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The Most Powerful Name in Corporate News

High Performance EMG Instruments for Movement Measurement Studies

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"Delsys technology is superior to that of our competitors. It provides a higher quality expression of the electrical signal that originates in the monitored muscle, thereby yielding a more factual indication of the activity of the muscle. Our technology is suited for rudimentary applications as well as for sophisticated and refined applications, where accuracy is relevant."- Carlo J. De Luca

About Delsys Inc.
Delsys is a world leader in the design, manufacture, and marketing of a broad portfolio of high performance Electromyography (EMG) instruments, and a variety of physiological and biomechanical sensors used in movement measurement studies in research and education.

Since our inception in 1993, we have focused on solving the engineering challenges associated with the acquisition of reliable EMG signals, such as electrical noise from ambient power line sources cross-talk from adjacent muscles, and movement artifact from movement of the skin.

Our products are used in 85 countries worldwide. In the clinic they are used to monitor muscle dysfunction; in research laboratories for understanding the brain controls muscles to generate force; in sports to improve muscle performance; in ergonomics to monitor muscle fatigue and task suitability; and in biomedical engineering to control robotics and prostheses.

Interview conducted by: Lynn Fosse, Senior Editor, CEOCFO Magazine

CEOCFO: ***Mr. De Luca, what is Delsys?***
Mr. De Luca: Delsys is a company that design, manufactures and markets devices that detect and use the small electrical signal that is generated in the muscle when it contracts. This is known as the Electromyographic (EMG) signal and it can be sensed on the skin above the muscle of interest. Recently we have incorporated Inertial Movement Units in our EMG sensors to monitor the movement of the segment to which it is attached, so that a relation can be drawn between the activity of a muscle and the resulting movement.

Our technologies use the signal in various areas, for example in clinical environment where one might want to monitor the manner in which muscles are used in individuals who cannot walk correctly. By looking at the signal that comes from the muscles during walking, you can tell when the muscles in the lower limb are active and inactive, and the activity pattern, can be compared that to a normal pattern. In research laboratories it is used to understand how the central nervous system controls muscles that perform all the wonderful functions that allow us to interact with our environment. It is used in sports activities; for example where you want to enhance muscle performance. How do you make a javelin thrower further? What training is required, and how do you monitor improvement on performance? In the work environment, where people who perform heavy activities that challenge the physical capacity of muscles. For example, you might use the information from the EMG signal to design an assembly line. These are only a few examples.

CEOCFO: ***How personalized is the measuring of muscle activity? Would a woman have different readings than a man? How do you account for differences in people, or is it much more general than that?***
Mr. De Luca: It is more general than that. There are very few, in fact right now I cannot think of any gender-related differences in the EMG signal.

CEOCFO: ***What is it that you understand fundamentally at Delsys to create equipment that measures accurately and provides useful information?***
Mr. De Luca: I have been working in this field for over 40 years and have had the good fortune of working with remarkable colleagues who have also made careers in the field of Electromyography. I believe we have a deeper understanding than others as to how EMG sensors should be designed so that they provide high quality signals with minimal contamination from confounding factors that are ever present. For example, if you have a sensor placed on the skin above a muscle of interest and you are walking, every time you have a heel strike, that is when the foot hits the ground, a shock wave travels up the leg and displaces the skin underneath the sensor. This motion generates a movement artifact, a signal that has nothing to do with what the muscle is doing. Our sensors minimize the influence of the movement artifact. Or sensor design also reduces the contamination from adjacent muscles so that the detected EMG signal more faithfully represents the activity of the target muscle.

CEOCFO: ***How do you do so?***
Mr. De Luca: If you compare our sensors to those of our competitors which are based on designs that have been around for 100 years you would find that we have four metal contacts, or electrodes, whereas all others have two. So why do we have four? Two of the electrodes are used to monitor the movement artifact and to remove most of it on site in the sensor. Then we have software that analyzes the signal and further removes frequency components that come from the movement of artifact. The reduction of the cross-talk signals from adjacent muscles is performed by the geometrical arrangement of the electrodes in sensors. The ambient line noise is reduced by sophisticated electronic circuit design within the sensor. All these factors provide assurance to our customers that the EMG signal recorded with our sensors provides the best available expression of the activity of the targeted muscle.

CEOCFO: ***What is the competitive landscape? What is the industry in general for this type of equipment?***
Mr. De Luca: Delsys technology is superior to that of our competitors. It provides a higher quality expression of the electrical signal that

originates in the monitored muscle, thereby yielding a more factual indication of the activity of the muscle. Our technology can be used in more sophisticated and refined applications, where accuracy is relevant.

We have several advantages over our competitors: 1) The design of our sensors is based on new knowledge from our own research published in high-quality peer-reviewer scientific journals. 2) It is revolutionary. 3) It is patented. 4) Our competitors used designs and concepts that are vastly outdated. Our designs employ sophisticated state-of-the-art concepts. 5) Our EMG sensors have within the same footprint a gyroscope and acceleromers and a magnetometer. Thus, from one sensor we provide high fidelity EMG signals and information that tracks the movement of the segment to which the sensor is attached. In so doing we can monitor simultaneously the activity of the muscle and the consequential movement of the body segment. Comparable devices from our competitors require two or three separate sensors to accomplish the same function. Their approach is much more cumbersome and requires more gadgetry that entangles the recording procedure. Imagine monitoring eight separate locations on the body; our technology requires eight sensors, our competitors would require 16 to 24 sensors to obtain the same set of data.

