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iTraceRT-F400-E

Accurate Real-Time Surveying, Vehicle Trajectory and Dynamics Estimation with deeply coupled INS/GNSS Filtering

iTraceRT-F400 is a very compact INS/GNSS deeply coupled inertial navigation, measurement, surveying and control system for applications on the surface (land/sea) and in the air. It provides all kinematic measurements, like acceleration, angular rate, attitude, true heading, velocity and position, of the target vehicle in real-time with a data update rate of up to 400 Hz.

- robust, compact, light weight system
- fiber optic gyro technology (FOG)
- output of angular rate, acceleration, attitude, true heading, course over ground, velocity and position via USB and Ethernet in real-time with up to 400 Hz (adjustable)
- CAN interface (100 Hz, up to 1 MBd)
- Dual-Antenna Option (allows output of heading at standstill without drift)
- Accuracies: 2 cm position, 0.01° roll/pitch/ heading, < 1 mg acceleration and 0.02 m/s velocity with L1/L2 RTK
- shortest re-acquisition time after loss of RTK due to **deeply coupled INS/GNSS**
- Interfaces: Ethernet/USB/RS232/CAN for real-time data, RS232 for RTK correction input
- no export restrictions, not ITAR controlled

To determine the motion of a vehicle with centimeter accuracy, conventional systems are using a RTK aiding of the INS with GNSS data in an unidirectional way. After loss of GNSS the standard GNSS receiver in those systems need a longer time to find the next RTK fix, which is much too long to perform precise measurements. Therefore those systems are only suitable in an environment which guarantees an open sky all over the measurement (no bridges, no urban canyons), and any loss of GNSS will drop the performance dramatically.

Due to the deeply coupled INS/GNSS (i.e. bidirectional data flow between INS and GNSS) the iTraceRT does overcome the lack of those systems. Inside of the iTraceRT, the RTK GPS information is used to aid the INS, and additionally the accurate INS position and velocity solution is fed back to the GNSS engine to improve the signal tracking and signal processing inside of the advanced GPS receiver and to reduce multipath effects dramatically. At the end of a period of GNSS outage the receiver knows its own position from the INS and this leads to the superior re-acquisition time and system performance. The re-acquisition time for RTK performance is therefore dramatically reduced (typically less than 10 sec).

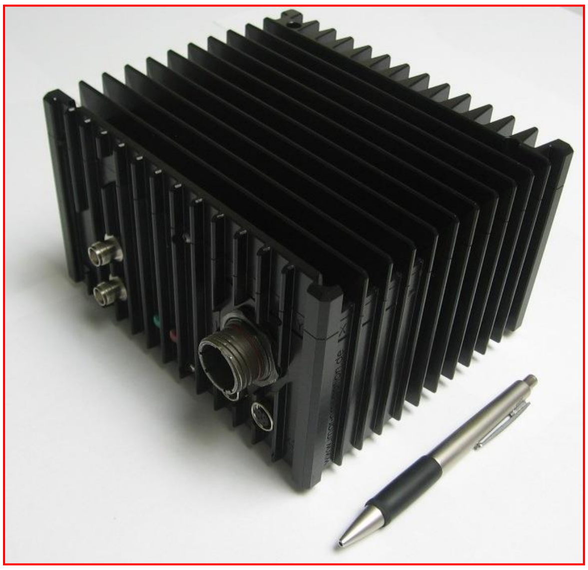
RTK-GPS → INS → Output

Classical INS/GPS Coupling

RTK-GPS ↔ INS → Output

iTraceRT: Deeply Coupled INS/GNSS

The bidirectional coupling (deeply coupled solution) and aiding between INS and GPS, using a



precise fiber optical gyro based inertial measurement system (FOG-IMU) of class 0.75 deg/hr, provides the high system performance and system reliability which is required in all advanced tasks of vehicle motion dynamics testing, automatic vehicle steering, trajectory surveying and motion control (car / truck / naval vessel / civil and military aircraft).

For land vehicles additionally an odometer aiding capability is available as an option.

