Making sense of real-time load measurement

The handling of dry bulk materials used to be a completely manual process, but it is now being increasingly automated in a drive to reduce both the costs and the risks of injury, while also increasing throughput and accuracy.

The demands of today's highly competitive commerce and modern industry are such that speed, accuracy and efficiency are required within every process. This includes the handling of dry bulk materials, such as grain, coal, aggregates, minerals and chemicals through every stage of their logistical journey from producer through processor and distributor to eventual end-user.

Not surprisingly, major handling facilities are now highly computerized, and often have a control room with a bank of computers, which would not look out of place on the USS Enterprise. Their job can be summed up as collecting information from many, many different sources, collating it, and then calculating the optimum procedures for every stage of the overall process.

The computers represent a well-developed technology and their data processing abilities, while hugely impressive, are based on relatively simple logic algorithms. The technology developments that are driving the advancement of bulk handling are at the sensing end of the system, where the prevailing conditions of the moment are detected and converted into data signals for the computer to use.

"Sensors are the eyes and ears of the computerized system," says Mark Ingham of Sensor Technology Ltd, one of the companies at the forefront of developments. "They constantly monitor what is going on and feed real-time data to the computer."

One of their latest products is a load sensor with a difference. Called LoadSense, it is wireless, so is ultra easy to deploy in situations like docks and grain banks where installing cables would be difficult – and maintaining them even harder!

LoadSense is online permanently and constantly sends real-time load value signals to either the central computer or its own local computer or receiver for preliminary analysis. It can be used in all types of materials handling operations, but is particularly useful for measuring loads in augers and on conveyors, where materials are 'in flight', so the load varies constantly with time.

LoadSense can be thought of as a two-part system. First, is a strain gauge-based stainless steel tension type sensor, with a twin antenna transmitter built into it for transferring the load data the instance it is generated. The second part of LoadSense is the receiver, which can be either fixed in place or handheld. The receiver reads, displays and records the data and can pass it onto the central control system for integration with other data streams for analysis.

The receiver includes an in-built 32MBit memory, which can hold up to 280 hours of data, thus providing both a local control station and a backup databank for the wider system. It is also notable that each receiver can collect data from several nearby load sensors simultaneously, in a range of up to 100m.

Importantly, the LoadSense transmits using the worldwide licence-free frequency of 2.4GHz, so can be installed and operated freely without disrupting other radio-based equipment. In operation, data is transmitted at up to 10 times a second, so LoadSense is constantly updating and providing real-time information so that operations can be optimised for best results.

The key benefits LoadSense brings to materials handling installations include: the simplicity of wireless installation, easy reconfiguration, its long battery life (which is complemented by easy recharging), and the dual antennas which represent just one part of the overall rugged design.

Technology transfer

In fact, Sensor Technology originally developed LoadSense for use with helicopters, as Mark explains: "Helicopters often carry cargo in nets slung from cargo hooks on their underside, and it is important that the pilot knows its weight. A conventional load sensor in the hook could provide this data, but wiring it back to a readout in the cockpit would invalidate the craft's Certificate of Airworthiness, implying the need for expensive recertification. When we heard about this dilemma, we instantly realised that a wireless solution was the answer!"

Since its development LoadSense has been adopted by many other industries, too. For instance, in forestry tree harvesting is often best done by pulling the trees over with a large tractor – this uproots them, so that the whole tree is recovered and also the ground is left stump-free so is in better condition for reuse – a LoadSense on the pulling cable will provide the tractor driver with vital live information and also collect data on harvest volumes for commercial analysis. They have also proved popular in the fly towers of theatres, allowing scenery and backdrops to be raised and lowered quickly and safely, for materials monitoring in road laying and civil engineering, in food production and processing, etc.

Sensor Technology has also transferred another of its technologies, TorqSense into the world of dry bulk materials handling. Like LoadSense, TorqSense uses a radio frequency signal transfer technique, but its sensing head measures the rotary torque in a turning shaft.

"Consider a screw conveyor or auger, both of which are driven by a rotating motor shaft," says Mark. "If this is rotating empty, it requires little power from its drive shaft. If it is half full, it requires rather more, and if it is completely full its needs a lot more.

"The same goes for speed – the faster, the more power consumed. Also, the denser the material being conveyed, the more power required. By constantly measuring the torque in the driveshaft, we can determine the volume and weight of material being conveyed."

Both LoadSense and TorqSense have been successfully used in dry bulk materials handling installations and have proved their worth many times over. As handling inevitably becomes more automated, the need for such technologies will become more and more crucial.