# INDUSTRIAL • UTILITY VEHICLE & MOBILE EQUIPMENT

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**Serving OEMs, Dealers, Service Professionals and Fleet Managers of Special Purpose Vehicles & Mobile Equipment**

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# 6th Annual Buyers Guide

CONSTRUCTION EQUIPMENT

## D-Series Compact Excavators From John Deere

Ranging in size from three to five metric tons, the new John Deere D- series, zero-tail-swing compact excavators provide reduced cycle times, added comfort with updated controls and cab, and lower operating costs.

*Please see article on page 4*

CONTROLS & INSTRUMENTS

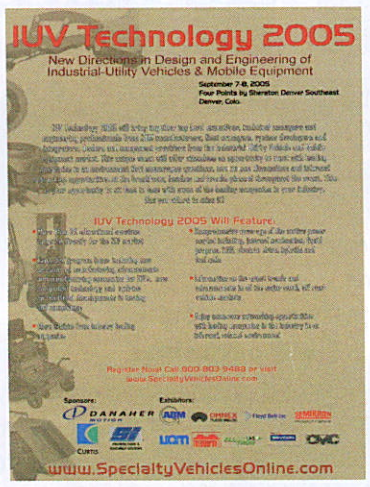
## New GraderStick Single Lever "Joy Stick" Control from Maddock Industries

*Please see article on page 9*

IUV TECHNOLOGY 2005 CONFERENCE PREVIEW ISSUE

## Expanded Exhibits and New Sessions from Leading Companies Highlight Second Year Event

IUV Technology 2005, being held September 7-8, 2005 in Denver, Colo., is fast approaching. This one of a kind industry event aims to educate attendees on the latest advancements in the design, engineering and manufacturing of lift trucks, industrial & utility vehicles, mobile equipment, AGVs and special-purpose off-highway vehicles and equipment. Attendees will be able to network in a relaxed environment with individuals in IUV market such as executives, technical managers and engineering professionals from original equipment manufacturers, fleet managers, system developers and integrators, dealers and component providers.




Some of the highlights of this second year event include an ever expanding list of exhibitors and sponsors such as Danaher Motion, Curtis Instruments, SI Systems and others. Besides a slue of industry leading exhibits IUV Technology also boasts an educational program unlike any other. The vast array of session topics include presentations on motion control, OEM and component provider panels, advances in battery and charging technology, standard compliance, hydraulic systems technology, steering systems, IUV manufacturing advances, fuel cells and information on integrated solutions for IUVs.

Inside this issue you'll find the IUV Technology 2005 conference brochure, which contains detailed sessions descriptions, a session schedule, list of exhibitors and information on how you can register, or for more information vist our website at ww.specialtyvehiclesonline.com.

*Please see our updated conference brochure between pages 12-13*

FEATURE ARTICLE

## What's Making That Noise? The Future of Acoustics Engineering for Human Machine Interfaces

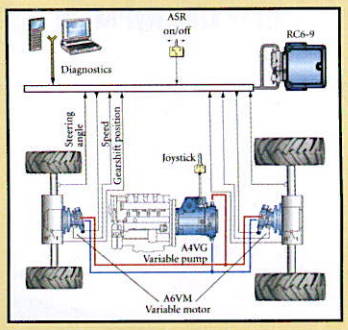
In an exculsive IUV Technology 2005 session preview, Frank Prince from Floyd Bell, Inc. writes about the future of acoustics engineering for human machine interfaces.

Prince writes about an approach to engineering, which includes human factor principles that can reduce costs and improve qaulity if they are implemented during the initial stage of a product design lifecycle.

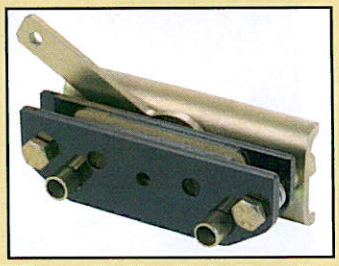
*Please see article on page 28*

## Features









## Departments

# What's Making That Noise? The Future of Acoustics Engineering for Human Machine Interfaces

**By Frank Andrew Prince Jr.**
**Technology Development Engineer**
**Floyd Bell, Inc.**

Each one of us is constantly subjected to a multitude of different sensory stimuli in everyday life. It starts with the dreaded high frequency blaring of an alarm clock that disturbs your sleep. There are the constant disturbances from emergency vehicles, lifts, cell phones, horns, emails, vehicles, pagers, PDAs, golf carts, industrial buzzers, watches, appliances and simply noise.

In the last decade, the growth of global market technology advances has completely altered the business environment. Businesses today face cut-throat competition. Customers expect low prices, excellent quality and faster response times. The pressures on new product development groups to introduce product innovations on a regular basis are increasing.

