

TARS-IMU Sensor Target Applications

An Application Note

Background

The 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

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 | SIX DEGREES OF FREEDOM

The Honeywell TARS-IMU offers 6 degrees of freedom (rotation) (see Figure 1). A vehicle experiences two different types of movement.

Translational Movement: Surge Heave Sway

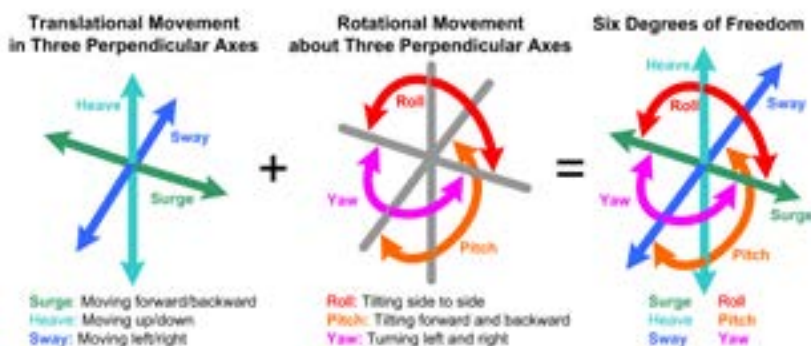
Rotational Movement: Roll Pitch Yaw that are the focused axis of measurement for the TARS-IMU.

Rotation around the front-to-back axis is called **roll "X"**. It is the shifting of a vehicles weight to the right or left. This helps identify potential unbalance on either side and help to provide more tire grip.

Rotation around the side-to-side axis is called **pitch "Y"**. This measurement signifies weight shift to the front or rear end of the vehicle.

Rotation around the vertical axis is called **yaw "Z"**. Yaw is the rotational movement to the left or right of the vehicle.

Figure 1. TARS Six Degrees of Freedom



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 2. X, Y, and Z Axis Measurements on a Forklift

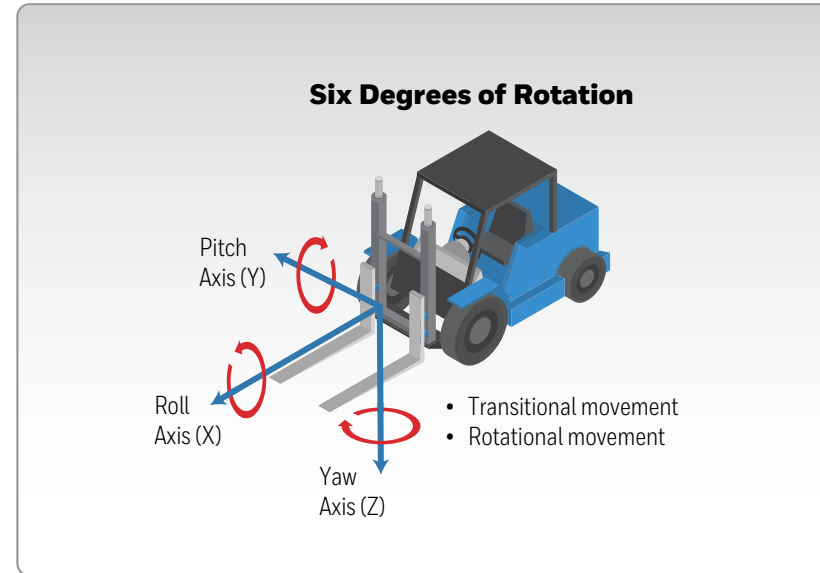
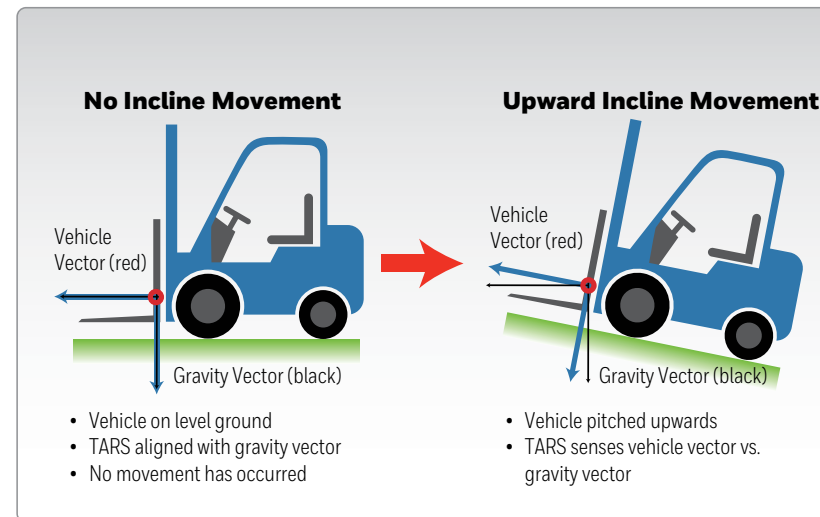


Figure 3. Changes in Inclination



Controlling a vehicle's ATTITUDE, or position of vehicle in respect to gravity, requires sensors. The Honeywell TARS-IMU has MEMS (3 MEMS chips) on board. Each chips measures either the X, Y, or Z axis.

