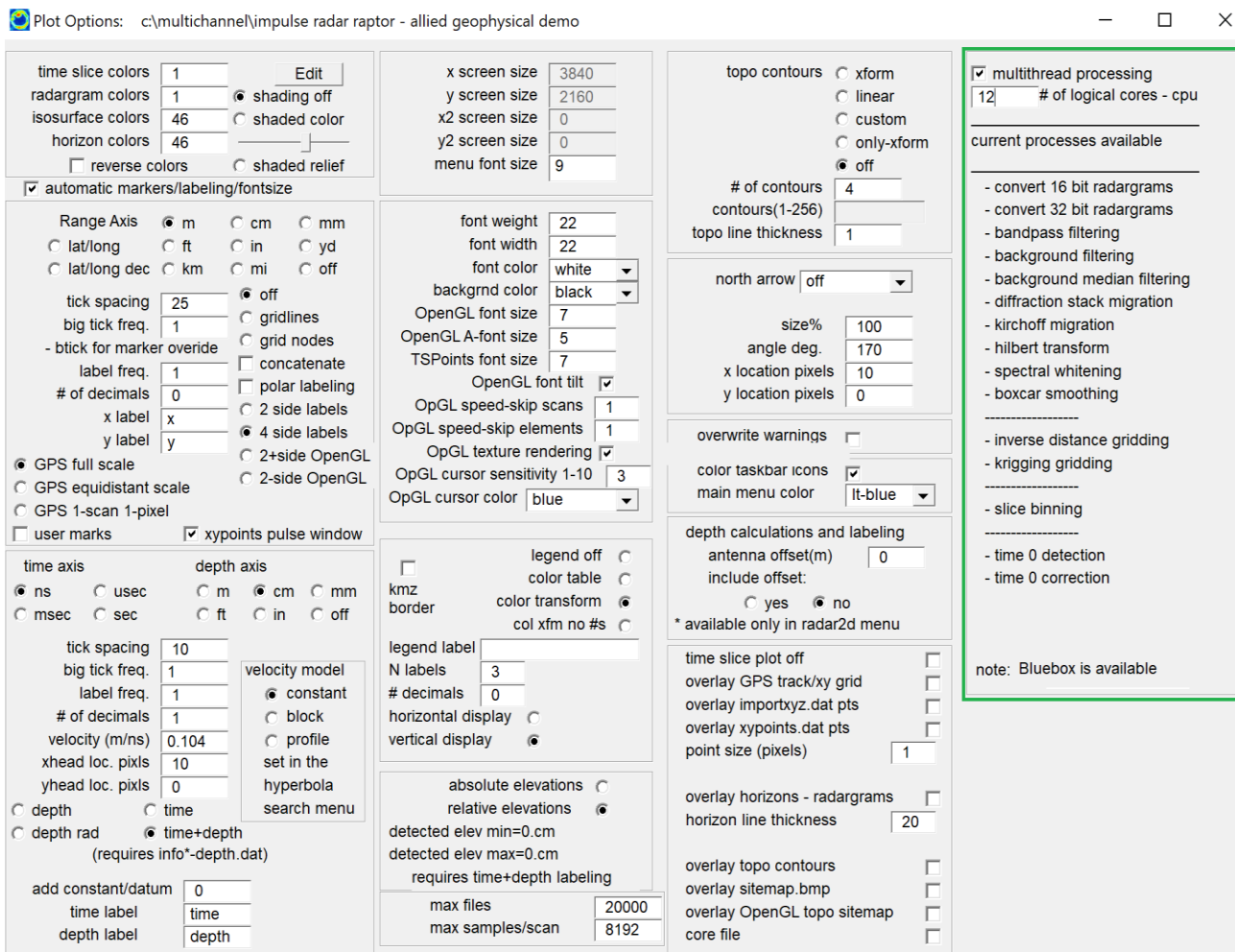

Figure 1. Option menu showing the available multithread processes

The list of processes currently available are outlined in the Options menu (Figure 1) and include radargram filtering, radargram conversion, radargram editing, time slice binning and gridding operations.   Specifically:

- Convert 16 bit radargrams
- Convert 32 bit radargrams
- Bandpass filtering
- Background filtering
- Diffraction stack migration
- Kirchhoff Migration
- Hilbert Transform
- Spectral Whitening
- Boxcar Smoothing
- -----
- Inverse distance gridding
- Kriging gridding
- -----
- Slice binning
- -----
- Time 0 detection
- Time 0 correction

These operations are the most fundamental processes and have been included in the first MT release.   The desired number of cores can also be set and is available in the Options menu. If you are running other applications, you can limit GPR-SLICE to any portion of the available logical cores so all active applications will run smoothly.   In addition, there can be a limit to the speed of operations such as when disk writing, so the user may want to test how many cores assigned improves the final speed of operations.   This can also be different with some of the processes that require different kinds of computer resources.

