

Newsletter - February 2017

GPR-SLICE users,

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

- Ceratonia Geophysics S.r.l, Ragusa, Italy (www.ceratonia.it)
- Capital Normal University, China
- Serramur & Associates, PC, Boone, North Carolina (www.seramur-associates.com)
- Proceq, Switzerland (www.proceq.com)
- Seismic and Exploration Geophysics, University of Bassra, Iraq
- Dept of History, Geography and Philosophy, University of Cadiz, Spain
- Dept of Earth Sciences, University of Florence, Italy
- ScanTech Geoscience, Ireland (www.scantech.ie)
- Dept of Earth Sciences, University of Memphis, Tennessee
- Soft Options, New Zealand
- Gyula Forster National Centre for Cultural Heritage Management, Hungary
- Sum Kee Construction Limited, Hong Kong (www.sumkee.com.hk)
- Peter Lanzarone
- Jorge Alarcon Anthropologist, Bogota, Colombia
- Anomali Jeoteknik Muhendislik Hizm Ltd, Turkey (www.anomali.com.tr)
- GeoPat, France
- BHP Billiton, Canada

GeoStudi in Italy, a long time user of GPR-SLICE + Multichannel options ordered a second license to the software.

GPRSIM Software licenses were delivered to:

- North China University of Science and Technology
- Changjian River Surveying Technology Research Institute, China
- BHP Billiton, Canada

Software Updates

Among the most important or requested improvements added to GPR-SLICE V7.0 Software are:

- Vector volume addition – example of a square column survey
- Spectral + Gain menu – application of gain w/bandpass
- GPS listings spreadsheet
- OpenGL Volume Draw Objects editing spreadsheet
- Differential Bandpass filtering
- DXF file export of object depth from local topography

Vector Volume Addition –example imaging of a 4-sided square column

GPR-SLICE has a new menu to synthesize a vector volume from separate localized volumes (Figure 1) This menu can be used for instance to combine all the surface surveys and their separate volumes taken on a 4-sided square column and generate a single vector volume! The new menu on the 3D volume pull down menu has slots to set the absolute origin that each volume is recorded on, along with their corresponding axes rotation needed to place the new volumes in their vector location. There are also separate gain values that can be applied during the addition process for each individual volume.

Some of the requirements and recommendations for this new vector operation are to: 1) make individual volumes that have more density than the output volume to insure that there are no empty cells during rotation and translation into the output vector volume, and 2) it is recommended that absolute or ABSOLUTE (user defined set min/man) normalization be used to

generate the volumes. With absolute normalization, keeping the gains lower at depth in each individual volume will help to ensure that volume elements that are overlapped - as will occur on the corners of the new volume - do not overwhelm the imagery - and only the true amplitudes are being added and not normalized amplitudes at each level from the time slice dataset. An example of a column concrete/rebar survey made with a Sensors and Software Conquest GPR system by Butch Federizon at Geomaster Corp in Quezon City in the Philippines is shown in the example imagery (Figure 2).

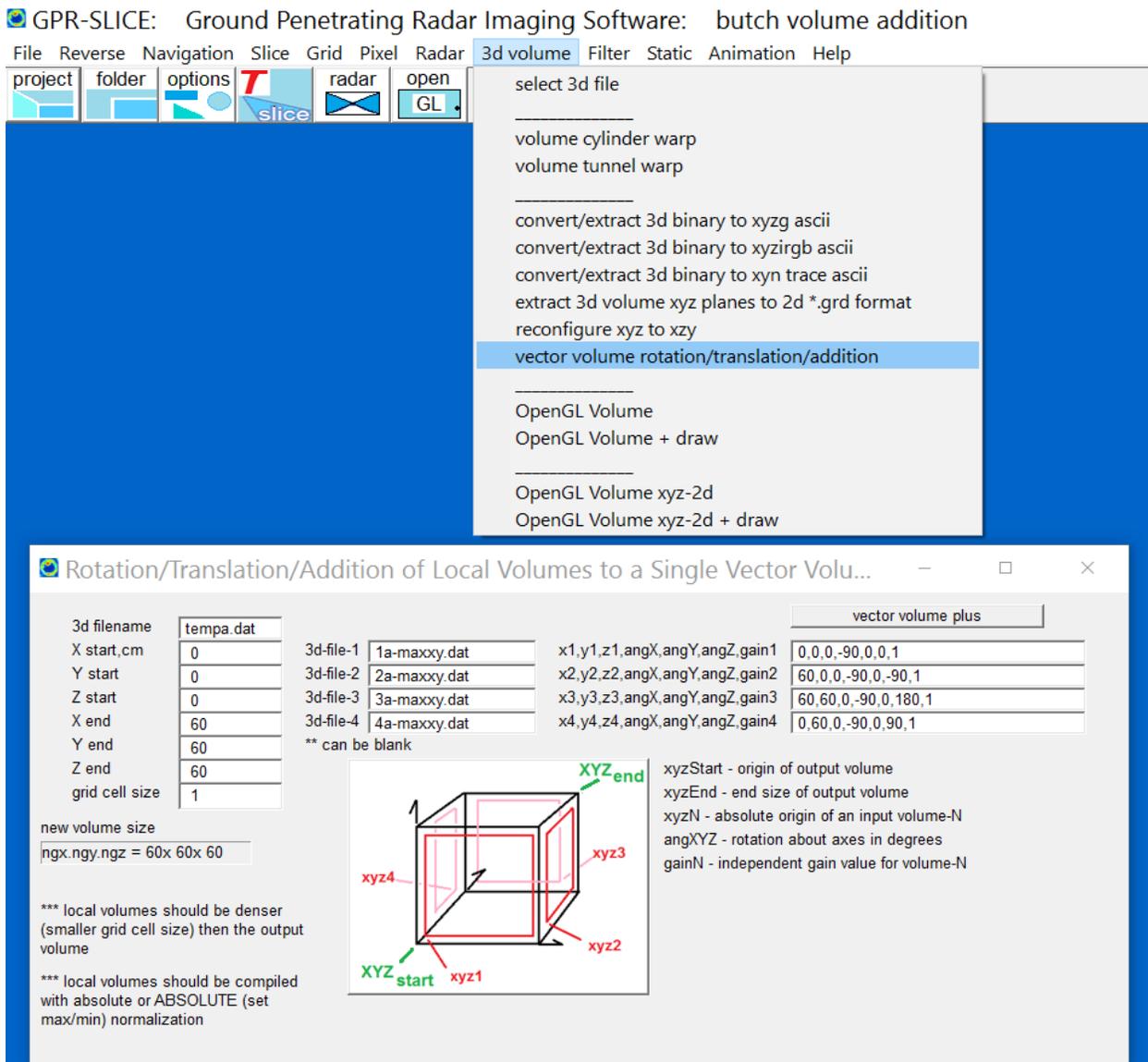
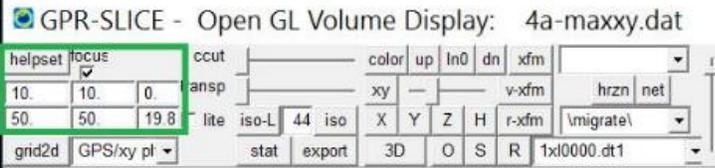


