Ascension Technology Puts Spotlight on DC Field Magnetic Motion Tracking

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Innovative applications for motion trackers are fighting for center stage. The spotlight sweeps from medicine to biomechanics to entertainment, pausing for new advances in virtual prototyping and simulation. Motion tracking is hot. And the versatility and reliability of DC magnetic field technology is making it even hotter.

The DC magnetic approach to motion tracking overcomes two obstacles facing other tracking technologies, which means it is highly adaptable to a broad range of applications. First, the challenge of maintaining a clear line of sight between transmitter and sensor impedes optical tracking. Devices using light or sound energy need a clear path or the data transmission will be broken. With DC field technology, transmitters emit a series of DC fields unaffected by a hand or non-metallic object in the transmission path. One DC tracking product made by Ascension Technology is essentially a front-end data acquisition system, which means that as long as there is a software driver and software for the application, it can deliver position and orientation data in binary format to any type of computer

Second, DC technology is the only magnetic approach that overcomes many of the metallic distortion problems of older magnetic technologies, such as AC electromagnetic systems. AC trackers continuously induce eddy currents in nearby conductive metals, such as stainless steel and aluminum, which distort accurate measurements. By sampling the magnetic field once it has reached a steady state in which no new eddy currents are being generated in conductive metals, the DC approach overcomes many of the distortion problems that plague earlier magnetic trackers. Furthermore, the DC signal format is significantly less susceptible to distortion errors than AC systems when near ferrous metals such as iron and carbon steel.

With these problems minimized and aided by a number of newly released tools to further control interference in any environment, DC field technology means motion tracking enter an operating room full of stainless steel instruments or a warehouse structured with rebar—with minimal distortion and noise. Clinicians, researchers and animators alike can then concentrate on maximizing the use of motion tracking to their advantage.

Consider an example from biomechanics. Innovative Sports Training, Inc. (IST) has just received a patent for The LiftTrainer™, a behavior modification biofeedback program based on IST's biomechanics software package called The MotionMonitor™.

The LiftTrainer is designed for use in clinical work-hardening and industrial material handling settings – food and beverage warehouses or high-volume pick-and-pack mail order houses, for example. In the LiftTrainer program, motion data is assessed in conjunction with other biomechanical factors such as box weights and force data. The LiftTrainer calculates the torque forces generated on the L5/S1 spinal joint during lifting exercises using an inverse dynamics mathematical model. A tone with a frequency proportional to the amount of torque on the spine sounds during lifting exercises. With this information and cues provided by a trainer, individuals can develop lifting techniques that reduce spinal stress and minimize the risk of low back disorders. Training protocols designed around motion and force data, using audio biofeedback cues, have been shown to reduce spinal stress by 30-50 percent.

Ascension Technology's MotionStar® trackers are used in The MotionMonitor to track body movements. Six-degree-of-freedom magnetic sensors are attached to head, arms and trunk with quick release sensor attachment

cuffs. The system samples each of seven sensors simultaneously up to 144 times per second, achieving position accuracy up to 0.3 inches/0.5 degree at a five-foot range and 0.6 inches/1.0 degree at a ten-foot range. Motion data and weight data are captured, audio tones are generated and 3D skeletons depicting the lift are rendered on ordinary PCs driven by Pentium II 450mhz processors.

Magnetic tracking using DC field technology provide several of the LiftTrainer system's benefits. There are no cameras to set up, no line-of-sight problems and no time delays for post processing. Everything is done in real time, capturing position and orientation data for as many as 18 body segments and instantly reporting the results relative to normal tables.

With back injury an expensive, time-consuming burden, the value of preventative measures cannot be underestimated. "Back injury is a big problem, including what it costs to an industry. A lot can be done through re-engineering the job, but we shouldn't ignore what the employee can do for himself or herself," said IST president Lee Johnson. "What's exciting about this is that it is an application where you can take very theoretical research with a solid basis in science and apply it to mundane, real-world situations like lifting in a warehouse and do something good for specific individuals."

Motion tracking is putting on a dazzling performance in the medical field as well. With high level accuracy, Ascension's miniBIRD tracker employs pulsed DC magnetic-field transmitting and sensing technology to measure the position and orientation of miniaturized sensors mounted on probes or attached to measuring equipment. Spatial locations are tracked in real time, presenting an opportunity for precise navigation inside the body for surgical and pre-operative procedures. Using the miniBIRD in conjunction with an ultrasound scanner, a surgeon can make sure biopsy needles reach their target. The tracker can even be used in orthopedic surgery, placing screws and nails into broken bones.

Jay Monahan, formerly a medical physicist involved in early 3D ultrasound development, is now manager of medical sales and marketing for Ascension. He described motion tracking as "providing the missing link between imaging devices such as an ultrasound head and the human anatomy."

The heart, blood vessels, stomach and other organs can be depicted in 3D images that are far more useful than traditional 2D ultrasound images. This is a non-invasive, radiation-free method of obtaining information about organ functions and small muscle movements or neurological disorders. Fetal monitoring is more precise with the unrestricted range of 3D ultrasounds. An obstetrician can closely watch the descent of a fetal head during labor in case the baby's position presents a problem.

To Monahan, the miniBIRD's greatest attribute is its precision. The sensor can be located beneath a drape, under a doctor's hand or inside a patient's body cavity without presenting interference in the data transmission.

Although medical imaging companies such as Echotech, TomTec and Life Imaging are expanding their use of motion tracking with great success, Monahan said the technology is still a novelty. "The probes are being made smaller and smaller—the sensors can operate inside the body for laproscopic procedures, but clinicians haven't really caught up with the technology yet. It will explode as folks start asking 'what if' type questions about its possible applications," Monahan said.

"What if" has never been a problem for the animators at Dotcomix, Inc., however. In the world of 3D animation, they have created a transmedia show on television, radio and the web. Dotcomix has transformed cartoonist Garry Trudeau's *Doonesbury* character Ambassador Duke into a 3D animated figure appearing on talk shows, news programs, live performance events and a weekly-updated web series. Ambassador Duke is running for president. As talk show host Larry King commented when Ambassador Duke appeared on *Larry King Live*, "Some candidates end up on the comics page. We've got one who started there."

The Duke 2000 campaign is the creative collaboration of Trudeau, Dotcomix's animation team and actor Fred Newman who provides voice and movement for the character. Dotcomix works with two different magnetic motion tracking systems and three magnetic motion capture stages. Doonesbury's 3D Duke is set into motion with Ascension's MotionStar tracker which captures Newman's movements and instantly transmits the motion data to a host computer where the motions are mapped onto the character.

To process the animation, Dotcomix uses its proprietary software, ALIVE, with its sophisticated rendering and behavioral algorithms. The software is scalable to and from broadcast quality, so the animation can be produced for television and the web at the same time. At this point, the Duke 2000 transmedia is scheduled to continue until the November elections, with the character appearing in a number of television broadcasts and live events.

Magnetic motion tracking is building a broad repertoire of applications. Portable motion capture stages bring performance animation to just about any venue. Automobile manufacturers rely on virtual reality technology to evaluate new car designs in real time. Multiple motion capture performers put on boxing matches for game developers. Surgeons practice suturing tiny simulated blood vessels. And on the immediate horizon—new ways to evaluate the environment so the applications for magnetic motion tracking using DC field technology can become even quicker, even easier.