Note: With MT turned on all processing graphics are disabled.   For quick viewing of radargrams signal processing, radar editing or gridding operations, the same checkbox that is available in the Options menu is conveniently available in these menus as well to shut MT off.

Other major features and options added to GPR-SLICE include:

- Specialized OpenGL Volume + Gridblock menu for generating a single Zscan image made across super large areas by compositing many individual gridblocks volumes together

- Dip limited migration for diffraction stacking and Kirchoff migration for improved migration in shallow areas

- OpenGL XYZ-2D style-xyr added for Zscan display with 2 side radargrams from any folder (useful for concrete surveys)

OpenGL Volume + Gridblock menu: Composite Zscan imagery generated from individual block volumes

One of the major obstacles in OpenGL for multichannel users has been to render large sites. For most sites, reading in a single volume of 200-500 mb which might comprise about 1-2 hectare of data was about the maximum capability. To increase the sizes of a site that can be rendered in OpenGL a new option to create a composite of all the gridblocks generated for a survey is now available.

In the Multichannel 3d Radar Pulse Volume menu on completion of creating block volumes, a new file with the append identifier "gridblock"+3D volume name will be generated. Selecting this file in the Select 3D File menu will allow the user to open the abbreviated OpenGL Volume + Gridblock menu which will tell the software to compile Zscans from all the available individual blocks comprising the survey. The new option is currently limited to just the Zscan imagery at present and memory is conserved by just reading in the individual blocks one at a time and then releasing this memory to insert the next block. Because of these memory conservation considerations, isosurfaces are not available for the composite render.

With the new option, users should be able to display significantly larger sites surveyed that are created with block gridding. OpenGL Volume Gridblock + Draw menu is also available for interpreting and drawing objects on top of the composite Zscan image. An example of a survey (Figure 2) made by our subscribers Socotec in the UK along with our newest distributor Allied Geophysical in the UK, a survey on a road that comprises 450m x 1300m. Gridblock operations were set to 50x50m blocks and generated 234 blocks. About 49 blocks of the total 234 blocks are actually compiled as the blocks in red are empty blocks. Each 49 blocks is about 75mb or 3.7 gb for the volumes. The individual block volumes can actually be even higher resolution and up to

about 500Mb. For the xy grid cell size and volume data were compiled at the antenna channel spacing of 0.085 cm.   There is no limitation on how big a gridblock site can be since none of the blocks are read into memory except the active block to composite the image together. The ultimate limitation on a site may be the graphic card. But sites several square kilometers and more should be accessible now for imaging with the new menu.   The response of step down in the volume is also reasonably responsive.