Figure 1. The new Vector Volume Addition menu



Vector volume comprised of 4 - separate volumes on each surface of a square column

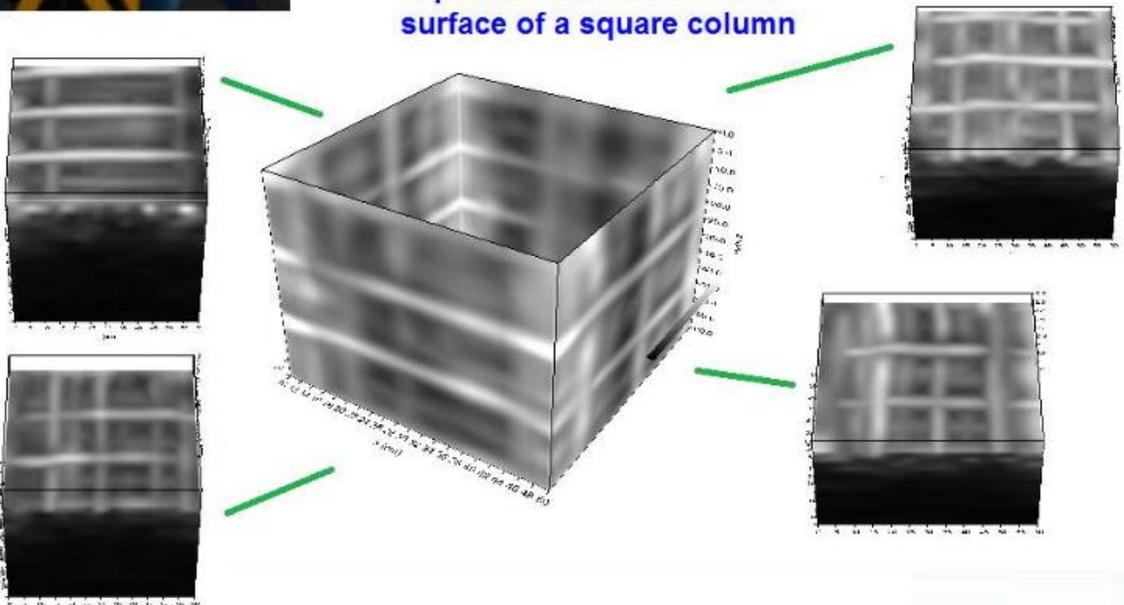


Figure 2. Example of vector volume addition on a GPR survey made on a 4 sided square column (survey data courtesy of Butch Federizon, Geomaster Corp, Philippines)

This new option is not limited to just 4 volumes. The menu can be run several times with the output volumes as input volume to comprise many more locations into a single vector volume. The size of the output volume if areas are separate by large distances can become "intolerable" for volume memory and it is recommended that adjacent areas be used to keep the output volume manageable. The vector volumes are distinguished from our typical volumes in that the z axis is no longer measured in time and the volume is a depth volume. Time axes will not appear in OpenGL for these new vector volume displays.

GPS Listings Spreadsheet

GPS navigation files that are made for each radargram in the information file can be easily accessed using the Show GPS File buttons in both the GPS track menu and in the Edit Info File menu (Figure 3). The GPS data will be presented in a spreadsheet available for additional editing if needed and can be used to quickly identify problem GPS points in the file. The 8 columns shown are the eastings, northings, elevation, time, scan#, gps quality, # of satellites and the HDOP. (GPS navigation files are 20 columns long with columns 9,10, 11 which are reserved for vector scan definitions, and 9 columns leftover for future growth)

