CleanHarbors
EXPLORATION SERVICES

nextGEN
ACCUSTACKER

NAVIGATION TECHNOLOGIES

NEXTGEN ACCUSTACKER

Surveying in Challenging GNSS Environments with Inertial Navigation Systems

Daniel Woodhouse BSc, P. Eng
Geomatics Development Manager

Presentation Design: Royal Bissell

Clean Harbors

Provider of Environmental, Energy and Industrial Services

NYSE:CLH

$3.4B Market Cap

10,000 employees North America Wide

HQ: Norwell, MA

Exploration Division

Provides frontend services to the Seismic Industry

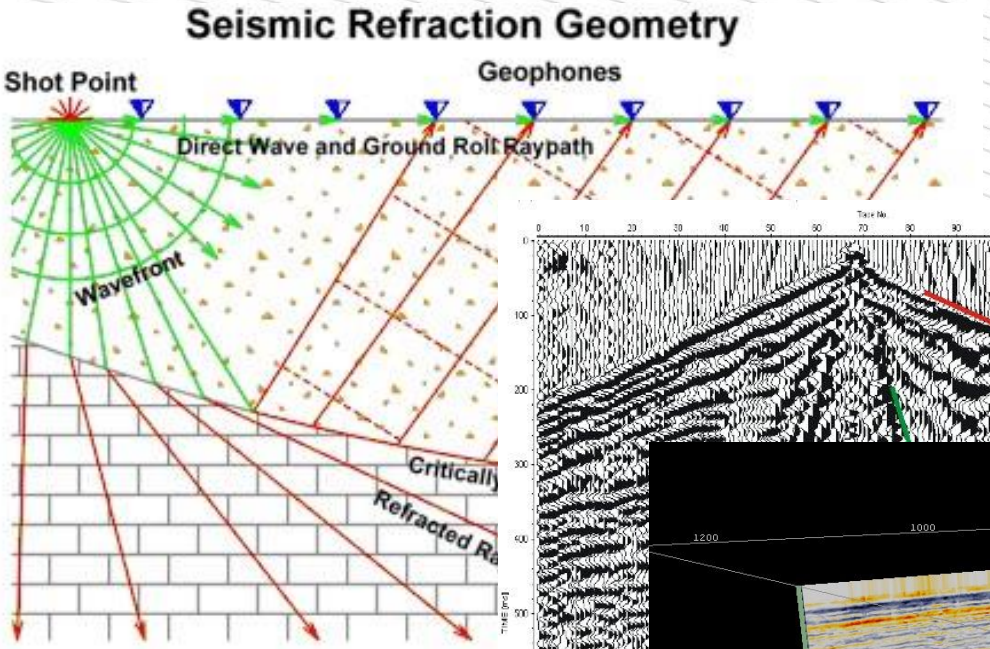
- Survey and Mapping
- Line Clearing
- Drilling
- Locating