Recently another subscriber made nearly solid imagery on a site that had 266 gridblocks. Most blocks were filled and the total volume which was made at a higher resolution of 4cm cells using multichannel equipment had a total of 70gb of volume rendered in the new menu!   Survey sizes up to several kilometers are no longer a problem to render in OpenGL!   We are waiting to hear from users that may need to provide surveys to see how the software responds for 5-10km of kilometers and what limitations there could be?
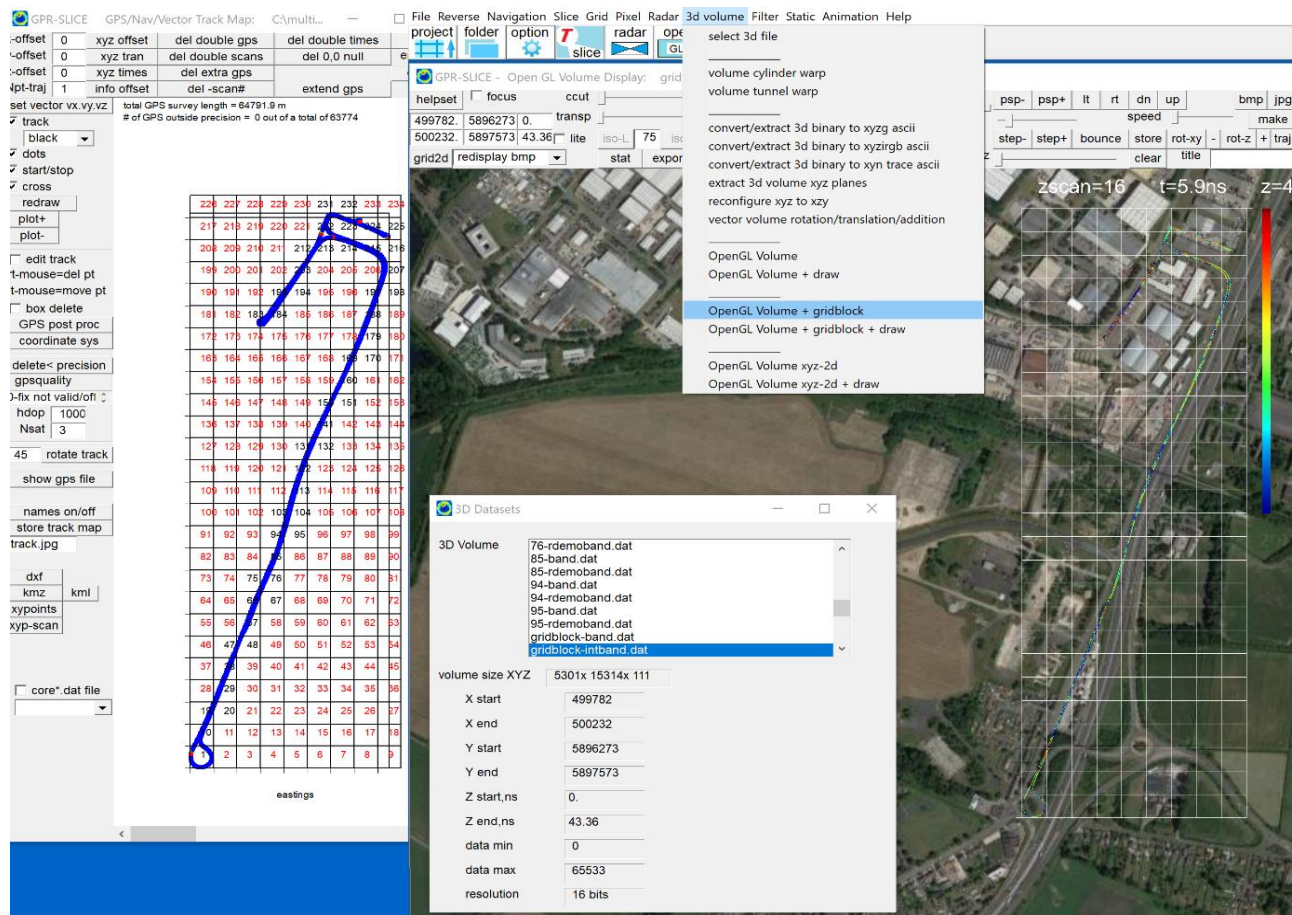

Figure 2.   Site that is imaged with block volumes with individual block sizes made at 50x50m and comprising a total area 1300mx450m.   The complete composite mage is put back together in the OpenGL Volume + Gridblock menu (data courtesy Socotec and Allied Geophysical, UK)

