

Honeywell

THE POWER OF **CONNECTED**

TRANSPORTATION ATTITUDE REFERENCE SENSOR IN CONSTRUCTION IMPLEMENTS

An Application Note





Background Some would argue that the most important piece of construction equipment (other than the operator) is the tool that interacts with the material being worked. With construction equipment having a long mechanical life, there is no shortage of creative and interesting implements that can be attached to the “business end.” From simple buckets to complex concrete curb laying equipment, there are many types of implements that can be attached to construction equipment.

One feature all construction implements share is that the quality and efficiency of work done with them is closely related to the experience and ability of the operator. A highly skilled operator can use a tool to deftly operate a piece of machinery to finish a job to specification and on time, saving cost and creating efficiency. However, the number of highly skilled operators has shrunk, making an expert operator few and far between. In spite of this, work and construction projects must proceed.



TARS-IMU: Transportation Attitude Reference Sensor
(TARS) Ruggedized Inertial Measurement Unit (IMU)

TARS Key Features

- High performance IMU, reports vehicle angular rate, acceleration, and inclination (6 degrees of freedom)
- Ruggedized design for most demanding applications and environments (IP67 & IP69K certified)
- Advanced fusion filtering to minimize unwanted noise and vibrations, improves positioning accuracy
- Optional metal guard for added protection
- Supports 5 V and 9 V to 36 V vehicle power systems
- Operating temperature of -40°C to 85°C [-40°F to 185°F]
- Reduced power consumption
- Small form-factor

The Solution

One way construction vehicle OEMs have reduced the impact of inexperienced operators is enabling the equipment with intelligence and autonomy for certain functions. These operator-assisting features can augment the skills of an inexperienced operator to allow him/her to perform repetitive tasks with ease and precision.

As an example, a construction site required hundreds of post holes to be dug to support pylons needed for the project and a barrier wall. The architects and engineers designed a plan that required the holes to be precisely placed in several rows. The contractor used a backhoe with an auger attachment equipped with a TARS-IMU enabled system that monitored its position and alignment with the ground. An onboard system and graphical user interface compared the information coming from the TARS-IMU and the site plan with details for the required holes. This allowed the operator to drive to a hole location, align the tool to specification, and dig the hole to required depth all according to plan. This operator-assist feature reduces the skills gap between an inexperienced operator and an expert operator, by providing the information and control required to dig the holes efficiently and accurately.

This assistance will be found more often as the industry moves toward some fully autonomous systems. TARS-IMU is a key piece as it provides and reports key vehicle and implement data. With six degrees of freedom, TARS-IMU reports the key movement data such as angular rate, acceleration, and inclination. Furthermore, TARS-IMU is equipped with customizable data filters; it can be tuned to reduce extraneous noise and vibration that would otherwise distort the valuable data. A bucket, auger, or even a concrete pumping nozzle can be made adjusted for applications through the TARS-IMU.

TARS-IMU utilizes a robust packaging design (IP67/IP69K) that makes it resilient to the rigors of the construction industry. In addition, a wide operating temperature range of $(-40^{\circ}\text{C}$ to $85^{\circ}\text{C})$ makes it ready for use in most demanding tool and implement applications.

Other Potential Applications

Construction equipment

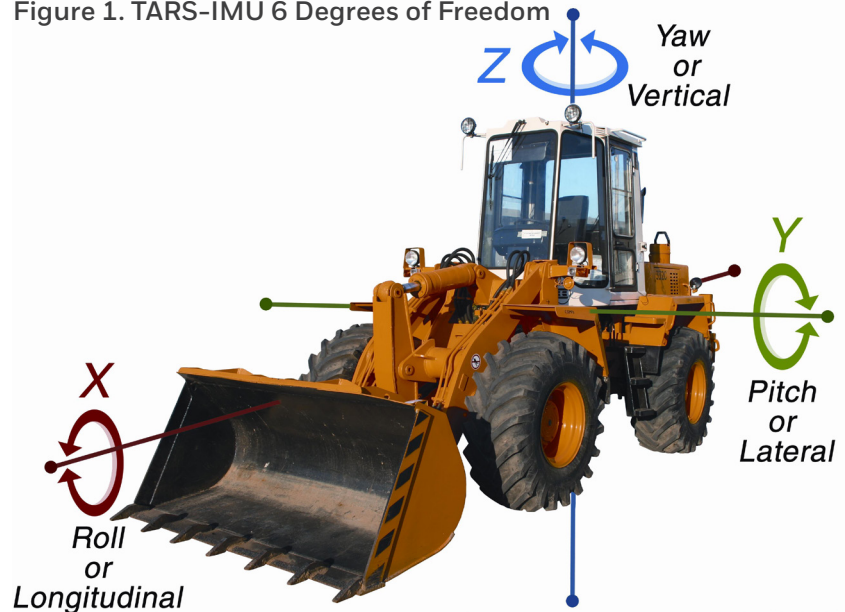
- Excavators, mining trucks, forestry equipment, telescopic handlers, loaders, cranes, graders
 - Improves operator awareness relative to equipment loading/extension arms in cranes, material/telescopic handlers
 - Provides real-time stability control in most rugged/steep terrain (Inclination outputs to prevent vehicle roll over)
 - Provides active control of graders/bulldozers (depth/angle)

Agricultural equipment

- Combines, harvesters, tractors, balers
 - Provides motion control feedback (attitude/acceleration) for stability and the leveling cutting blades, planters, tillers, and other equipment when on slopes/hills
 - Inclination outputs to prevent vehicle roll over
 - Improves automated steering capabilities by providing rotational rate change data to vehicle controls

Any application where inclination or position is needed.

Figure 1. TARS-IMU 6 Degrees of Freedom



Value to OEM Customers

Durability for the environment

- Corrosion-resistant housing/case minimizes the susceptibility to deterioration often experienced in salt-water environments
- UV-resistant plastic housing
- IP67 and IP69K ratings provide resistance to weather, harsh conditions and cleaning environments, reducing risk and cost associated with lower-rated products
- Wide operating temperature range withstands most thermal extremes, preventing package breakage
- Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) rating ensures device compatibility with the radio frequency environment

Ease of integration

- One high voltage (9 V to 36 V) model is designed for operation from heavy-duty vehicle battery power with immunity to load dump and electrical transients
- The second low voltage (5 V) model is designed for operation from a regulated 5 V power source
- SAE J1939 CAN output – allows more data to be transmitted than a RS-485 output
- AMPSEAL 16 connector, common in transportation applications, simplifies the customer's supply chain and reduces design complexity
- The TARS-IMU employs a boot-loader feature to facilitate program updates and integration with new functional requirements. New features can thereby be upgraded without opening the unit, keeping the calibration parameters and sensor performance intact

Performance in a wide variety of environmental conditions

- Calibration with 2-axis rate table with verification over temp. range
- Tested to mechanical shock, thermal shock, and random vibration

Warranty/Remedy

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DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

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- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

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