PinPoint™

Vehicle Positioning System

TORC ROBOTICS
RAPID. RELIABLE. PROVEN.

Description

The PinPoint™ localization system is a continuous positioning system for ground vehicles. PinPoint™ provides multi-sensor fusion of dual-GPS receivers, inertial sensors, and wheel speed sensors to provide real time position, orientation, velocity, and time information. All outputs are continuously updated regardless of a GPS fix, allowing operation during GPS degradation or complete signal loss.

Horizontal Position Accuracy (RMS)

Single Point L1: 1.5m
Single Point L1/L2: 1.2 m
SBAS: 0.6m
VBS: 0.6m
XP: 0.15m
HP: 0.1m

Time to First Fix

Cold Start: 50 seconds
Hot Start: 35 seconds

IMU Alignment (Internal or Precision)

Single GPS Core: Kinematic align after GPS fix
Dual GPS Core: Static align after GPS fix

Internal IMU Performance

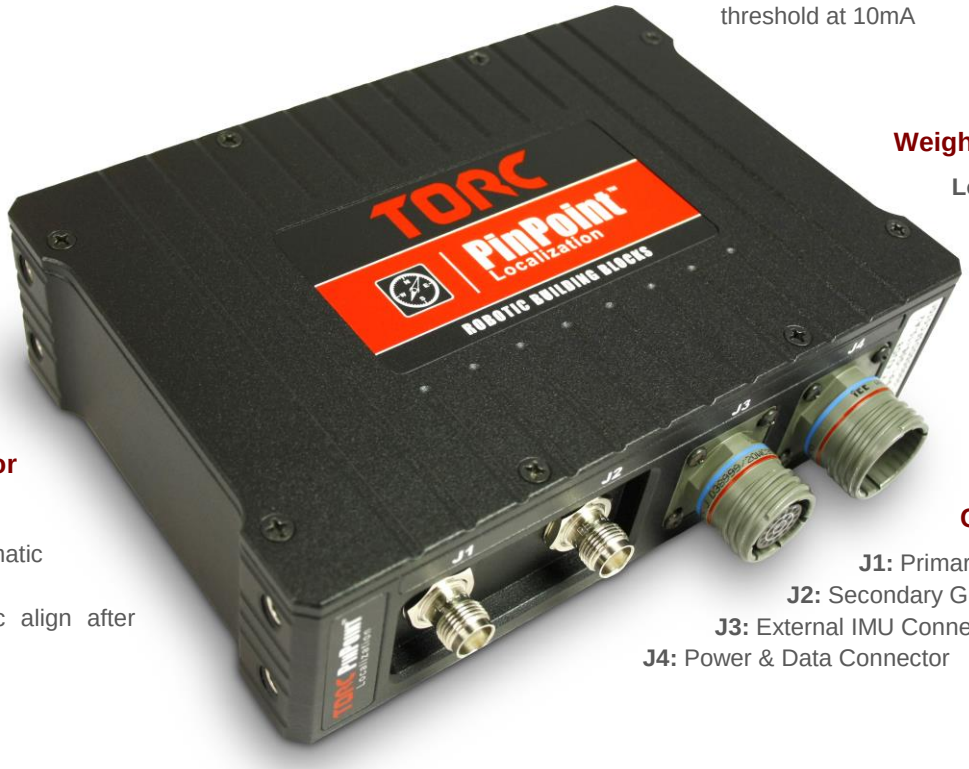
Update Rate: 102.5 Hz
Gyro Operating Range (degree/second): 450
Bias Stability (degree/hour): 6.25
Angular Random Walk (degree/rt) hour): 0.3
Acceleration Range (g): 18

Precision IMU Performance

Update Rate: 1000 Hz
Gyro Operating Range (degree/second): 1000
Bias Stability (degree/hour): 1.0
Angular Random Walk (degree/rt. hour): 0.06
Acceleration Range (g): 30

Electrical

Input Voltage: 9-36 VDC
Power Consumption: 8W (single GPS & internal IMU), 12W (dual GPS & precision IMU)
Wheel Speed Sensor Support: 7.5V source, threshold at 10mA



Weight

Localization Module: 3.2 lb
Precision IMU Module: 3.6 lb
GPS Antenna (each): 1.1 lb

Localization Connectors

J1: Primary GPS Connector
J2: Secondary GPS Connector
J3: External IMU Connector
J4: Power & Data Connector

User Interface

Two 100baseT Ethernet Ports
EIA-232 Serial
Embedded webserver allows for product configuration, firmware updates, & KML generation.