Gridblock operations were also modified to allow an overlap between the discreet volumes (Figure 3). One user found that when drawing utilities on a single gridblock it helps to see the continuation of anomalies slightly into the surrounding blocks. The overlap settings is available in the volume generation menu. For volumes created with overlap, the recompositing all the gridblocks back into a single image that have overlap is integrated into the OpenGL display.
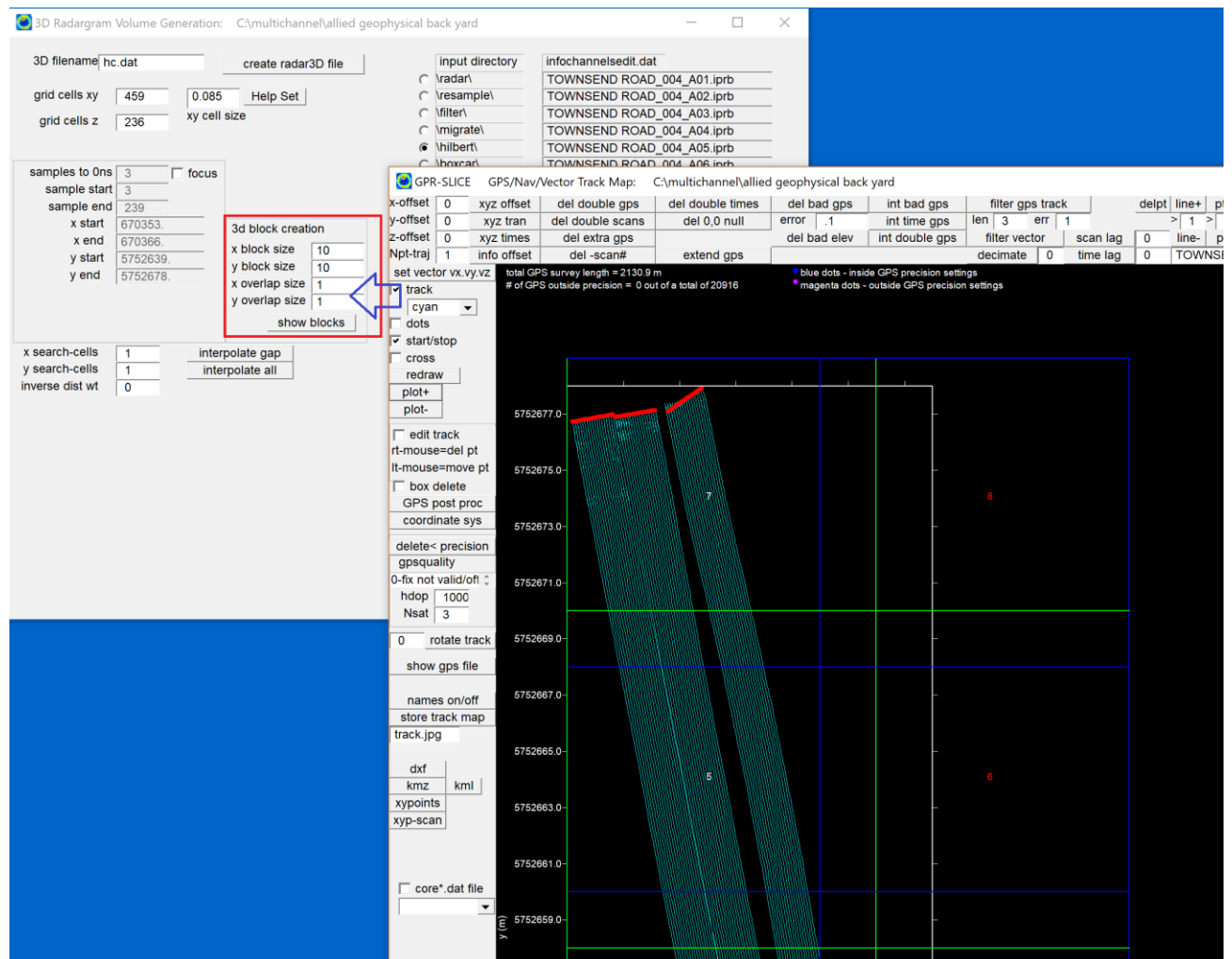

Figure 3. Example of gridblocks with overlap shown between adjacent blocks.