To succeed companies must learn to be lean and agile. The battle cries of driving down costs and improving the product quality require radical changes in the way businesses are operated. Many of the remaining product development groups need to do more with less.

A new approach being used that reduces costs and improves quality includes Human Factor principles during the initial stage of a product design lifecycle. A discipline of Industrial Engineering called Human Factors combines engineering and psychology. Human Factors Engineering (HFE) helps with the challenges of the Human Machine interface. HFE methods complement a technical team's deep knowledge of a particular technology with their deep knowledge of human behavior. This approach provides insight into the reasons someone would use sound technology. The reason would be factors such as their expectations, the human choices in technology use, and the limitations users might have during these interactions with the system.

Designers of machines, equipment and vehicles all must address the applications with respect to HFE. That is, designers must appreciate how humans behave physically, mentally and psychologically in relation to particular environments, products, or services.

HFE stresses three major goals: to enhance performance, increase safety and enhance human values to improve comfort or satisfaction.

> **"To succeed companies must learn to be lean and agile. The battle cries of driving down costs and improving the product quality require radical changes in the way businesses are operated."**

### 1. User Design

Design efforts need to be driven by the voice of the customer. HFE method seeks interaction with the user early in the project to inform them include them into lifecycle reviews. Simply running a validation test at the end of a project is not user-centered design.

### 2. Design Discipline

HFE stress that the experience of a team often blinds them about processes and technologies. Discipline and formal methodology stop engineers from getting isolated and not able to relate to the user. User information must be added to the project as soon as possible. An additional review for just HFE works very well.

### 3. System Design

A system consists of the unique interaction between a person's thought patterns/behaviors and technologies. Although the technical team might be heavily focused on the technology itself, the HFE methods can balance by focusing on the system aspects of technology.

Annunciations are critical to many products designs, whether they are technology improvements or unique applications of different technologies. We encounter HFE daily with appliances, computers, vehicles and machines. Often it is observed when it is the interface does not make sense. Have you ever pressed the left garage door opener button and the right door opens? Proper HFE design would place the buttons logically intuitively match door to the switch.

Alarms are an important system feature that can be used to guide the design of systems with which people interact. When designing an industrial vehicle or product that needs an alarm for an event there are three important criteria that need to be considered for the selection of alarm.

### Human Machine Interface

What is the user or human experience specification? Every product has event conditions for operations. There is a balance needed to prevent the two opposing problems of detection and "overkill" that our user might experience. It is important the event is guaranteed to be recognized and informative. Alarm events must be recognized to minimize confusion. Design should try to stay within the limits. The alarm should be below dangerous sound levels for the user. Also, the alarm should not be overly startling.

There might be multiple events that need to be addressed. This audible sensory need can be addressed with the specifications of individual sounds. A good approach for critical events or tone deaf operators is a multi-tone or multi-pitch alarm that automatically adjusts to ambient noise. A unique rhythm for a condition or a pre-warning to the critical event can be used to help avoid confusion. Then increase and decrease in intensity gives the perception of approaching or receding sound. A HFE review may determine that a design needs multiple alarms for a multidimensional wide area support.

If the requirement is that an alarm event must be recognized, then a traditional sound device is used. An example would be the tried and true old town fire bell. Alarms tend to be a uniquely sound design because of the omni-directional nature of sound. Our customers are able to sense auditory signals no matter how the users or operators are oriented. Innovation is being found with existing suppliers that can add value to auditory, tactile and vestibular solutions. Acoustics is the study of these types of sounds and the application of acoustics in technology is called acoustics engineering

Sound is produced from a vibrating source of rapid variation in the average air density or pressure of molecules above and below the current atmospheric pressure. A bell or piezo-crystal buzzer is a vibrating source that causes a disturbance to the surrounding air molecules (longitudinal waves), causing them bounce off each other with a force proportional to the disturbance. Sounds, perceived as these pressure fluctuations, cause our eardrums to vibrate.

*Floyd Bell s V09Q AudioLarm is a widely used industrial alarm ihat is available in 4 different tones, 3 sound output levels, 4 beep and 2 chime rates.*

When discussing sound, these changes in air pressure are referred to as sound pressure and the fluctuations in pressure as sound waves.