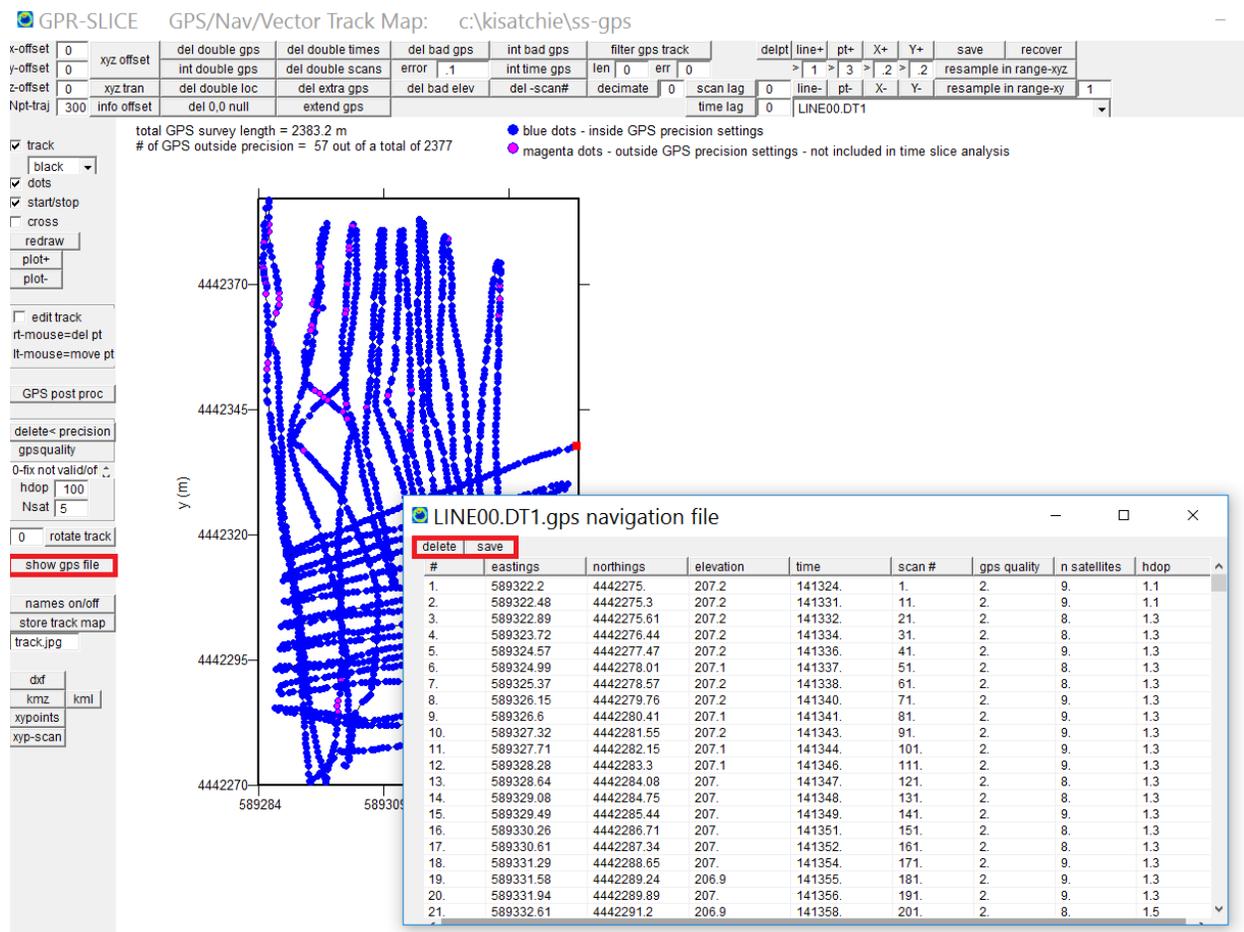


Figure 3. New Show GPS File spreadsheet in the GPS Track Menu.

OpenGL Draw Objects Spreadsheet

Drawn objects in OpenGL Volume Draw can be easily accessed using the new spreadsheet button Edit Objects (Figure 4). The spreadsheet can be used to easily reassign color or width/height/length settings for any object in the list as well as delete objects. A text descriptor to be shown in OpenGL on any point, line node, pipe or rectangle can also be easily added on any object with the new menu.

GPR-SLICE - Open GL Volume Display: lmaxxy3d.dat

helpset focus ccut color up ln0 dn xfm | psp- psp+ lt rt dn up | bmp jpg iso identifier
 0. 0. 0. transp xy v-xfm hrzn net | slow fast make animation beta google kmz
 48. 24. 4.79 lite iso-L 50 iso X Y Z H r-xfm vradar | step- step+ bounce store rot-xy rot-z trajanim. set
 grid2d GPS/xy pt stat export 3D O S R file_001.dzt | clear title Z-solid

save draw_a import
 sect del
 undo redo reset
 dxf dxf- kml
 arrow pgup/dn
 k-length w,q-width
 l,g-height r,e-rotate
 y-tilt
 edit objects

show/hide labels
 style line l to p
 sphere rect. pipe
 diam/width 0.36 in
 length 7.68 in
 height 0.36 in
 set size
 tspoints-off
 xypoints tspoints
 mport xyz tspointgl
 ight-intens. —|—
 ight-azimuti |—|—
 ight-latitude —|—

