iTraceRT-F402/7

Accurate Real-Time Surveying, Vehicle Trajectory and Dynamics Estimation with NovAtel-SPAN® based INS/GNSS Data Fusion

iTraceRT-F402/7, an upgrade of the well-known iTraceRT-400 series, is a very compact INS/GNSS 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 as well as standard deviations of the target vehicle in real-time with an internal 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, velocity and position
- all GNSS constellations supported simultaneously, i.e. GPS, GLONASS, GALILEO, BEIDOU etc. (NEW feature compared to iTraceRT-F402-E beside improved RTK)
- advanced interference rejection
- standard odometer aiding and performance improvement during GNSS outages[1]
- 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
- short re-acquisition time after loss of RTK fix, due to using leading GNSS receiver technology
- interfaces: Ethernet, USB, RS232 / RS422 and CAN for real-time data, RS232 for RTK correction data input
- Data output rate up to 200 Hz (raw data 400 Hz)
- fan-less operation
- 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 by means of position, velocity and standard deviation ("loosely coupled"). After loss of a GNSS fix with at least 4 satellites, the GNSS receiver cannot provide these measurements. Furthermore, the system has limited capabilities to cope with multipath. Therefore, those systems are mainly used in an environment which guarantees an open sky all over the measure-

ment cycle (no bridges, no urban canyons). Due to the INS/GNSS architecture inside the iTraceRT-F402/7, these disadvantages are mitigated.

Loosely Coupled INS/GNSS: POS/VEL/STDDEV

iTraceRT-F402/7: GNSS raw data + RTK

Inside the iTraceRT, the RTK GNSS information as well as the GNSS raw data are used to aid the INS/GNSS data fusion. This allows a powerful outlier detection and suppression as well as the capability to aid the INS even if less than 4 satellites are in view in difficult environment.

This data fusion solution, using an advanced tactical grade inertial measurement unit (IMU), based on precise fiber optical gyros and servo accelerometers inside the iTraceRT-F402/7, provides the high system performance and system reliability. This is required in all advanced tasks of vehicle motion dynamics testing, trajectory surveying and standard vehicle control (car /

truck / naval vessel / civil and military aircraft) with standard dynamics requirements regarding data output latency and jitter.

For land vehicles, additionally an odometer input is available as an option to aid heading during standstill and low yaw-rate condition.

The output data can be used also for post-processing within the tool InertialExplorer.

[1] see also our iNAT series with extended odometer filtering and minimum latency / jitter data output due to a different internal signal processing architecture

Technical Data: iTraceRT-F402/7 (rms)

	Rate	*Acceleration*	*Attit./Heading*	*Position*	*Velocity*		*Remarks*
Range:	± 450 °/s	± 5 g	unlimited	unlimited / no phys. limitations			
Bias day-to-day:	1 °/h	2 mg	pure INS, unaided, day-to-day, over temperature range				
Bias (filtered):	0.2 °/h	0.1 mg	after 5 minutes RTK-GNSS aiding under sufficient dynamics				
Angles:……………………………			0.01° RP, 0.025° Y[1]				(INS/RTK-GNSS)
			0.01° RP, 0.03° Y				(after 10 sec RTK-GNSS loss)
			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[1]			(INS/RTK-GNSS)
				± 10 cm / 10 cm			(10 s GNSS outage)
				± 1.8 m			(pure GNSS; CEP50)
				± 2 cm / 5 cm			(post-proc, INS/RTK)
Velocity:		………………………………………..			0.02 m/s		(INS/RTK-GNSS)
					0.02 m/s		(10 s GNSS outage.)
					0.05 m/s		(30 s GNSS outage)

	Rate	*Acceleration*	*Attit./Heading*	*Position*	*Velocity*
Noise:	< 0.15 °/√h	< 50 µg/√Hz	0.01 °	< 10 mm	< 0.01 m/s
Resolution:	< 0.000'1 °/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, during initial motion
Data Processing Rate:	400 Hz; PPS timing accuracy better 10 ns; sum of data output latency and jitter < 20 ms [3]
Data Output Rate:	LAN / USB 2.0 / RS422 / RS232: 1...200 Hz; CAN[4]: < 200 Hz; UART 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), CAN (1 MBd), Ethernet LAN (100 MBd)
Inputs:	RTK-Base (RS232); odometer (A or A/B at RS422 level)
Graphical User Interface:	MS 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, approx. 20 W
Temperature, Shock:	-30...+71°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 multi-frequency RTK-GNSS
	- Windows based GUI software iTraceRT-CMD
Options:	- GNSS antenna
	- GNSS reference station iREF-GNSS
	- Dual-antenna configuration for heading aiding at standstill (0.2 deg accuracy at 1 m antenna baseline)
	- Odometer 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
	- PostProc Software InertialExplorer (output of iTraceRT is compatible)

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[1] assumes sufficient GNSS conditions and motion dynamics for reliable data fusion state observability; values depend on trajectory

[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.

[3] If minimum latency of data output is required by the user's application (e.g. for advanced vehicle control), iMAR'siTraceRT-MVT-500 system with same inertial core and same GNSS core is available (sum of latency + jitter < 3 ms !).

[4] CAN bus compatible to iTraceRT-402 and iTraceRT-F400 and iNAT / iTraceRT-MVT SimpleCAN