Lightning Mapping System Bolsters Air Travel Safety

Researchers at the Langmuir Laboratory for Atmospheric Research at the New Mexico Institute of Mining and Technology have been getting a real charge out of their work. They have developed a system for mapping lightning named, simply enough, Lightning Mapping Array (LMA). LMA is a PC-based system that measures radiation to produce a three-dimensional map of lightning activity and it has been enhanced with Data Translation's DT301 PCI data acquisition board.

Langmuir Laboratory is the leading thunderstorm research facility in the United States and is recognized worldwide for the scientific work carried out there. The Laboratory's new and impressive Lightning Mapping Array measures the time of arrival of 60 MHz RF radiation from a lightning discharge at multiple stations, and locates the sources of the radiation to produce a provocative three-dimensional map of the total lightning activity. The LMA system shows the entire lightning structure, 'source to strike'. Most of the mapping systems that people are familiar with today are strike maps, in other words, they only show where lightning *ended* up, and not where it *initiated.*

The recently introduced version of the Lightning Mapping Array promises to have numerous commercial and research uses including, but not limited to, assisting busy commercial airports with safety precautions during potentially dangerous lightning producing storms. Lightning patterns may also help in the forecast of other weather hazards such as tornadoes or a frightening phenomenon known as a microburst. A microburst happens when severe winds blast downward unexpectedly and fiercely during a thunderstorm.

Although existing radar systems can give 'reasonable' warning of weather hazards, the cost is prohibitive. A commercial weather Doppler radar system costs about $6M, whereas the commercial version of the LMA is projected to cost about $500K making it much more affordable for smaller airports .The commercial LMA will be targeted towards two groups: researchers trying to learn more about lightning, lightning protection, or how lightning effects such systems as power distribution; and operational use for lightning warning and location.

To make the measurement in their LMA, scientists needed to digitize with high resolution (16 bits) at a 5 kHz digitizing rate. Again the key to being able to put the measurements together is precise timing at remote stations. That is why The Langmuir Laboratory for Atmospheric Research turned to Data Translation's DT301data acquisition board. The DT301 has 12-bit resolution, with a digitizing rate sufficient for Langmuir Labs needs. It has a PCI interface, allowing the lab to transfer large amounts of data (20 kB/sec) to the host computer without tying up the bus.

The key feature of the DT301 is its triggering features and its ability to put a digital word into the data stream. The lab needed to be able to synchronize the digitizer to GPS time, and insert the time information into the data stream so that the data could be correlated between stations. The DT301 with its 1,024-location channel/gain list allowed the Lab to switch between the electric field measurements and timing information. The LMA programs the DT301 to read the time (from the digital inputs of Ports A and B) into the data stream, then read 999 values of the electric field. The Lab can trigger the card externally from the GPS pulse-per-second signal so that they know precisely when the sequence starts. The Lab can use an external digitization clock, which they can derive from the GPS signal so that stations stay in sync.

"The DT301 provides very accurate timing when we gather the data from multiple stations," said Bill Rison, professor of engineering at New Mexico Tech. Langmuir Laboratory. "The primary reason for choosing the DT 300 series board was the ability to interleave digital data with analog data, and flexibility of triggering. Other things we wanted were available on other boards – 16 bit A/D, sampling speed of at least 5 kHz, PCI bus, and programmable channel-gain sequence. We needed to be able to accurately time-tag the data."

The potential use of the information being obtained is mind-boggling. In fact, the Langmuir Laboratory is currently working with a company, Global Atmospherics, Inc. (GAI), of Tucson, Arizona, to develop a commercial version of the system. GAI currently sells systems that locate CG discharges. They also have a network of CG location stations throughout the US and Canada, and sell data from this system to such clients as TV stations (for weather reporting), insurance companies (for lightning damage claims) and power companies (which use it to determine where lightning struck their power lines). Other possible uses are large areas where a number of people work in the field, or work with explosives, such as on military basis. Knowing when lightning is in the area, and its location, can be quite valuable.

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