



**Introduction to INROCK Drilling and HDD guidance technologies and tooling**  
*Lorenzo Pratico, Inrock International Ltd, UK*



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Introduction to INROCK

- Started in 1993, headquartered in Houston, Texas, since 2018 merged by Sandvik group
- Focused exclusively on the development and sale of products and services dedicated to the Horizontal Directional Drilling ("HDD") market
- Approximately 80 employees worldwide across offices in Texas-Houston, Canada - Edmonton and Europe - UK.
- Long historical partnership with Sandvik
  - + Distributor of rotary products for over 15 years
  - + Acquired in July of 2018



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INTRODUCTION TO INROCK DRILLING AND GUIDANCE TOOLING – TRENCHLESS MIDDLE EAST 2021



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Lorenzo Pratico BSc, Dipl. Geotechnical Eng.  
Operations Manager at INROCK INTERNATIONAL, and have been working in the HDD industry since 2002.



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Pilot hole tooling

Mud Motors

- Motor Sizes ranging from 3.5-3/4" to 9" S&P
- Side or front
- Access to market leading technology
- Motors modified to meet HDD demands
- INROCK controls service & repair functions



Drill Bits

- Supplied by Sandvik, Rotary or third parties as appropriate
- INROCK helps clients select bits for specific applications
- Predominantly roller cone, some PDC applications
- Provide bits at multiple price points
- Multiple R&D projects underway targeting M&E market



Air Hammers

- HDD specific hammer system
- Small rig tool, runs in place of mud motor
- Have pioneered the ability to combine with sensitive casing service
- Price & performance advantage
- R&D initiatives underway



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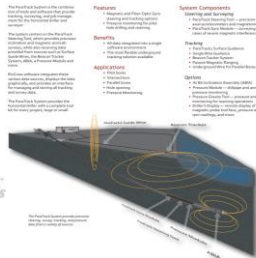
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Pilot Hole Guidance - ParaTrack System

ParaTrack is the main steering tool sold and used by Inrock. Manufactured by Vector Magnetics in the USA, it is an AC steering and tracking system with proven accuracy. It is used widely throughout the world, having achieved thousands of crossings with success.



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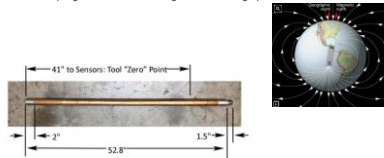
Benefits of ParaTrack

- Greater surveying precision
  - 0.1 Deg readings.
  - ParaTrack Coil >2% accuracy.
- Can steer to tighter tolerances than Walkover Tracking systems.
- Greater control in curved bores.
- Enhanced borehole radius control
  - "Smoother" bores - reduces stress on: Client product pipe, Drill Pipe, Rock Reamer Tooling
  - Reduces torque.
  - Not depth limited like Walkover systems.
  - Longer deeper bores possible.
- The most significant benefit of using ParaTrack is in its versatility. Many different types of tracking systems can be used alongside a ParaTrack steering tool, making it a system adaptable to almost any drilling job



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The ParaTrack Probe is the measuring device designed primarily to provide software with information about the alternating magnetic fields produced by a variety of sources (e.g. guide wire, BTS, etc.). It also reports its own inclination, temperature, and Earth's field data (magnetic azimuth and magnetic field strength).



**Wireline used to power the downhole probe and to send data to surface.**

For the purposes of the ParaTrack™ steering tool and most wireline steering the answer is still yes.

- Consensus remains that the drill wire to the probe, remains an efficient and relatively quick method of powering down hole electronics and a convenient conduit for high data rate telemetry.
- Wireless transmission can lead to the introduction of interference on telemetry leading to loss of signal.



*Magnetic Wire line Steering tools*



**What are they ?**

MWLSST tools like ParaTrack are a directional guidance system with magnetometers and accelerometers situated in 1-3/4" OD pressure barrel, that provides real time positioning of the borehole. The probe barrel is then located downhole in special non magnetic drill collars as part of a downhole drilling assembly.



**Steering Tool Interface Unit**



- The Steering Tool Interface unit provides the power control to the probe , probe signal demodulating and the interface circuitry.

### Driller Display – 2 Options



Tablet display – E.g. IPAD  
Toolface  
Directional Data  
Downhole Pressure data.



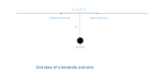
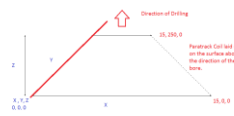
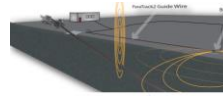
Simple LCD Display  
Toolface & Directional  
information only



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### How does ParaTrack work?

ParaTrack Coils are laid out on the surface of the ground using light gauge 6mm wire. The coil is land surveyed and coordinates of the coil are entered into the ParaTrack software. When drilling of drill pipe is finished the coils is energised with low 3 Hertz AC current, that creates an artificial magnetic field that is sensed by the downhole probe.