The left image illustrates no movement of the vehicle's inclination. The right image illustrates vehicle pitch in an upwards movement. Vehicle is traveling in an inclined position. The TARS-IMU sensor will provide data of the vehicle to report this angular rate, acceleration, and inclination.

Sensor Fusion in the TARS-IMU includes **Accelerometers** to provide a stationary indication of the gravity vector and **Gyroscopes** that can help in more accurately indicating how much rotation has occurred when the vehicle is moving. The data from the two sets of sensors can therefore be "fused" in order to get estimates of **pitch and roll during both static and dynamic conditions**.

TARS | POTENTIAL APPLICATIONS

Target applications where vehicles could benefit from TARS implementation.

1. Factory and warehouse forklifts
2. Rough terrain forklifts and aerial lifts
3. Telescopic personnel booms
4. Bucket trucks
5. Fire truck boom and ladder
6. Telescopic cranes
7. Tow trucks and wreckers



Applications

TARS | FORKLIFT STABILITY CONTROL

Forklifts come in all shapes and sizes; they are typically small agile machines used to move materials around in distribution centers, warehouses, and factory floors. These machines are extremely powerful and have the ability of lifting heavy loads vertically. Because of this ability, the machines also carry a possibly of becoming unbalanced if a load is too heavy or the load shifts. This could result in the machine tipping over, or the load falling off the lift.

Honeywell TARS-IMU can help detect the vehicle's position and abrupt motion. The system could also help to alert operator of possible safety issues by detecting inclination changes and other variable in the status of the machine either in motion or at rest. The response capability of the TARS-IMU could be utilized to implement automatic or manual additional adjustments to keep system from becoming unstable.

TARS | ROUGH TERRAIN FORKLIFTS AND AERIAL LIFTS FOR STABILITY CONTROL

Certain types of jobs require specialized tooling to get the job done. Forklifts, aerial lifts, and other similar equipment are necessary in projects involving construction work, landscaping, and more.

Much like shop-floor or factory-floor fork lifts, there are dozens of material and personal handling lift vehicles that could benefit from the implementation of TARS-IMU sensors.

Unlike shop forklifts that travel on smooth concrete floors, these vehicles with their high wheel base are specifically designed to be used on the rough, uneven ground commonly found in many construction work sites. The high wheel base is ideal for rolling over rough terrain; however, the uneven terrain can lead to load shifting and/or possible machine stability issues. The response capability of the TARS could be utilized to implement automatic or manual additional adjustments to keep system from becoming unstable.

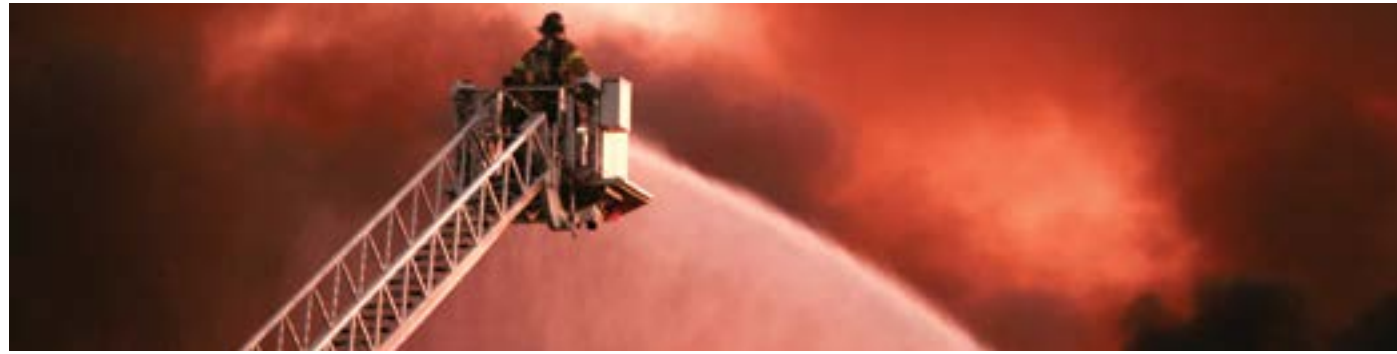
TARS-enabled vehicles could detect position and abrupt motion changes, system could help to alert operator of possible safety issues by detecting inclination changes and other variable in the status of the machine either in motion or at rest.

