

iTraceRT-F400-E

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

iTraceRT-F400 is a very compact INS/GPS bidirectionally 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 RTK L1/L2 DGPS
- shortest re-acquisition time after loss of RTK due to **bidirectional INS/GPS data fusion**
- Interfaces: Ethernet/USB/RS232/CAN for real-time data, RS232 for RTK correction input
- optional interface for video camera and steering robot (ISRIF)

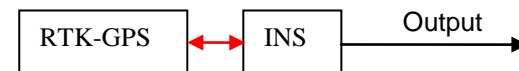
To determine the motion of a vehicle with centimeter accuracy, conventional systems are using a RTK aiding of the INS with GPS data in an unidirectional way. After loss of GPS the standard GPS receiver in those systems need a longer time to find the next RTK fix, which is much too long to perform precise 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 GPS 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 GPS 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 GPS out-

age 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-400 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 (stand-alone GPS or DGPS).

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 0.2°/h	1.5 mg 0.1 mg	pure INS, unaided, day-to-day, OTR pure INS, after 5 minutes RTK-GPS aiding		
Angles:		0.01° RP, 0.025° Y ¹ 0.01° RP, 0.03° Y 0.02° RP, 0.04° Y 0.1° Side slip angle (v > 10 m/s) ²	(INS/RTK-GPS) (after 10 sec RTK-GPS outage) (after 60 sec GPS outage)	
Position:			± 2 cm + 2 ppm (INS/RTK-GNSS) ± 10 cm (10 s GPS outage) ± 1.8 m (w/o Ref.station; CEP50) ± 0.7 m (INS/Omnistar-VBS)	
Velocity:				0.01 m/s (INS/RTK-GPS) 0.02 m/s (10 s GPS outage) 0.05 m/s (30 s GPS outage)
Noise:	< 0.1°/√h	< 50 μg/√Hz	0.01°	< 10 mm	< 0.01 m/s
Resolution:	< 0.001°	< 10 μg	0.005°	< 5 mm	< 0.005 m/s
Scalefactor error:	< 0.03%	< 0.15%	< 0.03%		
Initial Alignment:	automatic, with bidirectional (deeply coupled) INS/GNSS Kalman filter				
Data Processing Rate:	400 Hz				
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:	LabView based Windows software				
Power Supply:	11...34 V DC, 32 W				
Temperature, Shock:	-30...+55°C (outer case temperature); 60 g / 11 ms, 3 g rms (20-2000 Hz) endurance				
Mass, Size, Protection:	approx. 3.58 kg, approx. 188 x 168 x 112 mm (WxDxH) plus connector; IP68				
Deliverables:	<ul style="list-style-type: none"> - FOG based INS with integrated L1/L2-RTK-GPS, GPS antenna and optional usage as GPS reference station - LabView based operational software 				
Options:	<ul style="list-style-type: none"> - Dual-antenna configuration for heading aiding at standstill (0.5 deg at 1 m antenna distance) - Odometer interface for aiding during longer GPS outages (position error then limited to approx. 0.1% of distance travelled) - Omnistar based correction data interface; GLONASS option - 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.