Dip Limited Migration

A new option and an improvement to migration has been added to the Filter menu (Figure 4). Dip limited migration is introduced which can help to reduce noises caused by propagation of diffraction stacking of deeper off angle elements onto the near surface region. The simplest migration algorithm for either

diffraction stacking or Kirchhoff migration do not taper the migrator aperture in the near field. On data where sites have less white noise and have cleaner hyperbolic reflections at depth, one can see the propagation of deeper parts of the radargram onto the near surface region (as seen in the bottom radargram that contain faint and inverted hyperbola tails trending near the surface).
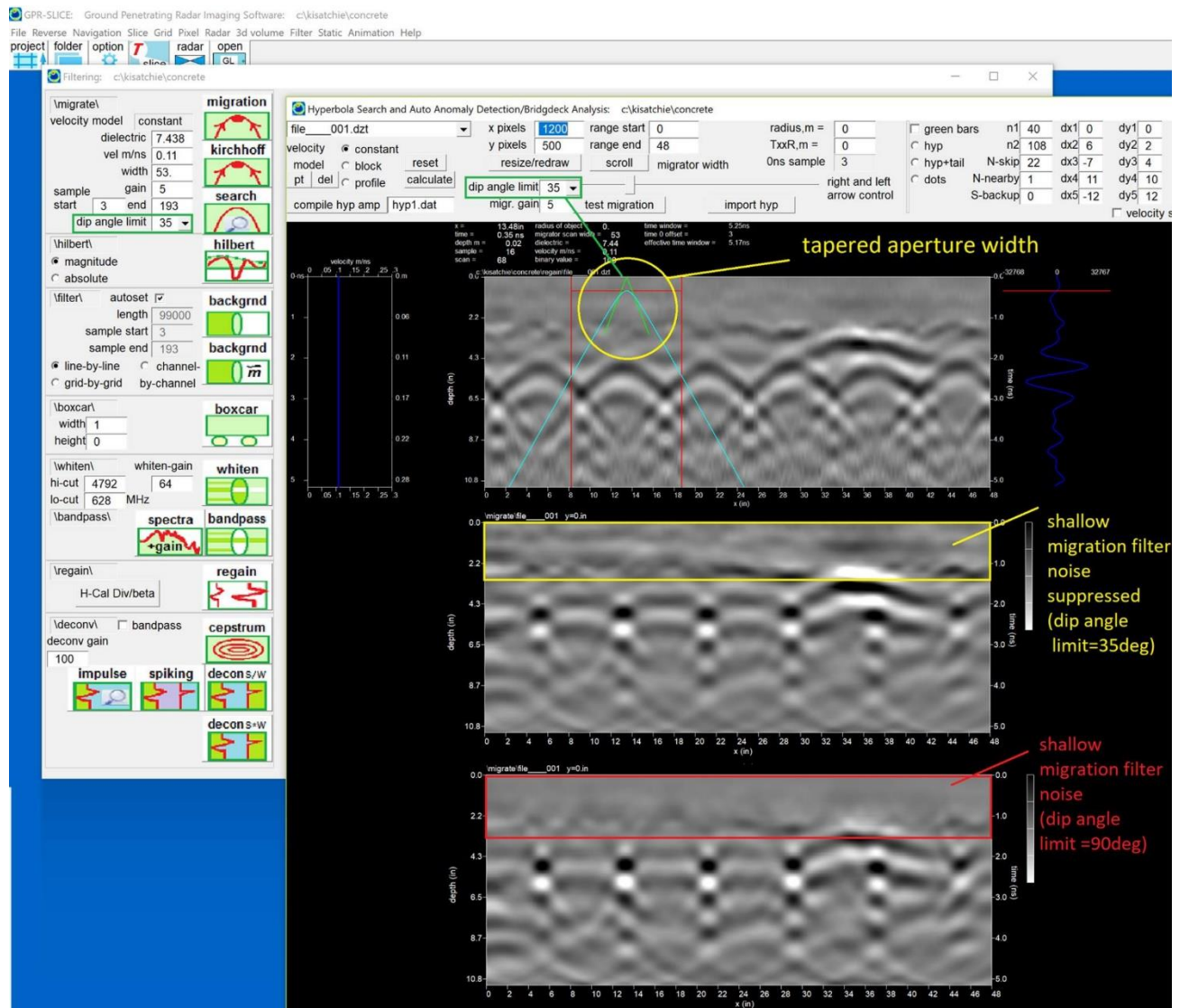

Figure 4. Example of dip limited migration applied to a rebar survey. Migration noises are suppressed for this data using a dip angle limit of 35 degrees.

