iTraceRT-F402-E

Accurate Real-Time Surveying, Vehicle Trajectory and Dynamics Estimation with Deeply Coupled INS/GNSS Data Fusion

iTraceRT-F402 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
- all GNSS constellations supported (new)
- CAN output with up to 400 Hz data rate (new)
- advanced interference rejection (new)
- Dual-Antenna Option (allows output of heading also at standstill without heading drift)
- Accuracy: 2 cm position, 0.01° roll/pitch / 0.02° heading, < 1.5 mg acceleration and 0.02 m/s velocity with RTK GNSS
- shortest re-acquisition time after loss of RTK fix due to **deeply coupled INS/GNSS** technology
- Interfaces: Ethernet, USB, RS232 / RS422 and 2 x CAN for real-time data, RS232 for RTK correction data input
- 4 GB internal memory for data logging (new)
- no export restrictions, not ITAR controlled

To determine the motion of a vehicle, conventional systems are using a unidirectional way of aiding the navigation filter with GNSS data. After loss of the GNSS fix, those systems need a longer time to recover, which is much too long to perform precise measurements. Beside that they have limited capabilities to cope with multipath. 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 or presence of multipath will drop the performance dramatically.

Due to the deeply coupled INS/GNSS architecture, the **iTraceRT** overcomes those disadvantages. Inside of the iTraceRT, the RTK GNSS 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 GNSS receiver and to reduce multipath effects dramatically. At the end of a period of GNSS outage, the GNSS receiver knows a very good estimation of its own position from the INS and this leads to the superior re-acquisition time and system performance. The re-acquisition time even for RTK performance is therefore dramatically reduced (typically less than 10 sec).

Loosley Coupled INS/GNSS

iTraceRT: Deeply Coupled INS/GNSS

The deeply coupled solution with aiding between INS and GNSS, using an internal inertial measurement unit (IMU) of class 0.75 °/hr based on precise fiber optical gyros and servo

accelerometer, provides the high system performance and system reliability which is required in all advanced tasks of vehicle motion dynamics testing, automated 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.

Technical Data: iTraceRT-F402-E

	Rate	Acceleration	Attit./Heading	Position	Velocity
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-GNSS)
					0.02 m/s (10 s GNSS outage.)
					0.04 m/s (30 s GNSS outage)

Noise:	< 0.15 °/√h	< 50 µg/√Hz	0.01 °	< 10 mm	< 0.01 m/s
Resolution:	< 0.001 °/s	< 10 µg	0.005 °	< 5 mm	< 0.005 m/s
Scale error:	< 0.05 %	< 0.1 %	< 0.05 %		
Linearity error:	< 0.03 %	< 0.05 %	< 0.03 %		

Initial Alignment:	automatic, with deeply coupled INS/GNSS Kalman filter based data fusion
Data Processing Rate:	400 Hz; PPS timing accuracy better 10 ns
Data Output Rate:	LAN / USB 2.0 / CAN / RS422 / RS232: 1...400 Hz; RS232/422 up to 230.4 kBd
Synchronization:	PPS output (TTL); with each PPS a time message is sent via CAN bus
Output (max. Baud-rate):	USB Host, RS232 / RS422 (230.4 kBd), 2 x CAN (1 MBd), Ethernet LAN (100 MBd)
Inputs:	RTK-Base (RS232); odometer (A or A/B at RS422 level)
Graphical User Interface:	Windows based software iTraceRT-CMD incl. supported features like integration support wizard (I/F setup, mechanical setup calibration, data storage etc.)
Power Supply:	11...34 V DC, 28 W
Temperature, Shock:	-30...+55°C (outer case temperature); 30 g / 11 ms, 3 g rms (20-2'000 Hz) endurance
Mass, Size, Protection:	approx. 4.0 kg , approx. 186 x 160 x 110 mm (WxDxH) plus connector; IP67
Deliverables:	- FOG based INS with integrated L1/L2-RTK-GNSS, GNSS antenna and optional usage as GNSS reference station iREF-GNSS - Windows based GUI software iTraceRT-CMD
Options:	- Dual-antenna configuration for heading aiding at standstill (0.2 deg accuracy at 1 m antenna baseline) - Heave output (< 5% / 5 cm) for marine vessels - Odometer interface for aiding during longer GNSS outages - Wireless data transmission for correction data from GNSS base station iREF-GNSS - GSM or GPRS based wireless modem iNetGo for internet based correction data

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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.