Honeywell

TARS-IMU Sensors for Wheel Slippage Detection

An Application Note

Background

In off-road vehicles, there are two types of contact that tires/wheels/tread can make with the surface. First, static content occurs when the tire/wheel/tread and the surface are not slipping relative to each other. Second, there's dynamic contact where the tire/wheel /tread is slipping relative to the surface. Wheel slip happens when the force applied to a tire/wheel/tread exceeds the traction available. The force applied to the tire/wheel/tread happens from two directions: longitudinal (force applied by the engine or the brakes to either accelerate or decelerate the vehicle) and lateral (force made when the vehicle changes in direction – usually the tires/wheels/tread and surface provide lateral force). To help ensure operator and vehicle safety, it's vital to have a measure of the longitudinal and lateral forces on a vehicle, along with other measures.

Under normal working conditions, it is sometimes difficult for an operator to know when a machine might be under load and not able to properly advance. The power of these machines coupled with the small footprint of the tires/wheels/treads makes them susceptible to wheel slippage. Applying more power to a machine that cannot advance will cause the wheels or tracks to begin to spin in place. The machine itself is no longer moving, but its wheels are in motion. This type of condition can cause damage to the machine itself, by stressing the engine transmission and drive train, not to mention wear of the tires or track. Another drawback from this slippage condition is that the articulating wheel can damage the worksite, resulting in added cost and time.

Solution

The Honeywell Transportation Attitude Reference System, or TARS-IMU, is a packaged sensor array designed to report vehicle angular rate, acceleration, and attitude data for demanding applications in industries such as heavy-duty, off-highway transportation.

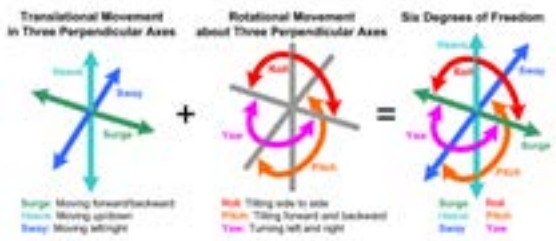
TARS-IMU enables autonomous vehicle characteristics and enhances efficiency and productivity by reporting key data required to automate and monitor movements of vehicle systems and components. The sensor fusion algorithm can be customized for specific vehicle applications through on-board firmware, allowing movement data to be filtered for extraneous environment and vehicle movements.

TARS sensors can be utilized to help detect wheel slippage and drive control, and motion data from TARS-IMU can help prevent traction wheel/track slippage. When the TARS sensor reports a movement that does not match the expected movement, electronic control can be used to limit

Features and Benefits

- Enhanced performance from IMU offers reporting of vehicle angular rate, acceleration and inclination (6 degrees of freedom)
- Ruggedized PBT thermoplastic housing design enables it to be used in many demanding applications and environments (IP67- and IP69K-certified)
- Advanced filtering of raw sensor data to minimize unwanted noise and vibrations, improving 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

Figure 1. TARS Six Degrees of Freedom



throttle and motor output response. This can help prevent major damage or destruction to landscaped or previously worked surfaces.

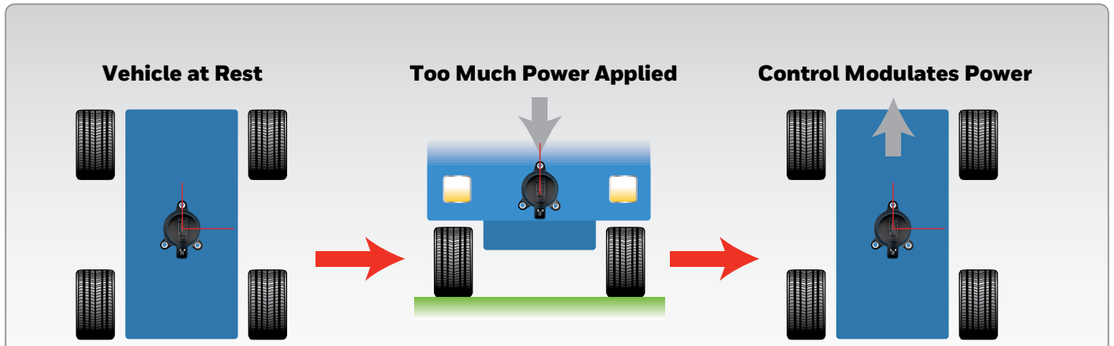
The TARS-IMU sensor may be used in conjunction with other sensors like wheel speed sensors to help detect, correct, and minimize wheel slippage. The Honeywell TARS-IMU sensor can deter vehicle motion, vibration, and position in real time. Coupled with input from other sensors, the IMU can be used to extrapolate and determine that the vehicle is not in motion and its wheels are spinning.

The comprehensive system can then inform the operator of the condition, or correct vehicle power-out in real time, making it safer to work, and helping to reduce the possibility of vehicle damage and prevent operator injury.

This assistance will be found more often as the industry moves toward some fully autonomous systems. The TARS-IMU sensor an be a key component as it both provides and reports key vehicle data. With six degrees of freedom (see Figure 1), the TARS-IMU sensor reports key movement data such as angular rate, acceleration, and inclination. Furthermore, the 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.

The TARS-IMU utilizes a robust packaging design (IP67/IP69K) that makes it more resilient to the rigors of the construction industry. In addition, a wide operating temperature range of -40 °C to 85 °C makes it ready for use in many demanding tool and implement applications.

Figure 2. Honeywell TARS-IMU in a Wheel Slippage Application



- Position data agrees with what the control system expects
- The drive wheels begin to slip
- Control system recognizes slip and limits power output or alerts operator
- Modulates power to minimize slip
- Traction is restored
- Vehicle moves in a controlled manner, limiting potential major damage to the environment

⚠WARNING
IMPROPER INSTALLATION

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

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

Warranty/Remedy

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