GeoEel SEG-D Integration Test

Portable Validation Tool for Seismic Data Delivery

Version 1.1 | January 2026

IMPORTANT: Simulated Timing
This demonstrator uses **simulated shot timing**. Files are delivered at fixed intervals, NOT synchronized to actual sparker firing. For production integration, a hardware timebreak signal (serial RTS or trigger string) must be connected to synchronize file delivery with real shots.

Quick Start

1 Launch the Application

Double-click `GeoEelTest.exe` (no installation required)

2 Check Timebreak Status

The traffic light indicator shows sync status: 🔴 Red = No timebreak

3 Select Test Type

Choose "Basic Validation" for a quick check, or "Timed Delivery" for full simulation

4 Click Start Test

Watch the progress and results in real-time

Overview

This tool validates the delivery of SEG-D seismic data files from the UWB-RTK acoustic hydrophone system to GeoEel acquisition hardware. It generates synthetic sparker signatures, validates file format compliance, and simulates timed file delivery at configurable shot intervals.

Timebreak Status Indicator

The application displays a traffic light indicator in the title bar and on the Timing/Sync tab showing the current shot synchronization status:

Indicator	Status	Meaning
🔴 Red	NO TIMEBREAK	No serial trigger connected - using simulated timing only
🟡 Yellow	WAITING / TIMEOUT	Serial connected but no triggers received recently (>10s)
🟢 Green	TIMEBREAK OK	Receiving trigger signals from sparker firing system

> **For Production Use:** The traffic light should be GREEN before running tests that need to correlate with actual shot points. A RED indicator means timing will be simulated and may not match real acquisition timing.

System Requirements

Requirement	Specification
Operating System	Windows 10 or Windows 11

Disk Space	~50 MB for test data
Network	Optional - for testing with real GeoEel share
Serial Port	Optional - for timebreak synchronization (RS-232 or USB-Serial)
pyserial	Optional - install with `pip install pyserial` for serial trigger support

Application Tabs

1. Network Setup Tab

Configure network connection to GeoEel:

- **Network Information:** Displays local IP, subnet, gateway, DHCP status
- **Manual Entry:** Enter GeoEel IP/hostname and share name directly
- **Network Scan:** Automatically scan subnet for SMB shares (port 445)
- **Discovered Shares:** Lists found hosts with their available shares

Click "Use Selected Share as Target" to set the discovered share as the file delivery destination.

2. Timing / Sync Tab

Configure shot synchronization and test network latency:

Timebreak Status

Large traffic light display showing current trigger status, with trigger count and last trigger timestamp.

Serial Timebreak Configuration

Connect to a serial port to receive trigger signals from the sparker firing system:

Setting	Description
Serial Port	`COM port connected to trigger source (e.g., COM1, COM3)`
Trigger Type: RTS/CTS	`Hardware handshake line - detects rising edge on CTS (connected to source RTS)`
Trigger Type: String	`Character or string trigger (e.g., "T" sent at each shot)`

File Detection Latency Test

Measures how quickly files can be detected on the target directory. This is critical for network shares where SMB caching can introduce delays. Run this test to characterize your network path before relying on file-based synchronization.

- **Samples:** Number of test files to place and detect (default: 10)
- **Results:** Shows placement time, detection time, and total latency (min/max/avg)

3. Configuration Tab

Adjust test parameters before running:

Parameter	Default	Description
Number of Shots	`10`	Files to generate and deliver
Shot Interval	`2.0 sec`	Time between file deliveries (typical marine: 6 sec)
Channels	`24`	Number of hydrophone channels per file
Sample Rate	`48000 Hz`	Audio sample rate
QC Window	`50 ms`	Short capture for real-time quality control
Decon Window	`500 ms`	Full signature for deconvolution processing
Energy	`1000 J`	Sparker energy (affects signature shape)
Target Directory	`./geoeel_input`	Where files are delivered (can be network share)

> **Tip:** Click "Save Config" to preserve your settings, or "Load Config" to restore previous configurations.

4. Run Tests Tab

The main interface for running tests:

- **Test Selection:** Choose Basic, Timed, or All tests

- **Progress Bar:** Shows current test progress
- **Start/Stop Buttons:** Control test execution
- **Log Output:** Real-time status messages with color coding:
  - Green = PASS
  - Red = ERROR
  - Orange = WARNING

5. Results Tab

View detailed results after test completion:

- **Summary:** Overall pass/fail status and key metrics
- **Detailed Results:** Full JSON output for analysis
- **Export:** Save results to file for reporting

Test Types

Basic Validation Test

Generates synthetic SEG-D files and validates their structure. This test verifies:

- SEG-D Rev 3.1 header compliance (General Headers, Channel Set Headers)
- BCD encoding validity in header fields
- Trace header and data structure
- Data integrity (no NaN or Inf values)

Timed Delivery Test

Simulates real-time file delivery at shot intervals:

- Delivers files using atomic write pattern (.tmp → .segd rename)
- Monitors target directory for incoming files
- Validates each file on arrival
- Measures processing time per file

> **Note:** The Timed Delivery test uses simulated intervals, NOT actual shot triggers. File timestamps will be based on the configured shot interval, not

real sparker firing times. For production, connect a serial timebreak signal and verify the traffic light is GREEN.

Testing with Real GeoEel Hardware

1 Connect Network

Use the Network Setup tab to scan for or manually enter the GeoEel CNT-2 input share.

2 Run Latency Test

On the Timing/Sync tab, run a latency test to measure file detection time on the network share.

3 Connect Timebreak (Optional)

If available, connect the serial trigger from the sparker controller. Select the COM port and trigger type, then click Connect. The traffic light should turn YELLOW (waiting) then GREEN when triggers are received.

4 Run Timed Delivery Test

Select "Timed Delivery" and click Start. Files will be delivered to the GeoEel share.

5 Verify on GeoEel

Check the CNT-2 software to confirm files appear in the import queue and data displays correctly.

Success Criteria

Metric	Pass Condition	Notes
File Validation	All files pass	

		Header structure and data integrity
Files Received	100% of delivered files	No missing files
Processing Time	< 500 ms per file	Validation must complete quickly
Network Latency	< 100 ms typical	File detection on network share

> **Overall Result: PASS** means all files were generated, delivered, and validated successfully within timing requirements.

Troubleshooting

Issue	Possible Cause	Solution
"File not found" errors	Target directory doesn't exist	Create the directory or check path spelling
Files missing	Network latency or antivirus	Increase shot interval; add exclusion for test directories
Slow processing warnings	Disk I/O or network bottleneck	Use local directory; check network speed; run latency test
Application won't start	Windows Defender blocking	Right-click → Properties → Unblock
Serial not available	pyserial not installed	Run: `pip install pyserial`
Traffic light stays RED	No serial trigger connected	Connect serial cable and click Connect button

Traffic light YELLOW timeout	No triggers received for >10s	Check trigger source is firing; verify cable connection
High network latency	SMB caching or slow network	Use wired connection; check SMB settings; consider local staging

SEG-D File Format Reference

Generated files comply with **SEG-D Revision 3.1** (October 2015):

- **Format Code:** 8058 (32-bit IEEE floating point)
- **Byte Order:** Big-endian
- **Header Encoding:** Binary Coded Decimal (BCD)

Header Block	Size	Contents
General Header 1	32 bytes	File number, format code, timestamp
General Header 2	32 bytes	SEG-D revision, extended fields
Channel Set Header	32 bytes	Channel count, filters, sample rate
Trace Header	20 bytes	Trace number, timing
Trace Header Extension	32 bytes	Sample count, geometry
Trace Data	Variable	IEEE float samples, big-endian