Environmental

Dust/Water Resistance: IP67
Operational Temperature: -33°C to 71°C

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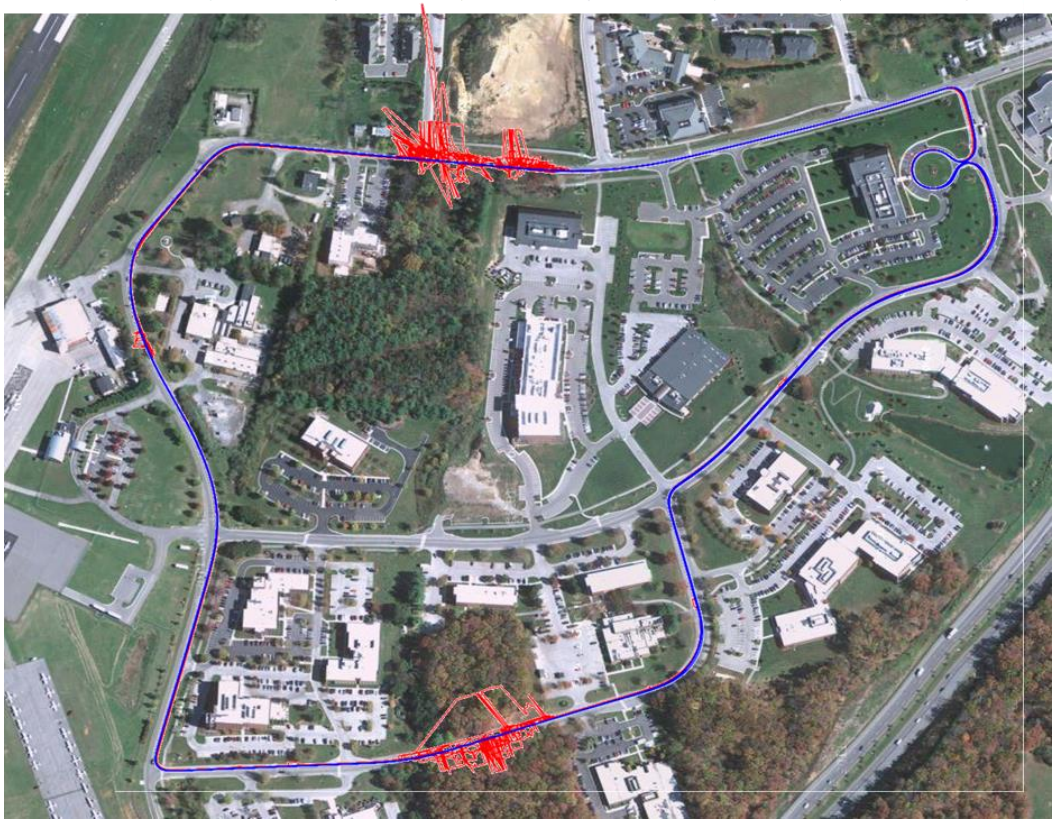
PINPOINT™ FILTER OUTPUT (BLUE) VS. RAW GPS DATA (RED)



COORDINATE SYSTEM OVERVIEW

PinPoint™ uses three different coordinate frames. A global frame is used for representing where in the world a vehicle is located, a local frame is used for representing where the vehicle is relative to nearby objects, and a vehicle frame is used for representing vehicle velocities. The interaction between the local and global frames is analogous to rolling a plane on top of a sphere, where the contact point is the current vehicle position. Both the local position (the location of the contact point on the plane) and the global location (the location of the contact point on the sphere) change as the vehicle moves across the surface of the earth. The origin of the local plane is not fixed to any global coordinate, and any transforms between the two coordinate systems are done with respect to the current vehicle location.

Global Position

PinPoint™ uses geodetic latitude, longitude, and height (LLH) above the ellipsoid to represent global position. This frame should be used for any globally referenced waypoints or object locations.

Local Position

PinPoint™ uses a floating, north-aligned local frame in north, east, down (NED) coordinates to represent local position. The local position is initialized on filter reset, and is intended to represent the location of objects in the vicinity of the vehicle. The local position is updated as the vehicle moves but never corrected; allowing calculations performed in local frame to be immune to GPS "pops", where the solution quickly changes as satellites come into and go out of view.

