



SPATIAL FOG FOG GNSS/INS

Spatial FOG is a ruggedised GPS aided inertial navigation system and AHRS that provides accurate position, velocity, acceleration and orientation under the most demanding conditions. It combines ultra high accuracy accelerometers, magnetometers and a pressure sensor with an RTK GNSS receiver. These are coupled in a sophisticated fusion algorithm to deliver accurate and reliable navigation and orientation.



PERFORMANCE

0.01 ° Roll and Pitch

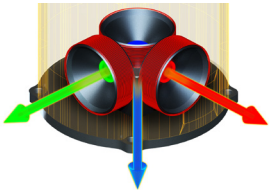
8 mm RTK Positioning

Heave : 2 % or 0.02 m (whichever is greater)

0.05 ° Heading

0.05 °/HR FOG Gyroscope

FEATURES



EXTREME INERTIAL PERFORMANCE

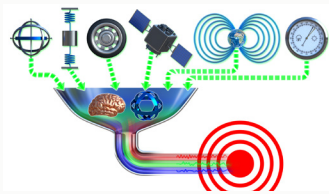
Spatial FOG contains the KVH Industries 1750 fiber optic gyroscope (FOG) IMU, which provides extremely accurate inertial data far beyond the best MEMS technology available.

This allows Spatial FOG to achieve very high accuracies and dead reckon without GNSS for extended periods of time. Despite the high accuracy FOG IMU, Spatial FOG has a very competitive price tag that is lower than many MEMS systems on the market.



RELIABILITY

Spatial FOG has been designed from the ground up for mission critical control applications where reliability is very important. It is built on top of a safety oriented real time operating system and all software is designed and tested to safety standards with fault tolerance in place. The hardware is protected from reverse polarity, overvoltage, surges, static and short circuits on all external interfaces. The GNSS contains RAIM, which excludes both malfunctioning, and tampered satellite signals. Spatial FOG contains a secondary MEMS IMU, which it uses to detect faults with the primary IMU.



ADVANCED FILTER

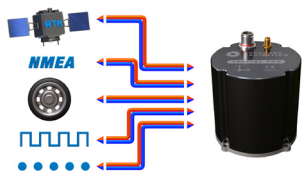
Spatial FOG contains Advanced Navigation's revolutionary sensor fusion filter. The filter is more intelligent than the typical extended kalman filter and is able

to extract significantly more information from the data by making use of human inspired artificial intelligence. It was designed for control applications and has a high level of health monitoring and instability prevention to ensure stable and reliable data.



RTK GNSS RECEIVER

Spatial FOG contains a triple frequency Trimble RTK GNSS receiver that provides up to 8mm accuracy positioning and supports all of the current and future satellite navigation systems, including GPS, GLONASS, GALILEO and BeiDou. Spatial FOG supports both real time RTK positioning and logging of raw satellite data for kinematic post-processing.



PERIPHERALS

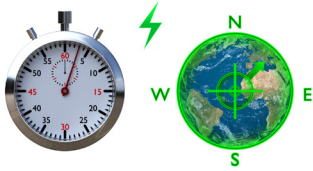
Spatial FOG features two general purpose input output pins and two auxiliary RS232/RS422 ports that support an extensive number of peripherals. Including odometer

based input for ground vehicles, DVLS and USBLs for underwater navigation, NMEA input/output and more. For an integration fee, custom peripheral devices can be added.



HIGH UPDATE RATE

Spatial FOG's internal filter runs at 1000Hz and data can also be output at this rate over high speed RS232 or RS422. This allows for control of dynamically unstable platforms.



HOT START

Spatial FOG contains a next generation battery backup system that allows it to hot start inertial navigation from its last position in 2 seconds and obtain a GNSS fix in approximately 3 seconds. The battery backup system lasts for the lifetime of the product and will provide backup for 48 hours without power. Advanced Navigation's Spatial series are the only GNSS/INS in the world to provide hot start inertial navigation.



RAPID NORTH SEEKING GYROCOMPASS

Spatial FOG features a revolutionary north seeking algorithm that is able to provide accurate heading in as little as 10 seconds after power on from a hot start and 10 minutes from a cold start. Spatial FOG's north seeking algorithm runs continuously while in operation and is not effected by velocities or angular movements. This allows Spatial FOG to provide high accuracy heading in environments where magnetometers and GPS aided heading cannot be used.

