DAY 2:

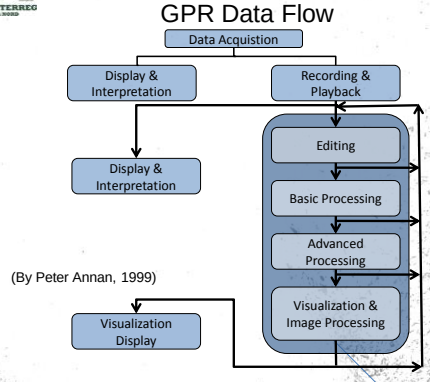
MARA NORD PROJECT-TRAINING 2010

LESSON 12: GPR DATA PROCESSING, NECESSARY PREPROCESSING TECHNIQUES, PROCESSING TECHNIQUES, BASIC FILTERING ETC.

GPR Data Handling Process

- Modern radars save data usually as raw data to keep the maximum dynamic range and processing possibilities
- The real-time display with basic processing is used for data quality validation and sometimes for real-time interpretation (utility lines, landmine detection, etc.)
- DMI-distance and GPS-positioning need calibration and correction
- Measuring configuration can be complicated and hard or impossible to handle in real-time

GPR Data Flow



(By Peter Annan, 1999)

Editing GPR Data

Data Editing keeps the data information content intact

- Separation of simultaneously measured channels
- Reversing the direction of profile measurements
- Removing sections with measurement failures (especially when measurements are triggered using a timer)
- Muting and interpolating noisy traces
- Cutting data or road sections
- Merging measurements
- Evening the length and/or the scale of the measured profile
- Data zero level correction (static shift)
- Attaching co-ordinate information to measurements
- Possible data header updates

GPR Data Processing

- The purpose of signal processing is to strengthen and to enhance information essential to the interpretation
- What is significant for one survey may be insignificant for another → the extra information may be interference and can be removed
- Special care must be taken not to "over-process" signals or perform operations, which the operator does not understand
- Most processing can be done as on-line processing without need to create new files in fast modern computers
- The processing should be kept simple → for large projects processing may take a lot of time and lengthen the start of interpretation
- The processing operations must be documented!

Basic GPR Data Processing

- DC-level removal
- High and low Pass vertical filtering → high frequency noise reduction, low frequency signal wowing (time domain or FFT-filtering
- Spatial (horisontal) high pass filtering reduces horizontal noise (moving background removal)
- Spatial (horisontal) low pass filtering averages traces and reduces high frequency noise
- Signal amplification gains the signal to compensate the signal attenuation in the ground → automatic, linear, exponential gain correction
- Constant background removal
- Arithmetic operations: multiplication, constant amplitude shift, gradient calculation

Basic GPR data processing for air-coupled antenna

- Air coupled antenna data editing is the same as for ground coupled
- Antenna bouncing removal → flattens the surface
- Antenna surface reflection removal → increases the surface resolution by substracting the scaled metal plate reflection from data
- Reading the surface reflection amplitude
- Calculation of the surface layer Er-value
- Metal pulse must measured for each of the measurement

Advanced GPR Data Processing

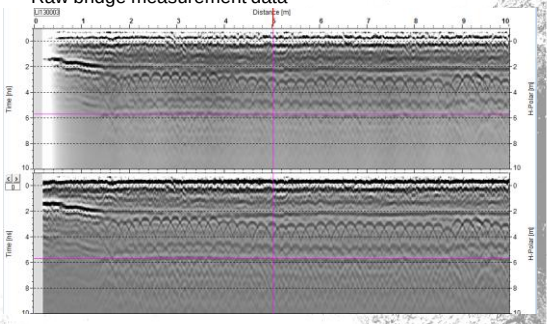
- Data content is changed considerably and operations usually take longer time
- Migration: focuses reflections from hyperbolas to originating points and correct positions of sloping interfaces
- Hilbert transform: tells about the amplitude resolution or frequency content of the signal
- F-K –filtering: enables removal of sloping interferences (the same for diagonal-filtering)
- Deconvolution: compresses the signal and removes reverberations (← sensible to noise)
- Matched filtering: data is matched (cross-correlated) with measured ideal reflection and points of maximum correlation are shown

GPR Data Image Processing

- The quickest way to manipulate GPR data is by changing colours or colour transforms
- Colour transform tells what signal level corresponds each colour
- Non-linear colour transforms correspond signal gaining without changing actual data
- Different colour palettes emphasize different features: gray scales highlight layer continuity, multicolour palettes highlight amplitude variations

Sample of GPR Processing

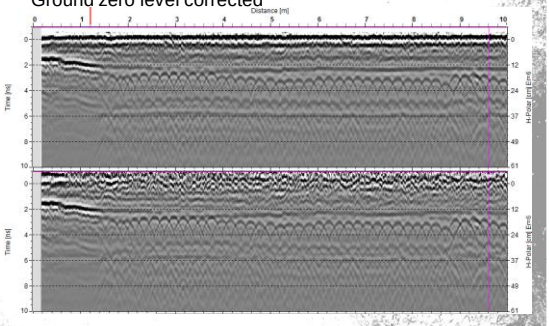
Raw bridge measurement data



Vertical time-domain high pass filtered, HP=700MHz

Sample of GPR Processing

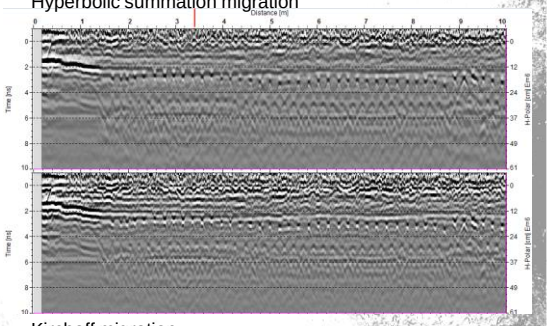
Ground zero level corrected



Horizontal high pass 2000 traces

Sample of GPR Processing

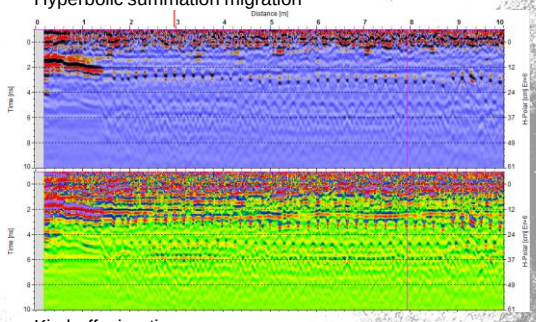
Hyperbolic summation migration



Kirchoff migration

Sample of GPR Processing

Hyperbolic summation migration



Kirchoff migration

Processed air-coupled antenna data