To reduce the effects of migration noise on the near surface region of the radargram, a dip angle limit is introduced as a new option setting in the migration menu. The dip angle will limit the total aperture over which diffraction stacking is done and which is tapered from the narrowest aperture at the ground surface to the full aperture width at depth. In the Hyperbola Search menu, the green angle bars show the dip angle limit and how the migrator aperture will be

tapered. The green bars are only shown partially in the menu but can be considered to continue beyond the drawn angled lines. Time slices, particularly for concrete imaging, will show less noises in the shallow regions with the dip angle limit engaged. The default setting for the dip angle limit is 35 degrees and the user can adjust this as desired.

OpenGL XYZ-2D menu - new style option

During a recent demo for the software for concrete imaging a client wanted to know if the active time slice in the volume could be seen with any 2 side radargrams collected on a survey grid. To provide this option a new style setting in the OpenGL XYZ-2D menu was added (Figure 5). The user can set "style-xyr" and then the 2 closest radargrams in each of the x and y directions will be shown next to the active time slice. The user can choose any folder and show raw radargrams that are synced with the processed time slice. Note, the x y radargrams are found from the closest point of approach where the user clicks on the Z-scan.   There are new options also to set a cursor color and thickness in the Options menu and on the Options button in OpenGL Volume Draw XYZ-2D menu.
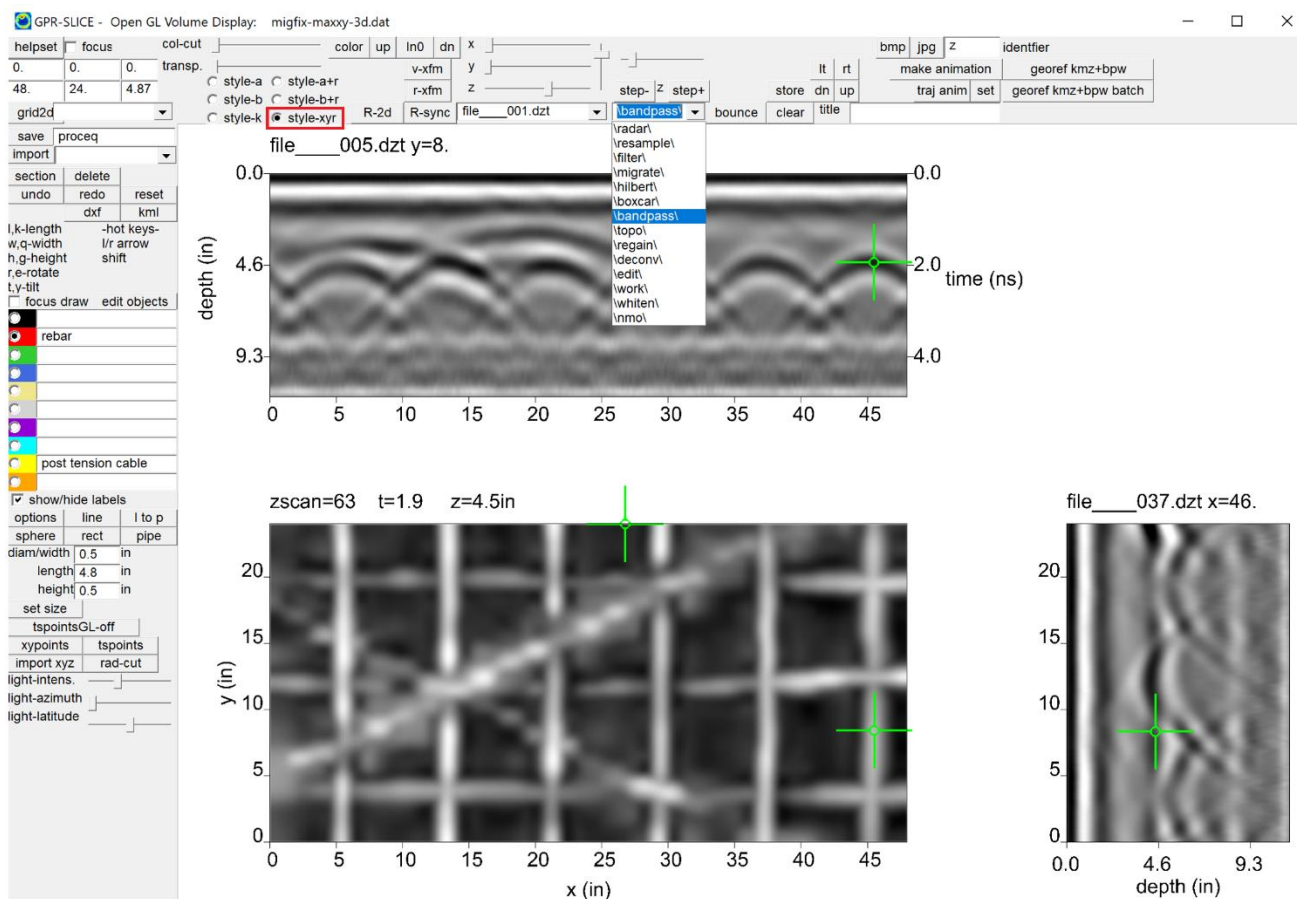

