GESELLSCHAFT FUER INERTIALE MESS-,
AUTOMATISIERUNGS- UND REGELSYSTEME MBH
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iTraceRT-F200-E

Accurate Real-Time Surveying, Vehicle Trajectory and Dynamics Estimation Performing bidirectional online INS/GPS Filtering

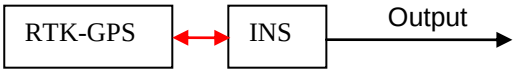
iTraceRT-F200 is a very compact INS/GNSS bi-directionally, deeply coupled inertial navigation, measurement, surveying and control system for applications on the surface (land/sea) and in the air. It provides all kinematic measurements, like acceleration, angular rate, attitude, true heading, velocity and position, of the target vehicle in real-time with a data update rate of up to 200 Hz.

- robust, compact, leight weight system
- fiber optic gyro technology (FOG)
- output of angular rate, acceleration, attitude, true heading, course over ground, velocity and position via USB in real-time with up to 200 Hz (adjustable)
- CAN interface (100 Hz, up to 1 MBd)
- Accuracies: 2 cm position, 0.01° roll/pitch/ heading, < 1 mg acceleration and 0.02 m/s velocity with RTK L1/L2 DGPS
- shortest re-acquisition time after loss of RTK due to **bidirectional INS/GPS data fusion**
- Interfaces: USB/RS232 for real-time data, RS232 for RTK correction input
- no export restrictions, not covered by ITAR

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 bidirectional INS/GPS coupling iTraceRT overcomes this 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 GNSS 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).

Classical INS/GPS Coupling



iTraceRT: Bidirectional INS/GPS Coupling

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-200 is delivered with LabView-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 GPS correction data.

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Technical Data: iTraceRT-F200-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)
				± 0.7 m (INS/Omnistar-VBS)
				± 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)
Noise:	< 0.1 °/√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
Linearity error:	< 0.03 %	< 0.1 %	< 0.03 %	

Initial Alignment:	automatic, with bidirectional (deeply coupled) INS/GPS Kalman filter
Data Processing Rate:	200 Hz
Data Output Rate:	USB: 1...200 Hz; CAN: 100 Hz ; RS232/422 up to 115.2 k
Synchronization:	PPS output (TTL), timing accuracy better 10 ns
Output:	USB, RS232, CAN; optional Ethernet UDP for ABD steering robot
Inputs:	RTK-Base (RS232); odometer (A or A/B at RS422 level) as an option
Graphical User Interface:	LabView based Windows software
Power Supply:	11...34 V DC, 25 W
Temperature, shock:	−30...+63°C (outer case temperature); 30 g / 11 ms, 5 g rms (20-2000 Hz) endurance
Mass, size, protection:	approx. 2.42 kg , approx. 148 x 148 x 104 mm, IP68
Deliverables:	- FOG based INS with integrated L1/L2-RTK-GNSS, GNSS antenna and optional wireless data transmission for GPS rover station data - Windows based GUI software
Options:	- Odometer interface for aiding during longer GPS outages (position error then limited to approx. 0.1% of distance travelled) - Omnistar based correction data interface - Heave output (< 5% / 5 cm) for marine vessels - wireless data transmission for correction data from GPS base station - GSM or GPRS based wireless modem for internet based correction data - Interface box iSRIF for ABD Steering Robot and 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.