TARS | TELESCOPIC BOOMS STABILITY CONTROL

The same could be said for Ariel Lift/personnel lifts. In a similar fashion the high chassis design makes these machines extremely flexible on different terrains. However uneven ground possesses a risk of possible tipping or nosediving of the machine. If uneven loads are lifted the machine could become unstable. The response capability of the TARS could be utilized to implement automatic or manual additional adjustments to keep system from becoming unstable.

By contrasts TARS enabled device could make for minor adjustment or provide operator feedback to improve the likelihood of helping to keep the machine working within it's safe zone.





TARS | BUCKET TRUCKS BOOM STABILITY CONTROL

Bucket trucks can be seen just about everywhere. They are specially designed to get personnel to elevated work sites, and are essential for the electrical and telecommunication industry to help serve transmission lines on utilities poles and other similar structures.

When the bucket boom is deployed, there are many unseen variables that could lead to the possibility of the vehicle becoming unstable and tipping over. If the boom is overextended, overloaded, has a high wind load, or placed on uneven or unstable ground, it could cause the truck to tip over.

The response capability of the Honeywell TARS-IMU could be utilized to implement automatic or manual additional adjustments to keep system from becoming unstable.

TARS-enabled vehicles could detect position and abrupt motion changes. The system could help to alert operator of possible safety issues by detecting inclination changes and other variable in the status of the machine either in motion or at rest.

TARS | FIRE TRUCKS FOR BOOM AND LADDER STABILITY CONTROL

Ladder trucks have become a necessity for most if not all fire and rescue departments. Their ability to quickly arrive on scene, get into position, and be deployed makes them among the first pieces of equipment to arrive.

Ladder and hoist trucks can quickly aid in rescue, allow first responders to reach upper levels structures, and be equipped with water cannons to provide an aerial water spray or other fire retardant chemicals to aid in containing, controlling, and extinguishing a fire.

For all its capability, these ladder trucks also present a great risk to the personnel and structures around them. Their compact size makes them ideally suited for on-road travel and quickly deployments. However, the same size constraints also present some limitations to its capabilities. The small footprint makes the vehicle highly unstable when ladders, personnel carriers, and/or water cannons are deployed. There is always the possibility of the vehicle becoming unstable and tipping over.

The response capability of the TARS-IMU could be utilized to implement automatic or manual adjustments to keep system from becoming unstable.

TARS-enabled vehicles could detect position and abrupt motion changes, system could help to alert operator of possible safety issues by detecting inclination changes and other variable in the status of the machine either in motion or at rest.



TARS | TELESCOPIC CRANES BOOM STABILITY CONTROL

Their compact size makes them ideally suited for on road travel for quick deployments. However, the same size constraints also present some limitations to its capabilities. The small footprint makes the vehicle highly unstable when it mast is fully extended or overloaded. There is always the possibility of the vehicle becoming unstable and tipping over.

Although the TARS-IMU sensors are not suggested for installation on the mast of the crane, they are suited for chassis position and inclination monitoring. A TARS-enabled system would be able to detect small changes in the vehicle's behavior and movements along with inclination changes. These systems could be integrated to enable safety system on board to auto correct or alert operator of possible unsafe situations.

TARS-enabled vehicles could detect position and abrupt motion changes. The system could help to alert operator of possible safety issues by detecting inclination changes and other variable in the status of the machine either in motion or at rest.

TARS | TOW TRUCKS WRECKERS BOOM STABILITY CONTROL

Much like mobile cranes, the wrecker's compact size makes them well suited for on-road travel. However, the same size constraints also present some limitations to its capabilities. The small footprint makes the vehicle highly unstable when its mast is fully extended or lifting heavy loads. There is always the possibility of the vehicle becoming unstable and tipping over.

TARS sensors are suited for chassis position and inclination monitoring. A TARS-enabled system would be able to detect small changes in the vehicle's behavior and movements along with inclination changes. These systems could be integrated to enable safety system on-board to auto-correct or alert operator of possible unsafe situations.

TARS | VALUE TO CUSTOMERS

Machines equipped with integrated safety assistance will be found more often as the industry moves toward fully autonomous systems. The Honeywell TARS-IMU can be a key piece in providing and reporting key vehicle data. With six degrees of freedom, TARS-IMU sensors report 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.

With two sensor models for different power levels, TARS-IMU accommodates both 5 V and 9 V to 36 V vehicle power systems. While communication is carried to the vehicle through industry standard CAN J1939 connectivity.

As a standard, TARS-IMU is calibrated on aerospace-grade rate tables at the factory to provide calibration consistency between units.

⚠️ 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

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items that Honeywell, in its sole discretion, finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

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