The majority of present use for our technology is in the research and clinical environment. At the present time we do not provide consumer products; however we are considering a possible future expansion in this area.

CEOCFO: ***For people who should be aware of your technology, do they know Delsys? How do they resist the fact that you have four sensors and not two?***
Mr. De Luca: We are accustomed to introducing revolutionary technology in the EMG field. We began the company with a revolutionary sensor that had electrodes consisting of parallel bars spaced at a fixed distance of 1 cm apart. This was the first substantial change in EMG sensor design in several decades. Other companies used silver/silver chloride disks separately attached and spaced 2 cm apart. There were some initial concerns about our technology, which we alleviated by performing experiments and publishing the advantages of our new sensors in peer reviewed scientific journals. Users of EMG sensors became curious and soon discovered the advantages of our technology. When we introduced the four electrode sensor, our clientele had grown to expect technological advancements from Delsys. They quickly and widely accepted the new sensor.

Certainly the research community is familiar with Delsys and we are making notable inroads in other areas that can benefit from our technology.

CEOCFO: ***What are some of the areas where Delsys products should be used but do not have the traction that you would expect? What are people missing?***
Mr. De Luca: The opportunistic use of high quality EMG signals has not yet entered the common awareness of the engineering and health science communities. Consequently, EMG technology is not exploited to achieve its potential. Delsys is positioned to play a role in defining the future of EMG technology.

We hope to make inroads in the control of robots, in the control of prosthesis and in monitoring the effect of medications in neuromuscular disabled patients, such as those suffering from Parkinson and Stroke,

and in designing the environment with which we interact physically, such as less physically demanding work environments.

I believe that we are entering a period of time where Electromyography will come of age. This evolution will be spurred by the growing emphasis that society is placing on the quality of life that we lead. I sense it.

CEOCFO: ***How do you take advantage as a business of the upcoming changes?***
Mr. De Luca: We spend an inordinate amount of time and funds in performing research into novel applications. We have some very interesting ideas, which hopefully will prove to be useful and should unfold over the next five or six years. As a small company we apply for and receive funding for specific projects from Federal funding agencies such as the Small Business Initiated Research program. Additionally, we have the advantage of using our own funds to supplement programs that show promise. The synergistic complement of Federal and indigenous funds give us a competitive advantage. We also use the research programs to attract the brighter minds in the field.

CEOCFO: ***Final thoughts?***
Mr. De Luca: Delsys was started to provide advanced, more useful, technology in the field of Electromyography so that users could collect better quality signals on which they could base their investigations, and pursue novel application. From the very beginning, Delsys had as a fundamental concept, the use of revenues from selling our technology to fund indigenous research programs. Such as those for novel uses of EMG technology, and those for executing fundamental studies into understanding how the central nervous system controls muscles to generate force that does all these wonderful things that allow us to interact with the environment. I wanted to generate a reliable, consistent, flow of funds that would insulate us from the occasional vagaries of government funding agencies. I feel comfortable in telling you that I think we have succeeded in doing so, and that both our product lines and our research programs are continuously expanding.

BIO: Carlo J. De Luca – (Biomedical Engineer) received his doctorate degree in 1972 from Queen's University in Canada, where he began his academic career. He was appointed to the faculties of MIT and Harvard Medical School simultaneously from 1974 to 1984. He then joined Boston University, where he currently holds the titles of: Professor of Biomedical Engineering, Director of the NeuroMuscular Research Center, Research Professor of Neurology, Professor of Electrical and Computer Engineering, and Professor of Physical Therapy. He served as Dean ad interim of the College of Engineering from 1986 to 1989.

He is recognized for introducing engineering principles to the field of Electromyography; for introducing technologies for decomposing the Electromyographic (from the muscle) signal decomposition technologies; and for introducing novel technologies to the study of muscle physiology. His body of work includes: a book, *Muscles Alive*, 113 peer-reviewed articles, 20 book chapters, 18 peer-reviewed conference papers, and 17 patents. His writings have been cited over 22,500 times.

He has been the subject of several biographical references including Who's Who in the World and Who's Who in America. He is a Founding Fellow of two Bioengineering societies (AIMBES and BMES), and a Life Fellow of the IEEE BMES. He served a term on the National Advisory Council for Biomedical Imaging and Bioengineering of NIH; and two terms as President of the Int. Soc. of Electrophysiological Physiology.

He received the 2012 Borelli Award (American Society of Biomechanics); The 1999 Isabelle and Leonard H. Goldenson Technology Award (United Cerebral Palsy Foundation); The 1989 International Volvo Award on Low Back Pain Research (Int. Society for the Study of the Lumbar Spine). He delivered the 1998 and 2000 John Basmajian Lecture (Int. Society of Electrophysiol. Kinesiology); the 1994 Stuart Reiner Memorial Lecture (American Association of Electrodiagnostic Medicine); and the 1993 Wartenweiler Memorial Lecture (Int. Society of Biomechanics).

He founded Delsys Inc., and continues to serve as its President and CEO. In 2006, Delsys received the Tibbetts award from the U S Small Business Technology Council for exemplary use of SBIR awards. He is the founder and President of the Neuromuscular Research Foundation, established to recognize researchers in the fields of Electromyography and Biomechanics with emphasis on Motor Control. The foundation provides an annual award, the Delsys Prize; and the Emerging Scientist Award administered by the International Society for Biomechanics.

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