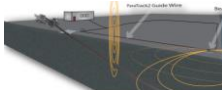


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### Guide Wire Power Supply



7 amps maximum peak to peak, and 46 volt



The Guide Power Supply is required to provide AC current to the guide wire/ coil when using Paratrack 2.

The Guide Wire is connected to the outputs on the front of the Power Supply. Polarity does not matter.



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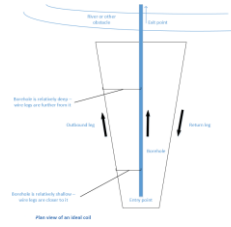


ParaTrack  
Coil data  
inputted into  
the RivCross  
Software



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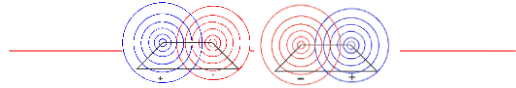
Plan of an Ideal ParaTrack Coil



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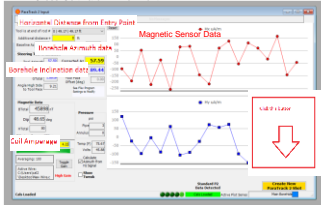
To visualize the effects of the coil when a magnetic field is applied, examine the following diagram.



An AC Current is applied to the coil and a magnetic field is generated. When the current is reversed automatically every 3 Hz the opposite magnetic field is generated.

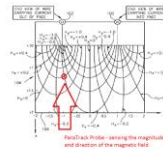
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RivCross Software Environment



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Cross section of magnetic fields in the ground, generated by the ParaTrack Coil



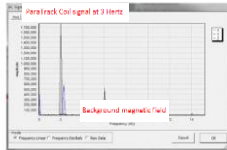
The amount of signal detected by the survey probe is proportional to the current provided by the Guide Power Supply & inversely proportional to the distance between the probe and the wire.



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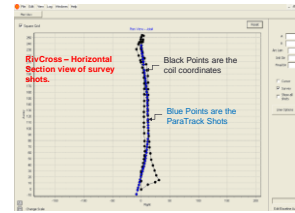
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What does the coil signal look like?



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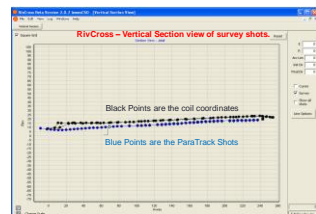
Survey Shot Data Table

Shot	Shot ID	Shot Type	Shot Date	Shot Time	Shot Location	Shot Depth	Shot Status	Shot Notes
1	10001	ParaTrack	2022-01-14	10:00:00	10001	10001	OK	
2	10002	ParaTrack	2022-01-14	10:00:05	10002	10002	OK	
3	10003	ParaTrack	2022-01-14	10:00:10	10003	10003	OK	
4	10004	ParaTrack	2022-01-14	10:00:15	10004	10004	OK	
5	10005	ParaTrack	2022-01-14	10:00:20	10005	10005	OK	
6	10006	ParaTrack	2022-01-14	10:00:25	10006	10006	OK	
7	10007	ParaTrack	2022-01-14	10:00:30	10007	10007	OK	
8	10008	ParaTrack	2022-01-14	10:00:35	10008	10008	OK	
9	10009	ParaTrack	2022-01-14	10:00:40	10009	10009	OK	
10	10010	ParaTrack	2022-01-14	10:00:45	10010	10010	OK	



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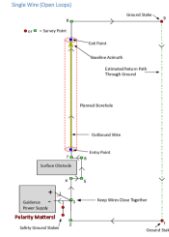
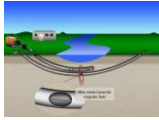


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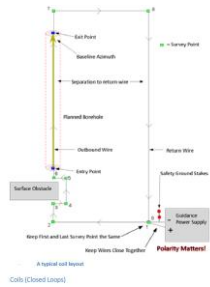
Another usual situation where PT can be really useful is the parallel drilling-  
**Precision underground tracking in tight-tolerance right of ways**

ParaTrack makes these challenging crossings possible by allowing real time positional tracking of the proximity between the bore you're in, and the bore you need to follow.

Running a wire through the existing bore or pipeline, end to end, and electrifying that wire for tracking from the Vector Magnetics probe in the drilling.



Single Wire



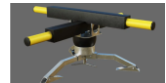
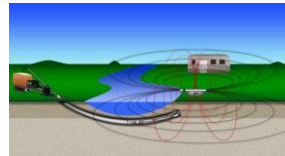
Closed Loop Coil



Beacon Tracking System- Tracking across obstacles. (Optional Extra).