Figure 5. OpenGL XYZ-2D new style option XYR to show x-y radargrams.

Additional options added to GPR-SLICE Software

- Mala Dual Frequency equipment type added to auto create info1.dat and info2.dat separate channel information files
- Option in the Pixel Map menu (and Radar 2D menu) to auto skip checkboxes for displaying a series of time slices - useful for large datasets such as those made by extracting from a 3D volume and to quickly look at every Nth map
- Redisplay BMP option added to the Grid2D listbox in OpenGL to quickly get an overlay georeferenced bitmap on the screen
- Impulse Radar Raptor user mark identity added to converted radargrams
- Separate V7 work folder written to handle multithread log file testing
- Display list rendering economy used for OpenGL Topo Volume Warp rendering to allow for larger volumes
- OpenGL cursor color and thickness option added to the Options menu
- BlueBox batch working with available multithread options
- XYpoints number drawing option and bitmap save button added to XYpoints dialog
- GSSI multiplex 3d XY file imported and demultiplexed directly in the Create New Info survey listbox with either one or two channel separation as well
- XYpoints mouse option increased to 65000 pixel displays from 10000
- Mala Mira non-multiplexed (legacy) multichannel data updated for *.cor file navigation
- Optimize speed/resolution radio buttons removed from Pixel Map and Radar 2D menus - plotting is now speed plotting with complete vector graphics stretching
- XYPoints comment spaced updated for any comment not just for utility mapping objects
- GSSI DZG to UTM button adjusted to read all the different formats for DZG log files
- Extract ez- *.grd files from a gridblock volume designation available on the 3D volume pulldown menu
- OpenGL focus drawing checkbox added to only show the current gridblock drawn objects and not surrounding blocks
- Real and graphical *.txt and *.stl isosurface export files written on the "stat" button in OpenGL Volume
- Quick set checkbox for multichannel zig-zag surveying to generate x or y survey grids in the Create New Info menu
- Beta Normal Moveout Correction opened in the Radar Edit menu and Tx-Rx offsets set in the Create Info File menu - currently available to multichannel licenses only
- 3D volume filtering operations recognize gridblock designation for batch volume filtering
- Google KMZ buttons in OpenGL now also make ArcGIS *.PGW/*BPW output simultaneously - buttons renamed to Georef KMZ+PGW and Georef KMZ+BPW Batch
- Scan start/end setting in running auto horizon detection option allowing for partial detections
- Additional ASCII file called Export XYPoints.dat file written with XYPoints adjusted for the active topography grid file
- Option to show the topography grid in regular OpenGL when a topo corrected volume is active for level plane slices

Events

   A 3-day GPR-SLICE workshop was made at AERO 360 from January 10-12th, 2019 at theit Manila offices in the Philippines.   AERO 360 is a young company that has government contracts to investigate the use of GPR drone surveys on sites littered with UXO from recent activities in the Southern Philippines.   Some UXO are said be as deep as 10m.   AERO 360 will be using some of their own designed drones along with GPR antenna manufactured by RadarTeam in Sweden as well as drone magnetometers to perform surveys on areas as large as 250 Hectares and at 7cm intervals on the site.   We wish them success in helping the government mitigate as quickly and as safely as possible areas that were torn apart by recent bombings and war.

Upcoming Events

Saitobaru Archaeological Museum - GPR Symposium, Workshop and Surveys - February 11-18th, Miyazaki Prefecture, Japan

Dean Goodman
GPR-SLICE Software
*This newsletter is available in *.pdf form at https://gpr-survey.com/newsletters.html