Vehicle Body

The vehicle specific parameters and the velocity state output are represented in vehicle body frame. This frame is represented using forward, right, down (FRD) convention, with the associated rotations given as roll, pitch, yaw, respectively. The origin of the frame should be placed at the center of the rear wheels for Ackerman vehicles or center of mass for skid-steer vehicles.

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EXTERNAL IMU CONNECTOR

Pin	Name	Description	I/O	Contact
1	RX_DATA_IN+	Connection to External IMU	Input	#22D
2	RX_DATA_IN-	Connection to External IMU	Input	#22D
3	TX_DATA_OUT+	Connection to External IMU	Output	#22D
4	TX_DATA_OUT-	Connection to External IMU	Output	#22D
5	SYNC_IN+	Connection to External IMU	Input	#22D
6	SYNC_IN-	Connection to External IMU	Input	#22D
7	CLOCK_OUT+	Connection to External IMU	Output	#22D
8	CLOCK_OUT-	Connection to External IMU	Output	#22D
9	IMU_RESET_OUT	Connection to External IMU	Output	#22D
10	IMU_MODE_OUT	Connection to External IMU	Output	#22D
11	POWER_OUT	Connection to External IMU	Power	#22D
12	POWER_GND	Connection to External IMU	Ground	#22D
13	PC_RX	Factory Use Only	Output	#22D
14	PC_TX	Factory Use Only	Input	#22D
15	PC_DTR	Factory Use Only	Input	#22D
16	PC_RTS	Factory Use Only	Input	#22D
17	PC_GND	Factory Use Only	Ground	#22D
18-21	(reserved)	Not Used		#22D
22	SHIELD	Chassis Ground	Ground	#22D

POWER & DATA CONNECTOR

Pin	Name	Description	I/O	Contact
1	POWER_IN	Input Power	Power	#22D
2	POWER_GND	Power Ground	Ground	#22D
3	SHIELD	Chassis Ground	Ground	#22D
4	CAN1_H	CAN High	Bidirectional	#22D
5	CAN1_L	CAN Low	Bidirectional	#22D

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Pin	Name	Description	I/O	Contact
6	GND	Signal Ground	Ground	#22D
7	CAN2_H	CAN High	Bidirectional	#22D
8	CAN2_L	CAN Low	Bidirectional	#22D
9	GND	Signal Ground	Ground	#22D
10	ETH1_TX+	Ethernet Transmit	Output	#22D
11	ETH1_TX-	Ethernet Transmit	Output	#22D
12	ETH1_RX+	Ethernet Receive	Input	#22D
13	ETH1_RX-	Ethernet Receive	Input	#22D
14	SHIELD	Signal Ground	Ground	#22D
15	ETH2_TX+	Ethernet Transmit	Output	#22D
16	ETH2_TX-	Ethernet Transmit	Output	#22D
17	ETH2_RX+	Ethernet Receive	Input	#22D
18	ETH2_RX-	Ethernet Receive	Input	#22D
19	SHIELD	Signal Ground	Ground	#22D
20	WSS_LI+	Left In-phase Current Sense	Bidirectional	#22D
21	WSS_LI-	Left In-phase Current Return	Ground	#22D
22	WSS_LQ+	Left Quadrature Current Sense	Bidirectional	#22D
23	WSS_LQ-	Left Quadrature Current Return	Ground	#22D
24	WSS_RI+	Right In-phase Current Sense	Bidirectional	#22D
25	WSS_RI-	Right In-phase Current Return	Ground	#22D
26	WSS_RQ+	Right Quadrature Current Sense	Bidirectional	#22D
27	WSS_RQ-	Right Quadrature Current Return	Ground	#22D
28	PPS_232	RS-232 Pulse-Per-Second	Output	#22D
29	GND	Signal Ground	Ground	#22D
30	NMEA_232	RS-232 NMEA Transmit	Output	#22D
31	PPS_5V+	Non-Inverted Pulse-Per-Second	Output	#22D
32	PPS_5V-	Inverted Pulse-Per-Second	Output	#22D
33	SERIAL_TX-	RS-232 Transmit / RS-422 TX-	Output	#22D
34	SERIAL_TX+	RS-422 TX+	Output	#22D
35	SERIAL_RX-	RS-232 Receive / RS-422 RX-	Input	#22D
36	SERIAL_RX+	RS-422 RX+	Input	#22D
37	GND	Signal Ground	Ground	#22D

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