0.00
 -1.00
 -2.00
 -3.00
 -4.00
 time (ns)
 255
 128
 0

0.00
 2.26
 4.53
 128

Object Listings

#	object	x(n)	y(n)	t(ns)	width	length	height	rotation	tilt	***	color	opacity	descriptor	line width
1	pipe	0.68	17.67	1.08	0.48	77.76	0.11	64.	0.	0.	2.	255.		0
2	pipe	0.	4.4	1.54	0.48	90.24	0.11	117.	0.	0.	2.	255.		0
3	pipe	5.36	0.	1.84	0.22	50.08	0.05	180.	0.	0.	3.	255.		0
4	pipe	13.35	0.	1.84	0.22	50.08	0.05	180.	0.	0.	3.	255.		0
5	pipe	21.26	0.	1.84	0.22	50.08	0.05	180.	0.	0.	3.	255.		0
6	pipe	29.21	0.	1.84	0.22	50.08	0.05	180.	0.	0.	3.	255.		0
7	pipe	37.31	0.	1.84	0.22	50.08	0.05	180.	0.	0.	3.	255.		0
8	pipe	45.75	0.	1.84	0.22	50.08	0.05	180.	0.	0.	3.	255.		0
9	pipe	47.62	19.53	2.31	0.22	100.16	0.05	270.	0.	0.	3.	255.		0
10	pipe	47.81	12.53	2.31	0.22	100.16	0.05	270.	0.	0.	3.	255.		0
11	pipe	48.	3.67	2.31	0.22	100.16	0.05	270.	0.	0.	3.	255.		0
12	linestart	10.46	18.07	0.23	0.72	0.72	0.16	270.	0.	0.	7.	255.		0
13	line	13.99	18.47	0.23	0.72	0.72	0.16	270.	0.	0.	7.	255.		0
14	line	21.56	19.33	0.23	0.72	0.72	0.16	270.	0.	0.	7.	255.		0
15	line	25.54	17.4	0.23	0.72	0.72	0.16	270.	0.	0.	7.	255.		0
16	line	29.48	13.87	0.23	0.72	0.72	0.16	270.	0.	0.	7.	255.		0
17	line	35.25	10.6	0.23	0.72	0.72	0.16	270.	0.	0.	7.	255.		0
18	line	39.71	8.	0.23	0.72	0.72	0.16	270.	0.	0.	7.	255.		0

11 : 12 total points: 40

Figure 4. New Edit Object spreadsheet in OpenGL Volume Draw menu.

Spectra + Gain menu

A new menu called Spectra+Gain is available in the Filter pulldown menu (screen shot 1). This menu allows the user to apply range gain on the radargram pulses real-time with the bandpass filter engaged. The radargram that is displayed will be the instantaneous radargram with the gaining and bandpass applied. The menu can be used as an alternative/addition to removing wobble or the dc offset on the raw radargrams.

For GPR equipment that already have bandpass filtering applied to the raw recorded data, this new menu may not have such a large impact on your processing steps and your final imagery. However, for those surveys where bandpass is not engaged in the GPR control unit and is not recorded into the raw radargrams, this range gain feature set in the Spectra menu, can provide an alternative and perhaps superior method to condition the raw pulses than simple wobble removal. An example of a dataset which appears to be quite noisy – with an extreme dc offset - and was recorded without bandpass filters in the raw data is shown in Figure 5. The raw-ungained pulse (s) show a small offset that when gained without bandpass are completely out of the binary resolution and are clipped (Figure 6). The bandpass application with simultaneous gaining will insure that the raw filtered pulses are within range and the wobble/dc offset removed.

Note: 1) recommendations are to use this new menu with time 0 edited radargrams to avoid FFT (Fast Fourier Transform) wrap around effects that can cause noises above the 0 sample if not removed. This can potentially lead to false definitions of time 0 on processed radargrams.

Note 2) batch gain rather than batch gain - wobble in the convert menus will typically be used without any range gain engaged if the new Spectra + Gain menu will be implemented

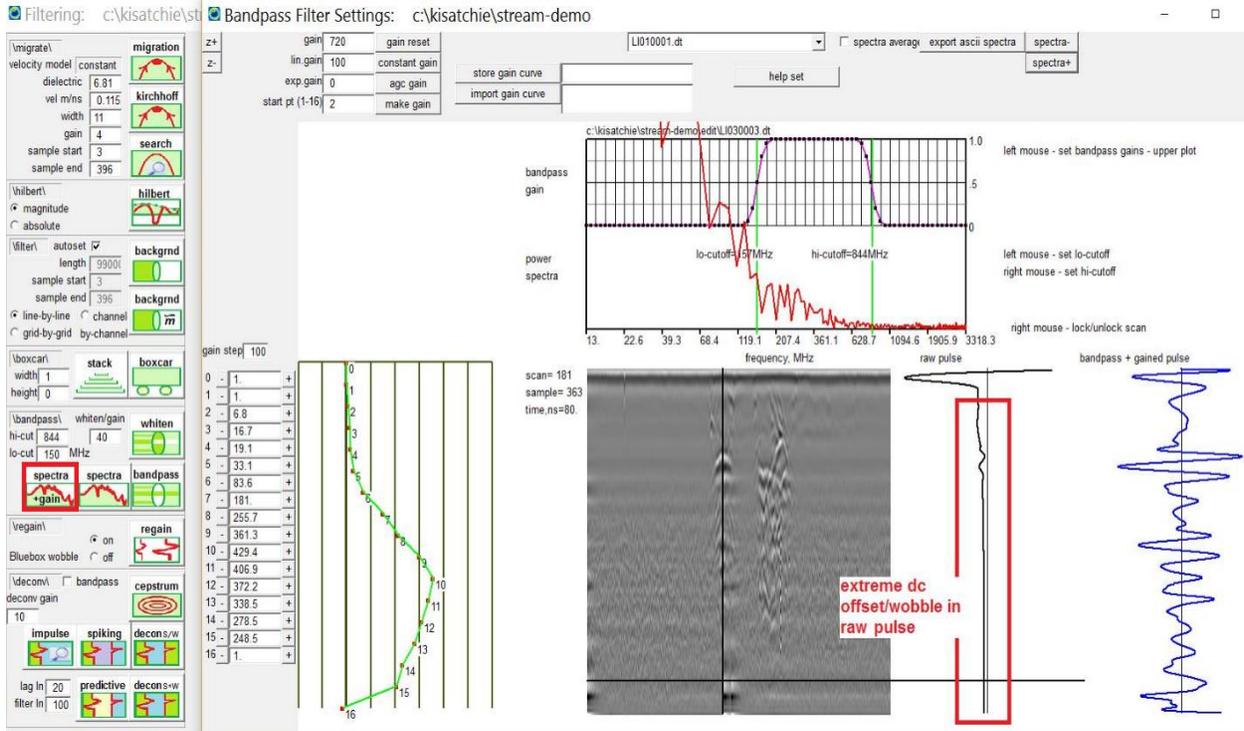


Figure 5. Generation of a range gain curve with application to simultaneous bandpass filtering.

