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Laser brings dimension of time to machine surveys

Falk PLI Engineering and Surveying has bought a Faro Technologies' Laser Tracker to assist in the dimensional verification of metalworking processes

The engineers at Falk PLI Engineering and Surveying built their business around the notion that for machine alignment it is necessary to move beyond 3 dimensional analysis to include a 4th dimension of time. This process recognises that measurements are only correct for the conditions in which they are taken.

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Emerging as one of the most significant players for dimensional verification of metalworking processes - particularly steel - the Portage, IN, company demonstrates the truth of this concept all over North America.

From coke plants to pickling lines, the larger-than-life nature of steel making would seem to belie the need for precision.

But secondary forming processes depend on tight dimensional tolerances, so, raw slab, billet, or rod stock must be produced under close controls.

Precise alignment of primary moulding and shaping equipment is critical for optimum throughput because yearly scrap from these lines can grow deep into seven figures.

Composed of more than 30 engineers, Falk PLI Engineering and Surveying is led by Mike Falk.

He has studied the science of measurement for over two decades and been associated with a number of massive construction and alignment projects, including the huge superconducting super collider that was assembled on a 54-mile circumference near Dallas in the late 1980s.

Early in his career, Falk began to notice that actual machine dimensions were not always what they were purported to be on drawings.

The challenge was to help OEM's achieve 'first time fit' in the field as they struggled to reassemble massive equipment components to pre-cast mounts.

The reality is that machine elements built in one location at one temperature and shipped to and assembled in another location rarely retain their original size.

Even the act of transporting them can change the dimensions.

Compounding the problem is the fact that the equipment may not have been built using precision measuring equipment.

During assembly, this 'dimensional delta' becomes a major headache for machine riggers trying to get the final alignment right.

'These errors are additive, and we have seen a coke plant or caster or rolling line be off significantly from what the drawings said the dimensions were,' explained Falk.

Equipment already in service experiences a similar but slightly more complex problem.

Not only does it undergo thermal expansion/contraction, but dimensions shift due to heavy usage; a fact of life in most metal-forming processes.

Falk concluded that machine alignment was beyond a three-dimensional problem, and began to incorporate the 4th dimension of time into the analysis.

'Years ago, alignment was seen, at best, as a two-dimensional problem.

The surveyor would use optical equipment to perform anchor bolt verifications.

But now we know that machine components have a 3-D spatial relationship, and alignment must be done in a reasonable period of time to ensure good fits with the mating equipment.

This is the only way to confirm that the sections of a machine work together smoothly and meet product to specifications.

Optical systems are very labour intensive in handling the third dimension'.

With this in mind, the alignment of coke batteries, casters, rolling lines, or pickling lines must be done thoroughly - and fast.

Several years ago, Falk's work at the superconducting super collider introduced him to a laser measuring system that bounces a beam off a movable target, then automatically calculates the position of the target to a 3-D single point accuracy of 0.001 in.

The system, known as the Faro Laser Tracker, can be set up on a tripod in almost any manufacturing environment and gather data in a matter of minutes, in environments that range from - 15 to 50degC (5 to 122degF).

Operating speed is no limitation as the instrument makes 10,000 samples/sec.

A novel feature ensures that data collection is smooth.

Unlike cell phones where 'dropped calls' are common and the caller must take time to redial, the laser visually 'tracks' the motion of the target.

If a pillar, motor, or other obstacle interrupts the beam, the Tracker easily reacquires it, and data gathering continues.

The Laser Tracker is part of the Faro Technologies' family of metrological instruments that are designed for industrial and scientific applications.

The niche of the Tracker is measuring huge objects - anything within a 230 ft.

range - with pinpoint accuracy.

For instance, the 96-foot Canadarm that flies on the Space Shuttle is built under the watchful eye of a Faro Tracker.

Other applications include checking dimensions for aircraft wing tooling and aligning bearing pads for huge ball mills in Nevada gold mines.

During a survey, data collected by the Tracker is processed by a computer and compared to embedded CAD drawings of the equipment.

Locations of bolt holes, pins, or machined surfaces that are out-of-spec are noted on the computer's display, and the data is used to bring the sections into alignment.

Sometimes with older equipment it is more expedient to find a 'best fit' for machine sections.

'Equipment dimensions change with age - bearings can become pitted or even the foundations become soft - and occasionally we find that the best alignment is one that takes into account the relative position of the equipment as they are, as opposed to resetting everything to the plan schematics,' Falk said.

Alignment is not the only use for Tracker data, however.

It can be downloaded into a number of other disciplines, including rendering, architectural, or CAD programs.

In some cases, this information can be used to develop custom programs for in-house applications.

The quality of an alignment depends on thoroughness, but survey time greatly affects project costs.

Because the Laser Tracker gathers data so rapidly, engineers are able to complete measurements quickly and more efficiently.

For example, projects that normally take from 8 to 12 hours to gather data with optical equipment can often be handled by the Tracker in under 20 minutes.

Recently, at an older mill, operators dramatically reduced downtime during an outage with the Laser Tracker.

Working on the mill floor, engineers positioned the Faro Tracker near the caster and ran the instrument's calibration routine, which takes about five minutes.

Then, they began collecting data on the caster and bow frame.

The caster, itself, has a radius of approximately 50 feet.

If the owner had been using optical measuring equipment, the optical survey would have taken anywhere from one-and-a-half to 3 days.

But with the Laser Tracker, the needed measurements were collected in under two hours.

The results of the survey were a little unsettling.

According to the schematic plan for the mill, 24 of the 36 bearing pads in the bow frame needed to be adjusted.

But this is where experience and the versatility of the laser system come into play.

Falk engineers were able to find a 'best fit' alignment for the equipment such that only 7 of the bearing pads would have to be adjusted.

'This way, they avoided having to re shim 17 bearing pads - and cut several hours off the outage,' Falk said.

Because this new survey technology is so fast and cost effective it enables clients to reduce clients downtime and costs associated with quality disruptions.

'It is results like this that keep us coming back,' noted Falk.