immersion

Active Sensing Technology

Create Compelling New Automotive Haptic Use Cases with Active Sensing Technology

A smart algorithm and system design that maximizes the haptic system's capabilities to create sharp, crisp, haptic effects

Active Sensing Technology is the combination of advanced system software and system design that provides robust control of the actuator. It produces high-fidelity haptic effects, as sharp as the click of a mechanical button, and increases the actuator's frequency range, creating greater performance consistency across various actuator grades.

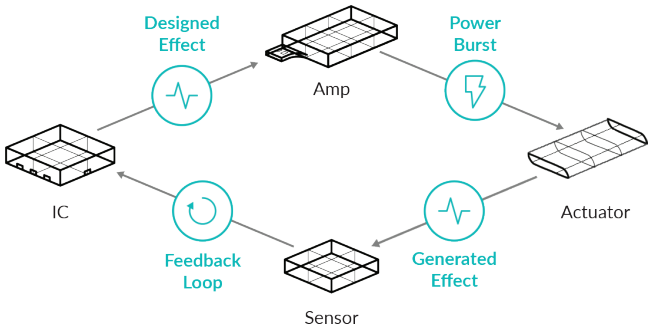
Active Sensing Technology achieves high-definition haptic effects by relying on a sensor to measure and send actuator acceleration data to the IC controller for real-time recalibration. Using a smart algorithm to store and process the data, the controller adjusts the drive signal's timing and strength for more precise control of the actuator every time. Such precision means optimized drive signals and exceptional braking for crisp effects and better, more consistent performance from the actuator.

How Active Sensing Technology Works

Active Sensing Technology is built based on a closed-loop haptic system, rather than the traditional open-loop system.

The **system software** runs on an **IC controller** and employs a complex algorithm that uses data from **the sensor** to make decisions every sub-millisecond on the strength and the timing of the signals sent out to **the actuator.** Depending on what is warranted to track to the desired effect **waveform**, the IC controller may send out a signal to overdrive the system to nullify the acceleration tail and get rid of any unwanted residue vibrations.

In a typical haptic system, IC controllers are not designed to generate voltage signals strong enough to drive actuators to produce the desired haptic effect. The



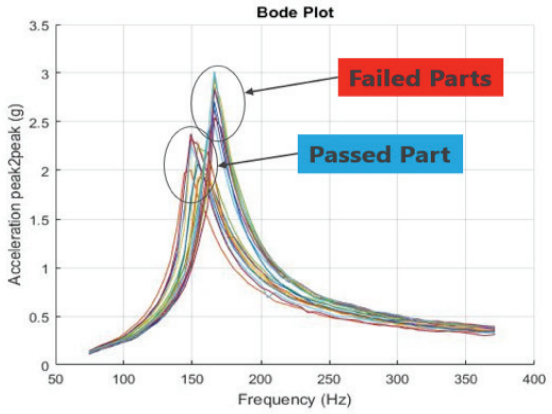
Active Sensing Technology's **mechanical system design** includes **an amplifier,** which is used to boost the voltage and provide an ample amperage to satisfy what the actuator needs to move masses in both whole-body haptic systems and suspension mounted haptic systems. This type of implementation in a suspension-mounted system enables the localization of haptic effects to the touch surface only, a criterion required to negate the mass or movement of the larger device body.

To create sharp **haptic effects**, an actuator must accelerate to peak magnitude rapidly, then stop vibrating rapidly. The IC controller pushes the actuator into overdrive to achieve fast acceleration. While reaching overdrive quickly is possible in an open-loop system, stopping the actuator almost instantly (with no detectable effects tail) is much more complex. Linear resonant actuators, for example, have a low damping capacity and a long settling time. Braking is a matter of timing. With Active Sensing Technology, the IC controller uses real-time and historical feedback data about the actuator's performance to time the release of drive signals to accurately counteract acceleration and rapidly stop vibration.

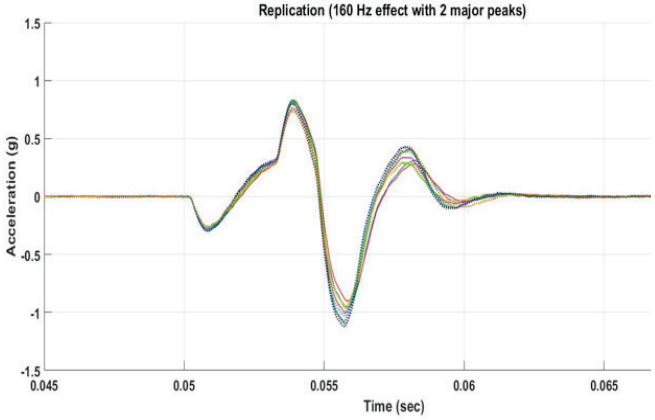
Testing the Technology

In a test of 20 identically manufactured actuators with varying (ten passing and ten failing) performance ranges, Active Sensing Technology normalized performance and brought the actuators within a passing range.

The tests with Active Sensing Technology demonstrated that the controller's new capacity to calibrate the next drive signal to the actuator's real-time function closes the performance gap among similar actuators.



Results of Single-Peak Actuator Test without Active Sensing Technology



Results of Peak-to-Peak Actuator Test with Active Sensing Technology

Benefits

High-quality performance through precise actuator control
Increase haptic fidelity with the ability to deliver vibrations close to designed effect waveforms. Precisely reproduce mechanical acceleration profiles with increased acceleration, frequency range, and strength. Use to effectively drive actuators that operate at high-voltages.

Robust braking
Improve the haptic system ability to cleanly stop oscillation by applying the proper voltage to counteract the unwanted residual tail. Get ultra-fast, robust braking without auto-resonance detection and reduce effects tails to undetected levels.

More consistent performance
Narrow actuator performance variance to a negligible degree in acceleration over time, thereby increasing OEM tolerance for inherent manufacturing inconsistencies. Move out-of-range actuators into passing range. Equalize performance among actuators of differing grades, cost, and quality.

Improved component compatibility and flexibility
Multi-source actuators and hardware components using the same system design and get comparable performance. Actively manage component variability within the closed-loop cycle.

PRODUCE HIGH-FIDELITY EFFECTS WITH A NEW CONTROL TECHNOLOGY THAT IMPROVES ACTUATOR PERFORMANCE

With the advanced performance capability, consistency, and compatibility enabled by Active Sensing Technology, Automotive OEMs can expand their implementation of haptics across the car HMI.

- **Linear sliders:** Stack sharp, high-definition haptic effects close together to create a sliding scale.
- **Button clicks and circular dials:** Hit the target acceleration to replicate button clicks realistically and dial turns to replace mechanical buttons and dials.
- **Surface textures and edge detection:** Create the illusion of a tactile surface for button detection with fine-grain haptic effects.
- **Localized effects:** Enable a fluid interface with the localization of haptic effect playback based on user interaction with the digital touchscreen.
- **Programmable:** Increase auto UI flexibility with an upgradable software-based haptics design
- **Multi-effect implementation:** Use a variety of effects on a single surface with the same actuator.