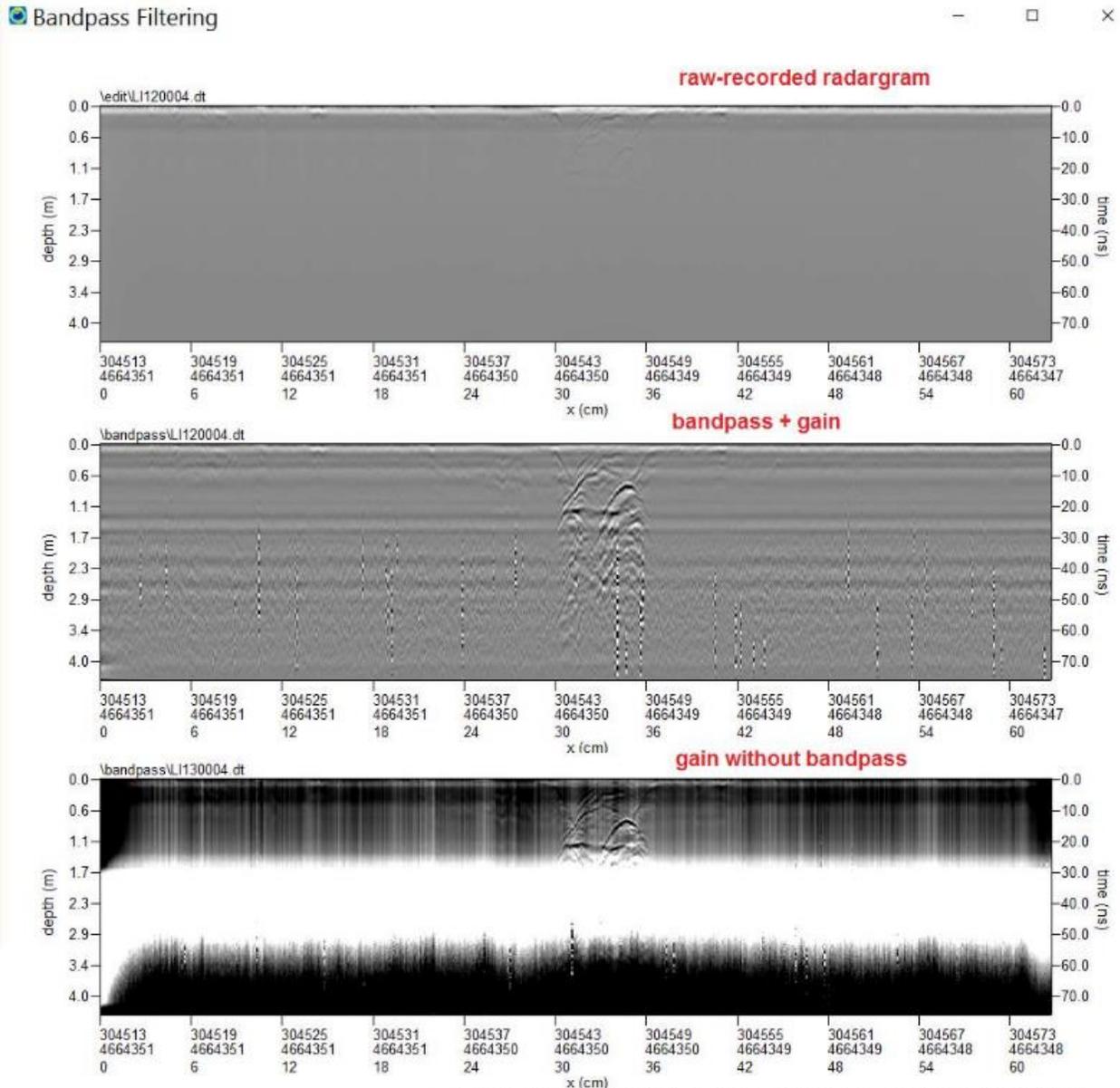


Figure 6. Example of an ungained radargram where bandpass+gain are added simultaneously. A comparison with gain without bandpass filter engaged is shown.

Customizable scan start/end for application of bandpass filters

A new option to apply bandpass filtering just to a set of selective scans in a dataset in which there are severe noise issues, without having to apply the filter across the entire radargram was added to the Filter menu. To

accommodate this request a new flag option - set in the Filter menu will read the XYpoints file to discover those scan sections to apply the customized processing on (screen shot 1). The scan start/end values are set via the XYpoints operation, and should be made consecutively across the radargram. (XYpoints record among other things, the scan # of the chosen anomaly points, which makes this features convenient for providing this specialized feature.

Note: This new option currently requires working with an info.dat file with just the single radargram name for the differential bandpass filtering to be applied to.