The iTraceRT-400 is delivered with Windows-based configuration software. All output data can be displayed and stored online on the user's computer. With reduced position accuracy, iTraceRT can also be operated without RTK GNSS correction data (stand-alone GPS or DGPS). Upgrade to GALILEO as option.

Technical Data: iTraceRT-F400-E

	Rate	Acceleration	Attit./Heading	Position (LLA)	Velocity (ENU/Body)
Range:	± 450 °/s	± 5 g	unlimited	unlimited / no phys. Limitations	
Accuracy (1σ):	0.75 °/h	2 mg	pure INS, unaided, day-to-day, OTR		
	0.2 °/h	0.1 mg	pure INS, after 5 minutes RTK-GNSS aiding		

Angles:

0.01° RP, 0.025° Y[1]	(INS/RTK-GNSS)
0.01° RP, 0.03° Y	(after 10 sec RTK-GNSS outage)
0.02° RP, 0.04° Y	(after 60 sec GNSS outage)
0.1° Side slip angle (v > 10 m/s)[2]	

Position (horizontal / vertical):

± 2 cm / 5 cm + 2 ppm	(INS/RTK-GNSS)
± 10 cm / 12 cm	(10 s GNSS outage)
± 90 cm / 30 cm	(60 s GNSS outage)
± 1.8 m	(pure GNSS; CEP50)
± 2 cm / 5 cm	(post-proc, INS/RTK)

Velocity:

0.01 m/s (INS/RTK-GPS)
0.02 m/s (10 s GPS outage.)
0.04 m/s (30 s GPS outage)

	Rate	Acceleration	Attit./Heading	Position (LLA)	Velocity (ENU/Body)
Noise:	$< 0.1\ °/\sqrt{h}$	$< 50\ \mu g/\sqrt{Hz}$	0.01 °	< 10 mm	< 0.01 m/s
Resolution:	< 0.001 °/s	< 10 µg	0.005 °	< 5 mm	< 0.005 m/s
Linearity error:	< 0.03 %	< 0.1 %	< 0.03 %		

Initial Alignment:	automatic, with deeply coupled INS/GNSS Kalman filter
Data Processing Rate:	400 Hz; PPS timing accuracy better 10 ns
Data Output Rate:	LAN / USB 2.0: 1...400 Hz; CAN: 100 Hz; RS232/422 up to 230.4 k
Synchronization:	PPS output (TTL); with each PPS a time message is sent via CAN bus
Output:	USB Host, RS232, CAN (1 MBd), Ethernet LAN (100 MBd)
Inputs:	RTK-Base (RS232); odometer (A or A/B at RS422 level) as an option
Graphical User Interface:	Windows based software iTraceRT-Command
Power Supply:	11...34 V DC, 32 W
Temperature, Shock:	−30...+55°C (outer case temperature); 30 g / 11 ms, 3 g rms (20-2000 Hz) endurance
Mass, Size, Protection:	approx. 3.58 kg , approx. 186 x 160 x 110 mm (WxDxH) plus connector; IP68
Deliverables:	- FOG based INS with integrated L1/L2-RTK-GPS, GPS antenna and optional usage as GNSS reference station - Windows based GUI software iTraceRT-Command
Options:	- Dual-antenna configuration for heading aiding at standstill (0.5 deg at 1 m antenna distance) - Heave output (< 5% / 5 cm) for marine vessels - Odometer interface for aiding during longer GPS outages (position error then limited to approx. 0.1% of distance travelled) - Wireless data transmission for correction data from GPS base station iREF-L12 - GSM or GPRS based wireless modem for internet based correction data - Interface for ABD Steering Robot with Ethernet data output - Interface for video camera incl. time stamp (via user's PC)

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[1] RPY = Roll/Pitch/Yaw (Azimuth = −Yaw)
[2] The side slip angle is the angle between course over ground (CoG) and true heading. It is calculated from the longitudinal and transversal velocity of the vehicle. Its accuracy therefore increases with increasing velocity. At standstill the side slip angle cannot be defined.