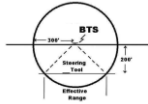
The Beacon Tracker System (BTS) accurately measures the location of the PT Tool without use of a guide wire. The BTS consists of two perpendicular solenoids labelled 'Away and Right'. The 'Away solenoid' is aligned with borehole azimuth and surveyed in position. Radio modems provide two-way communication, eliminating the need for direct connection between BTS and the computer running RivCross. An example of where this would be used is a larger River.



Beacon Tracking System - Tracking across obstacles.



Tripod base - Waterproof Hand Held Controller with all electronics. This has a built in 2.4GHz modem for communication/control at the computer running RivCross and buttons for manual operation. - 3 cables to connect Tripod BTS



Range - 91 metres



Smart Mud Motor Technology - AI Bit Inclusion Assembly ("ABIA")

- ABIA Tool Bar measures inclination readings directly behind the bit
- Accelerometers located in manifold of mud motor, sends data to ParaTrack 2 probe via low frequency magnetic.
- The AI-Bit Inclusion Assembly (ABIA) measures the inclination of the bit bar. With ABIA, the driller can detect changes in inclination of the bit that often correlate with changes in drilling responses. This is critical information to help determine what is causing that change - for example, when drilling from one formation into another. Identifying changes in inclination while drilling helps the driller and surveyor to assess the risk of getting stuck or losing off.
- Because the ABIA reports inclination at the bit, the surveyor and driller can take corrective action immediately if ABIA reports an unexpected change in inclination. This eliminates waiting time and avoids potential errors from having to drill ahead to get a survey probe to reach the same MD.
- Typical applications
  - Fractured formations or zones with formation changes
  - Tight radial zones.

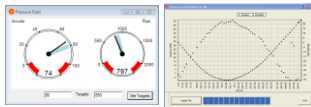


Downhole Pressure monitoring - Optional Extra



The Vector Magnetics ParaTrack Tool (PT Tool) is available with an optional Pressure Sensor setup that can be used to monitor pipe and annular pressure. It consists of a Pressure Module, which connects directly to the PT Tool, and a Pressure/Orienting Sub that connects to the Pressure Module.

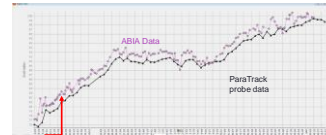
Pressure Data and Survey Data can be exported for use in Excel or AutoCAD.



Smart Mud Motor Technology - AI Bit Inclusion Assembly ("ABIA")



Comparison of ABIA data and Survey Probe data.

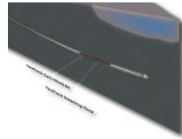


- Data shows good correlation in solid rock.
- Difference in values is due to the ABIA sensor being in the bend portion of the Mud Motor



**Paratrack Gyro Module (PGM) Overview**

- Fiber optic north seeking gyro system
- Measurements not impacted by magnetic interference
- Tested and proven in high vibration environments
- No requirement to stop drilling and north seek increasing productivity
- Observed accuracy of 0.1°
- No specialized handling or personnel required
- Compatible with the entire ParaTrack line of Steering, Tracking and Surveying tools
- Specifications
  - Outside Diameter: 2.75" (requires 3.5" ID collar)
  - Length: Head to foot - 48" (122 cm)
  - Electrical Connection: 1-3/16", 12 tpi (standard wet connect)

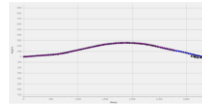


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**Raritan River Crossing, NJ**

**TECHNICAL CHALLENGES**

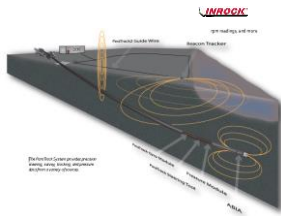
- Gyro used for first 650m of drilling (no entry coil utilized)
- Beacon utilized to track assist with location on exit
- Successfully navigated 35° S turn within tolerances



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**PGM compliments the entire P2 Suite**

- Multiple, independent, sources of locating improve confidence in location accuracy
  - Standard magnetic coil
  - Beacon tracking
  - Gyro
- Multiple options to locate upon exit
- Ability to simultaneously utilize all Paratrack offerings
  - AISA
  - PMR – Leading intersect technology
  - Pressure monitoring

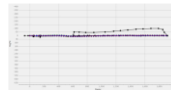


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**Carnegie Lake, NJ**

**TECHNICAL CHALLENGES**

- Hard and fractured rock
- Extreme high vibration environment
- 2.5-4 hr joint times
- Gyro used for first 175m of drilling (limited entry coil)



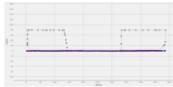
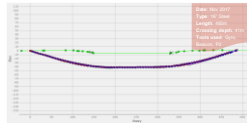
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Canadian INTERSECT, AB



TECHNICAL CHALLENGES

- Bore required intersect (not planned)
- Gyro and secondary verification used to complete intersect
- PMR was available and could have been activated without tripping, but was not needed due to accuracy of gyro



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How they used to do it in the Good Old Days



Thanks for your attention



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