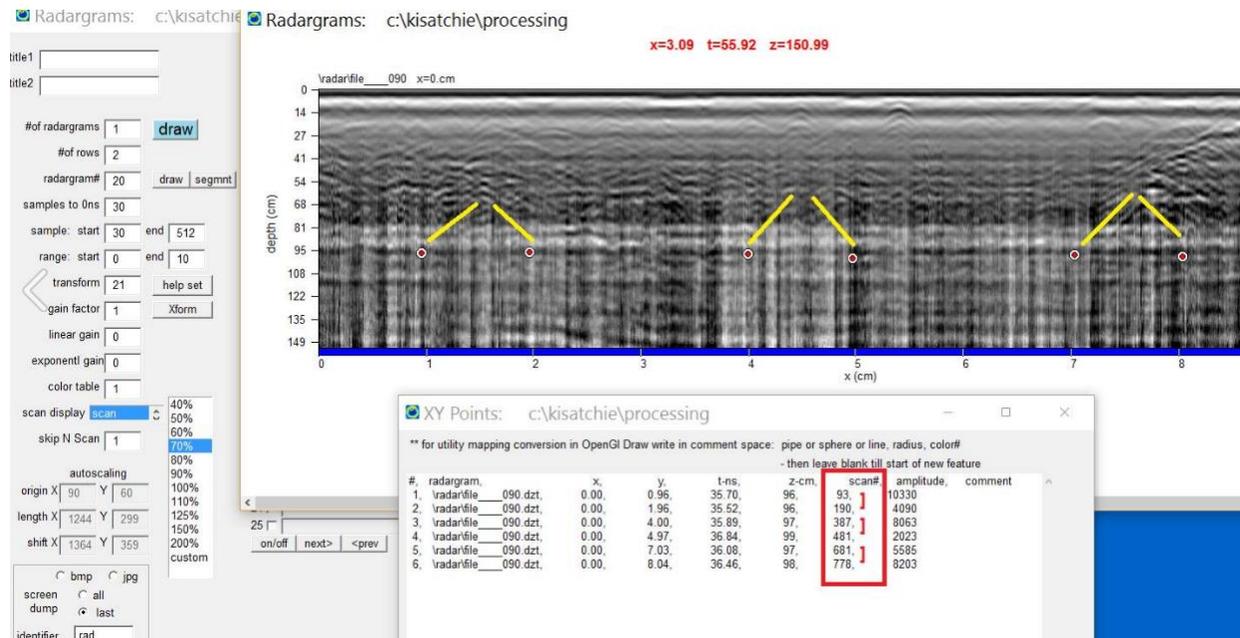


Figure 7. Example of setting consecutive points for application of bandpass filtering using the XYPoints operation (right mouse click on graphic).

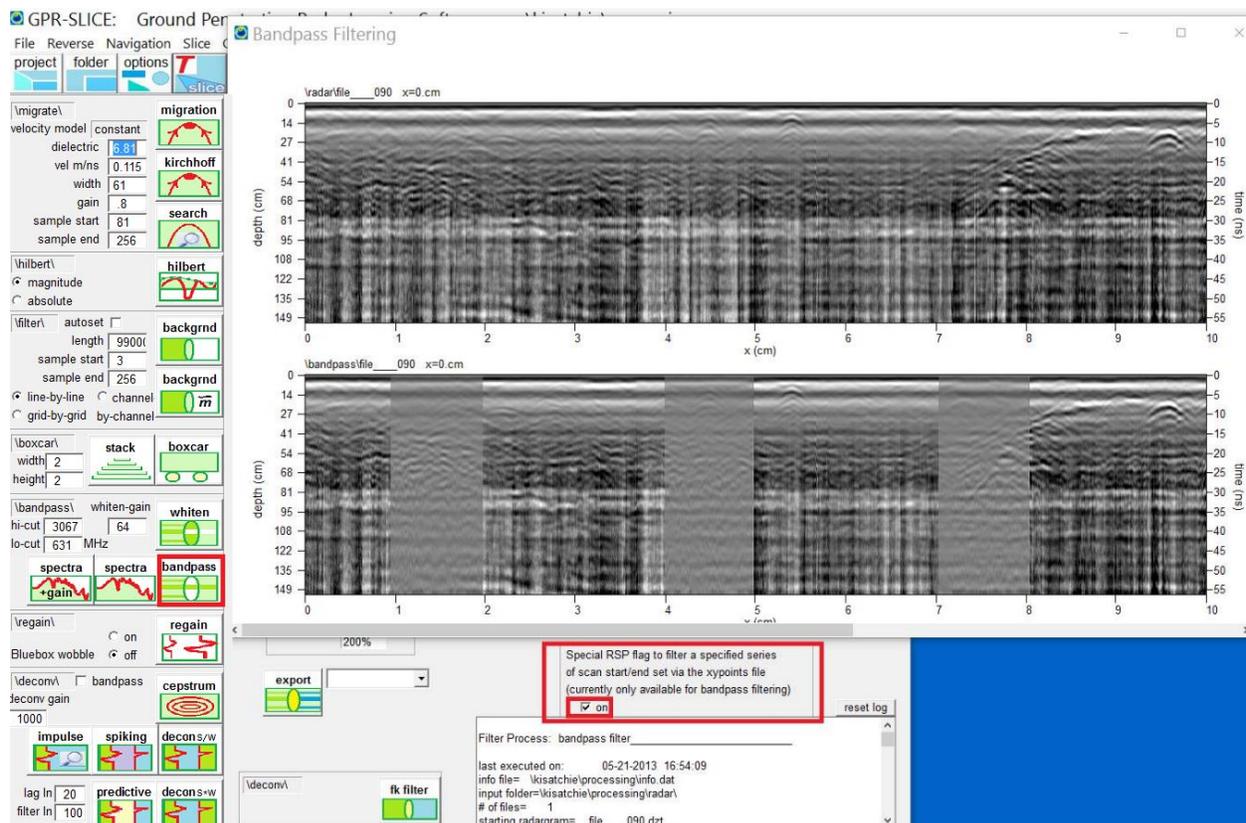


Figure 8. Example of differential bandpass filtering following the XYpoints junctures chosen for the radargram.