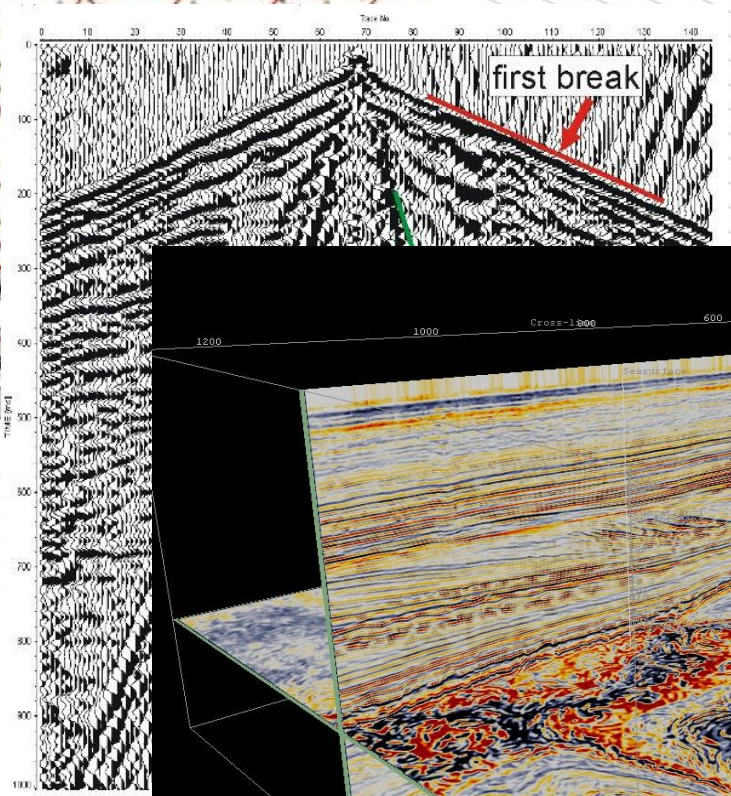
NavTech Group

Provides custom, high-precision navigation and survey solutions for seismic vehicles

SESIMIC EXPLORATION

What is it?

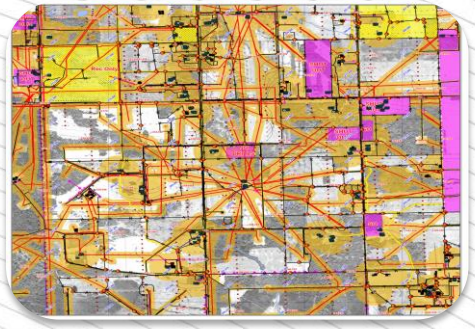




CLEAN HARBORS EXPLORATION

What We Do

Line Clearing



Survey and Mapping

Seismic Drilling

Buried Utility Locating

NAVIGATION TECHNOLOGIES

Addressing the Challenge

Survey

Drilling

STAKELESS DRILLING

Let’s ocess!

STAKELESS DRILL SURVEY

STAKELESS DRILLING

Land: AccuStacker Challenges

Dense Canopy

- High attenuation of GNSS signals. Positions require long observations
- GNSS only navigation is impossible

Drill Stem Location

- Survey location needs to be at drill bit, within 0.50 m 3D
- Vehicle has non-zero pitch and roll

Vehicle Functions

- Sense the state of the vehicle
- Safely disable RF transmission

STAKELESS DRILLING

Air: AccuDrill Challenges

GNSS Blockage

- 60 cm wide metal blades “chop up” GNSS signal.
- Moved antenna to tail, but now 8m offset from hook

High Dynamics

- Aircraft pitch and rolls SIGNIFICANTLY during landing of equipment
- Banking during flight loses tracking on SVs

Automatic Surveying

- Must not distract pilot from his job: Flying, not surveying
- Position must be within 0.50 m vertically and 2.0 m horizontally

INERTIAL NAVIGATION SYSTEMS

True Synergy

Global Navigation Satellite System
- GPS
- GLONASS
- Etc...

Inertial Measurement Unit
- Fiber Optic Gyro (FOG)
- Ring Laser Gyro (RLG)
- Microelectromechanical (MEMS)

Tightly Coupled

Weak
fron

Completely self contained

No He

3-Axis Attitude

Subject to
and
Noise

Absolute Position (X,Y,Z)

tive
n only

Very Accurate (cm level)

NEXTGEN ACCUSTACKER

Features

Inertial Navigation

- Full GNSS constellations (GPS and GLONASS)
- Tightly coupled inertial navigation system (INS)
- Dual antenna heading (NovAtel Align™)
- Wide range of supported IMUs

Hardware

- Robust Hardware Design
- Improved RF Network (Pseudo Cell Network)
- API runs NavTech's own proprietary CANBus interface
- Multiple voltage sensor inputs
- NMEA output, 1 PPS, 7A switched relay
- Hardware Independence

Software

- Full-feature moving map and navigation
- Carmenta mapping engine with OpenGL hardware rendering
- QT API for rapid development turnaround
- Hazard avoidance

STAKELESS DRILLING

Advantages

Safety	Environment	Quality
• Reduced risk exposure for crews • Accurate position on shot holes requiring reclamation • Known distance to water wells and structures • Hazard avoidance	• Significantly reduces the use of flagging and lath • Avoid Pipelines, unpermitted land, water wells, wildlife habitats, etc. • One pass over agricultural land	• Increased accuracy • As-Drilled survey • Eliminates “missing” shot points

Thank You

Questions?