Palaeontologists model the Original Tyrannosaurus rex with Leica LR200 Laser Radar Scanners

(Above): The T. rex skeleton scanned resides in the Dinosaur Hall at the Carnegie Museum of Natural History, Pittsburgh, PA. It was the actual evidence -"Type Specimen" - used by Henry Fairfield Osborn to first classify the world's most popular dinosaur species in 1905. This original skeleton was discovered in the Montana Badlands by the famous dinosaur hunter Barnum Brown. Today, the dinosaur is estimated to be worth over 50 million dollars

(Below): The museum will pose two Tyrannosaurus rex fossils, including the actual type skeleton, battling over an Edmontosaurus

High-tech laser radar scanners from Leica Geosystems have been used to produce the most complete digital model to date of the massive dinosaur, Tyrannosaurus rex. In order to demonstrate the current state-of-the-art Coherent Laser Radar (CLR) technology, a team of metrology experts from Leica Geosystems, MAGLEV, Inc. (McKeesport, PA), and MetricVision, in association with the Carnegie Museum of Natural History (Pittsburgh, PA), used two Leica LR200 Laser Radars to scan every inch and surface of the world's most famous dinosaur that resides in the Museum's Dinosaur Hall.

Collection of 3D data sets

The pair of networked LR200 coherent Laser radars were placed upon six-foot towers and navigated around the perimeter of the historic skeleton in order to collect accurate 3D data sets, otherwise known as point clouds. The gathered point clouds were then used to measure and build a 3D computer solid model - an exact digital prototype of the 17-foot tall dinosaur, and the most accurate and comprehensive set of measurements taken of a dinosaur of *T. rex's* scale. The Leica LR200 is the ideal measurement device for precisely measuring large objects with scan rates up to 1000 points per second at volumes up to 48 cubic

meters with accuracy up to 20 microns. The instrument is the first non-contact measurement device to combine radar, laser and 3D software technologies. Other supporters of the project included measurement specialists from ATT Metrology Services®, New River Kinematics® with Spatial Analyzer™, the operating software and Unigraphics® for their surfacing software, Imageware™. The team of engineers and scientists donated the entire digital library of *T. rex* data to the Carnegie Museum of Natural History for use in future research and artefact conservation.

Modelling with a digital replica

Palaeontologists now believe the *Tyrannosaurus* species carried its tail high in the air. The museum will therefore pose two *Tyrannosaurus rex* fossils, including the actual type skeleton, battling over an *Edmontosaurus* (see sketch left), thus setting the stage for an investigation into carnivorous dinosaur behaviour. With an exact computer digital replica, the museum will be able to easily model the 3D skeleton in different configurations, choose the most appealing positions, and then design the required support. This high precision data can also be used further down the road for scientific analysis of the fossilized bones.

"Using a direct measurement instrument, we are capturing very high precision *T. rex* surface data, in contrast to less accurate artistic methods - the laser radar has enabled us to acquire accuracy up to 250 microns," Steve Hand, an expert metrologist at MAGLEV, Inc. and project manager, said. "Using the resultant 3D computer model, Carnegie palaeontologists will be able to take *T. rex* apart in sections, even vertebrae by vertebrae, to re-position the dinosaur."
"But the benefits of the scan do not stop here. The precise model will serve as the foundation for scientific analysis, comparisons to other fossils, and more."

The *T. Rex* walks again

The story, however, did not end there. Extrude Hone Corporation's ProMetal Division, took the scanned data and replicated the famous *T. rex* in solid metal. This was created by 3D Printing – a process that manufactures highly accurate and complex metal, ceramic, or metal ceramic composites from three-dimensional computer-aided design (CAD) models.

The partnership proved that science and technology - combined with a little imagination - can help museums preserve and promote one of the earth's most valued artefacts. This demonstration of accuracy in measurement, scanning capability and rapid manufacture will not only help revolutionize the field of palaeontology, but it will benefit generations of dinosaur lovers for many years to come.

About MAGLEV, Inc.
Incorporated in 1990, MAGLEV's mission is to create an integrated Pennsylvania Industry/Government partnership and implement manufacturing, construction, and deployment of a Transrapid International magnetically levitated high-speed transportation system beginning in Pittsburgh, Pennsylvania. "Based on the same level of precision, we will use the laser radar technology to build highly accurate guideway beams for high-speed magnetically levitating trains," Steve Hand said.
The company acquired their coherent laser scanner through a contract with the Office of Naval Research for a study of weld distortion in steel beams for shipbuilding applications. The collaborative endeavour between MAGLEV and U.S. Office of Naval Research (ONR) provides the research and testing groundwork to perform weld distortion analysis for the manufacture of highly accurate large steel curved beams using the LR200 laser radar. For more information, visit http://www.maglevinc.com.

(Right): The LR200 coherent Laser radars had to be placed on towers in order to navigate around the skeleton

(Below left): The Laser radars produce accurate 3D data set known as point clouds

(Below): The gathered point clouds were then used to measure and build a 3D computer solid model