DXF Export of Depth from the Local Topographic Surface

In the OpenGL Volume Draw menu a variety of DXF export files are made to accommodate user requests. The latest export option provides a DXF export file that will report the local depth from the local topography for the drawn object (Figure 9). For this option to work, there must have been a topographic grid created that was used to generate the binary corrected topographic radargrams in the project. Anomaly points are then chosen in the 2D radargram menu on the \topo\ folder (Figure 10). With import to OpenGL Volume Draw using the XYpoints button, DXF export will write the absolute depth as well as display the local depth as labels from the ground surface for the anomaly points in AutoCAD.

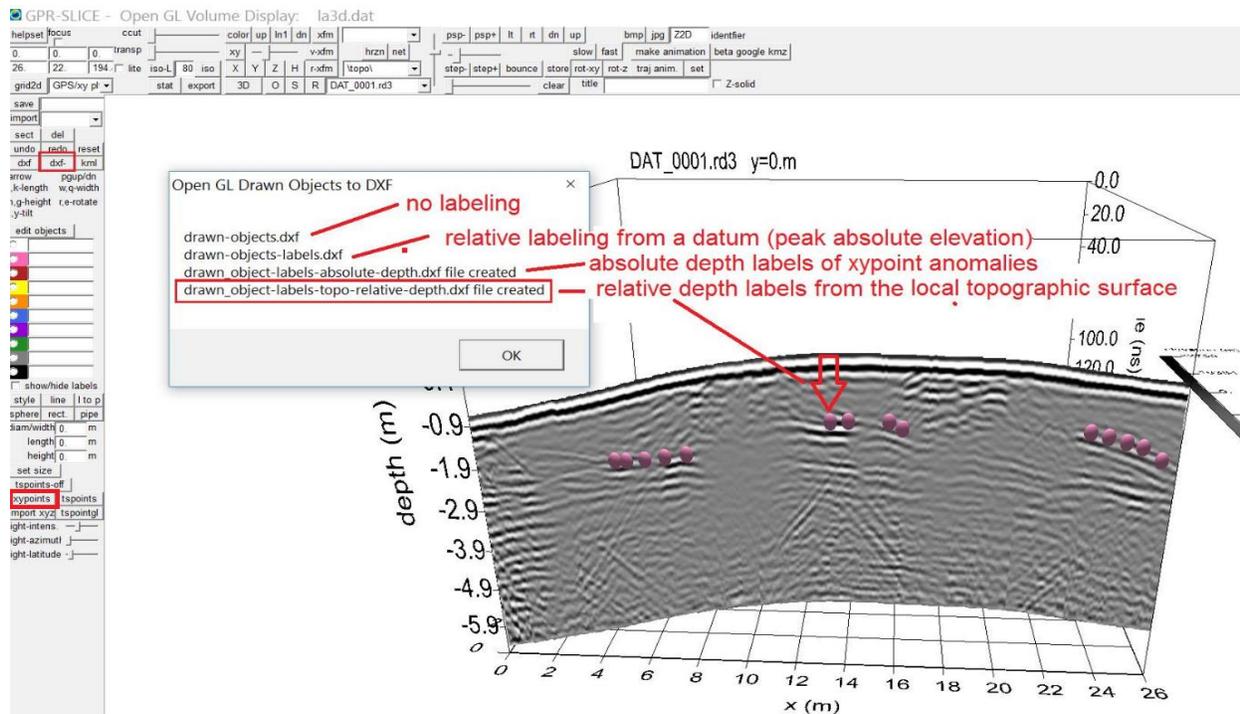


Figure 9. DXF file output w/depth labels from the local topographic surface.