SPECIFICATIONS

NAVIGATION

| | |
|--|---------------|
| Horizontal Position Accuracy | 0.8 m |
| Vertical Position Accuracy | 1.5 m |
| Horizontal Position Accuracy (with SBAS) | 0.5 m |
| Vertical Position Accuracy (with SBAS) | 0.8 m |
| Horizontal Position Accuracy (with RTK or Kinematic PPK) | 0.008 m |
| Vertical Position Accuracy (with RTK or Kinematic PPK) | 0.015 m |
| Velocity Accuracy | 0.007 m/s |
| Roll & Pitch Accuracy | 0.01 ° |
| Heading Accuracy | 0.05 ° |
| Roll & Pitch Accuracy (Kinematic post-processing) | 0.005 ° |
| Heading Accuracy (Kinematic post-processing) | 0.01 ° |
| Heave Accuracy (whichever is greater) | 2 % or 0.02 m |
| Orientation Range | Unlimited |
| Hot Start Time | 2 s |
| Internal Filter Rate | 1000 Hz |
| Output Data Rate | Up to 1000Hz |

HARDWARE

| | |
|-------------------------------|----------------------|
| Operating Voltage | 9 to 36 V |
| Input Protection | -40 to 100 V |
| Power Consumption (typical) | 6.6 W |
| Hot Start Battery Capacity | > 48 hrs |
| Hot Start Battery Charge Time | 30 mins |
| Hot Start Battery Endurance | > 10 years |
| Operating Temperature | -40°C to 75°C |
| Environmental Protection | IP67 MIL-STD-810G |
| MTBF | > 36,000 hrs |
| Shock Limit | 40 g |
| Vibration Limit | 12 g |
| Dimensions | 90 x 90 x 88 mm |
| Weight | 655 grams |

SENSORS

| SENSOR | ACCELEROMETERS | GYROSCOPES | MAGNETOMETERS | PRESSURE |
|----------------------------|----------------|--------------|---------------|---------------|
| Range | ± 10 g | ± 490 °/s | ± 8 G | 10 to 120 KPa |
| Bias Instability | 15 ug | 0.05 °/hr | - | 10 Pa |
| Initial Bias | < 1 mg | < 1 °/hr | - | < 100 Pa |
| Initial Scaling Error | < 0.03 % | < 0.01 % | < 0.07 % | - |
| Scale Factor Stability | < 0.04 % | < 0.02 % | < 0.09 % | - |
| Non-linearity | < 0.03 % | < 0.005 % | < 0.08 % | - |
| Cross-axis Alignment Error | < 0.04 ° | < 0.02 ° | < 0.05 ° | - |
| Noise Density | 120 ug/√Hz | 0.7 °/hr/√Hz | 210 uG/√Hz | 0.56 Pa/√Hz |
| Bandwidth | 200 Hz | 440 Hz | 110 Hz | 50 Hz |

GNSS

| | |
|--|---|
| Model | Trimble BD930 |
| Supported Navigation Systems | GPS L1, L2, L5 GLONASS L1, L2 GALILEO E1, E5 BeiDou B1, B2 |
| Supported SBAS Systems | WAAS EGNOS MSAS GAGAN QZSS |
| Update Rate | 20 Hz |
| Hot Start First Fix | 3 s |
| Cold Start First Fix | 30 s |
| Horizontal Position Accuracy | 1.2 m |
| Horizontal Position Accuracy (with SBAS) | 0.5 m |
| Horizontal Position Accuracy (with RTK) | 0.008 m |
| Velocity Accuracy | 0.007 m/s |
| Timing Accuracy | 20 ns |
| Acceleration Limit | 11 g |

COMMUNICATION

| | |
|----------------------|---|
| Interface | RS422 (RS232 optional) |
| Speed | 4800 to 10M baud |
| Protocol | AN Packet Protocol or NMEA |
| Peripheral Interface | 2x GPIO and 2x Auxiliary RS232 |
| GPIO Level | 5 V or RS232 |
| GPIO Functions | 1PPS Odometer Stationary Pitot Tube NMEA input/output Novatel GNSS input Trimble GNSS input AN Packet Protocol input/output Packet Trigger Input Event Input |