The human ear is sensitive to a range of sound frequencies from about 20 to 20,000 Hz. The wavelength range is about 17m for 20Hz sound and 1.7 cm for 20,000 Hz. A sound wave is characterized by speed, wavelength, and amplitude. The frequency of stimulus corresponds approximately to the pitch of the audible tone. The amplitude corresponds to the loudness of the tone. In describing the effects on human hearing the amplitude is typically expressed sound pressure (P) measured in decibels (dB). That is, Sound Intensity (dB) = 20 log (Pi/P2).

| TABLE 1: The Decibel Scale | |
|---|---|
| 140 and up | Ear Damage; Jet at take-off |
| 130 | Painful Sound |
| 120 | Propeller plane at take-off |
| 110 | Loud Thunder |
| 100 | Subway Train |
| 90 | Truck or Bus |
| 80 | Vacuum Cleaner |
| 70 | Average Auto; Loud Radio |
| 60 | Normal Conversation |
| 50 | Quiet Restaurant |
| 40 | Quiet Office; Household sounds |
| 30 | Whisper |
| 20 | Quiet Whisper |
| 10 | Normal Breathing |
| 0 | Threshold of hearing |

Product designers do not often take the time to analyze the characteristics of sound and the mechanisms by which sounds are produced, propagated and detected even in critical IEC 61508/61511 projects. LEAN and value stream mapping initiatives reveal a beneficial approach with a couple of new product development projects.

### Machine Interface

A system interface that connects an audible device may be hard wired to instrument or wireless for remote placements. The physical connection to the system should not affect the user or the operation of the product.

*Machine interface examples*

### Environmental and Task Analysis

What is the ambient noise in the environment? Understand the quality and intensity of the other sounds, noise or communications that might characterize the environment in which the alarm is presented to guarantee detectability and minimize disruption of other essential tasks. Other conditions that need to be addressed are the temperature, pressure, vibration and humidity.

Typically the alarm needs to be tailored to at least 10 to 15 dB above the ambient noise level. The general rule of thumb to guarantee detection is about a 30 dB difference above the ambient noise level. This is a measurement of the amount of pressure in the air being sensed at a given location.

It follows that its value can be determined through direct experimentation. There are two popular ways for scientists to perform acoustical measurements. They include a "direct method", and a "comparison method". The direct method computes sound power levels by calculating an equation of environmental factors (room temperature, humidity, etc.) and sound pressure levels. The comparison method uses a NIST or traceable reference source in comparison to the device under test.

### A Sound Solution

Including HFE practices during the different phases of development like Specification and Requirements, Conceptual Design, Development Phase, and Engineering Prototype Deployment Testing and Analysis, and V&V Phase is very critical to reducing costs and improving quality in product design.

HFE practices vary with the product and the design lifecycle. Often there is emphasis on a particular method, because it produces a measurable positive customer experience. There are several common elements that are easily implemented within most design processes. HFE is a team based cross-functional multidisciplinary approach. When performing HFE activities, we call on a wide range of in-house specialists from marketing, sales, firmware engineers, quality, repair technicians, field service engineers to industrial engineers and systems operators.

Acoustic engineering for sound interfaces applies HFE principles appropriate to product design to adapt a human-made environment to the people involved. A specialized area is the use of very loud piezoelectric alarms. These products are used for critical systems like emergency, safety and hazardous events. Examples include fire alarms, monitoring systems or equipment/vehicle control. The audible annunciations may affect complex technical systems or work tasks, equipment, and workstations, or the tools and vehicles used at work, home, or during leisure times.

Successful applications are measured by improved productivity, efficiency, safety, and acceptance of the resultant system design. Designs are tightly coupled to electronics and electrical engineering technologies that are driving the technology explosion. Common everyday devices like cell phones, PDAs, MP3 players, and computers are raising the level of expectation for each of our product designs. There are many factors affecting the complex interaction of the all-too well known world market. Acoustic engineering using HFE principles is one of the fastest growing areas of the design for interfaces.

*Frank Andrew Prince Jr. is the Technology Development Engineer for Floyd Bell Inc., a provider of Sound Solutions. These solutions include traditional piezo-crystal alarms, multimedia visual and sound solutions, and custom microprocessor based systems for Human machine interfaces. He lives with his wonderful wife and 2 children.*

*He has been an R&D Engineer, Quality Manager, LEAN Project Manager and Engineering Manager for the last 20 years. His design experience includes embedded systems used for instrumentation and sensors in Military, Aerospace, Scientific, Industrial and Commercial process control markets. Most recently he was Senior Development Engineer for the En-tronics R&D Controls Group for the Industrial Turbine Division of Rolls-Royce. A graduate from the University of Pittsburgh with a Bachelor of Science he has been a long standing member of the IEEE and ASQ engineering societies.*

*Floyd Bell Inc. goes beyond traditional market research and surveys to better understand customer needs and uncover the unstated needs. Our continuous improvement and development of new products are driven from the voice of our customers and their business requirements. Engineering offers custom services with an expanding product line that includes multimedia visual and sound solutions, buzzers, and component systems to provide our customers with complete solutions for interface design and Human Machine interface management.*

*Floyd Bell's topic, What the Hell is Making That Noise, is also a session at the IUV Technology 2005 conference. If you found this article interesting Frank Prince will be giving an indepth session on the topic during the show. IUV Technology 2005 runs September 7-8, 2005 in Denver, Colo. For more information visit www.specialtyvehiclesonline.com*