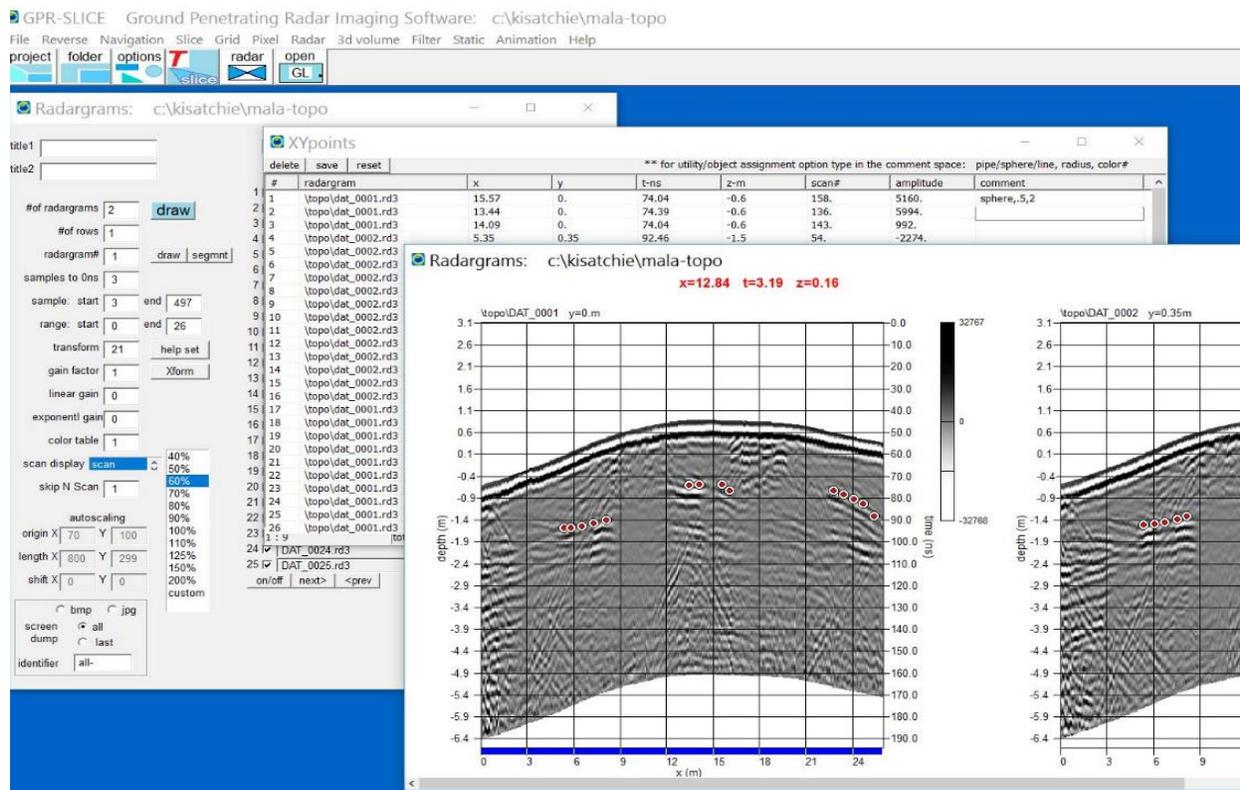


Figure 10. Generation of XYpoints on top of topographically/binary corrected radargrams

Other features and options added to GPR-SLICE include:

- Animation menu and exportable animation enhanced with scale slider bar (1/31/17). GSSI Structure Scan Mini XT format added (1/31/17).
- For colors, the standard American Public Works Association has been set as the default colors for object drawing as requested by several users: <http://www.engineersupply.com/APWA-Utility-Color-Codes.aspx>
- IDS Stream *.gec main track GPS navigation read included in the Edit Info File menu - can substitute for *.geox when used in conjunction with xy channel offsets and Array To Nav operations with infochannels.dat active
- FK radargram 8 bit radargram support added to Filter menu.
- Loza Russian GPR 7 bit to 8 bit radargram support added to Conversion menu.
- Mala Object Mapper beta read included in Create New Info menu
- Transient Technologies of the Ukraine GPR equipment format added to Conversion menu. GPS distance added to horizon export file (12/29/16).
- Closest point of approach calculation made on horizon core GPS location for display on a 2D GPS radaragram display.
- Triple labeling in OpenGL with zscan#, time and depth.
- 4 corner ESRI world file designation for local grid georeferencing added to Pixel Map menu
- XYZ to NAV import option in the the Edit Info File menu enhanced to include vector calculations from the x and y import navigation for assuming horizontal application of the antenna where it is normal to the z plane (e.g. horizontal) (12/6/16).
- Spiking - deterministic deconvolution, spectral wavelet-signal convolution deconvolution and beta predictive deconvolution added to the Filter menu
- Batch preview graphic shutoff on FK filtering added to significantly speed up processing 10-20 times faster.
- Limitation in FK radargram filtering removed so that radargrams of different lengths can be processed with the same FK filter in batch processing - all data resampled to the longest radargram in the project.
- Draw_track.dat layer creation added to OpenGL Volume Draw menu to create a separate GPS/XY track object file that can be appended to the drawn object file.

- Explicit time window/depth window radio button for time slice labeling option in the Pixel Maps added to Options menu (11/7/16).
- APWA American Public Works Association recommended color designations for underground utilities/surveys/excavations/sewers/water/reclaimed water/communications/gas/electric set as the default colors in OpenGL Volume Draw menu.
- OpenGL Volume XY element skip option to allow display of super large volumes - setting added to the Options menu
- OpenGL Volume Draw menu kml exports now also includes sphere objects which will translate into Google Earth pushpin displays.
- GPR-SLICE time/depth/velocity labeling generalized to be able to handle GPR or Seismic datasets - time and depth units set in the Options menu.
- Delete 0,0 null navigation points added to GPS Track menu.
- Scan stacking/decimation added to Filter menu - currently available only for GPS/vector radargrams.
- GPR-SLICE Animation Menu - internal and the export menu- updated for auto-resizing to the dialog size along with vector graphic resizing for cleaner scaling. `Binary radargram appending in the Radar Edit menu will now include associated GPS log files.
- SEG-2 IEEE 32 bit format added to convert menu.
- BlueBox Run Regain menu wobble option added - useful for surveys where time 0 corrections are done.
- OpenGL Speed option for skipping scans on over sampled radargrams and improving display speed, added to the Options menu.
- Re-export of *.sgy, *.dzt, *.rd3, *.dt1, *.dt processed GPR-SLICE radargrams back to original manufacturer's file format available in the Filter menu.
- Improved filtering of bad GPS removing the top 10% and bottom 10% of readings to discover a better average and to remove GPS points a desired distance error from the average.
- Subscribers Only page launch to check the update version available on the Help menu.
- Boxcar radargram filter reengineered to be able to handle super large radargrams > 500k scan and for increased processing speed.
- Auto arrange dialog button added to XYpoints operation for GPS radargrams with the sync GPS track plot active.

We are accepting sponsorship for the next GPR-SLICE 2-day workshop. If there are any universities or organizations that are interested in hosting the next GPR-SLICE workshop that can handle up to 30 attendees, please let us know. The dates for the workshop are flexible and would be based on the level of interest.

Facebook Forum

The Facebook Forum for GPR-SLICE has been actively used and is a useful resource for finding more in-depth answers and discussion on relevant GPR-SLICE software topics. All the new options have been first introduced in the Facebook forum for GPR-SLICE right at the time they were developed and released. If you have not yet joined the GPR-SLICE Facebook page, I would encourage you to do so at:

<https://www.facebook.com/groups/gpr.slice/>

Dean Goodman
GPR-SLICE Software

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