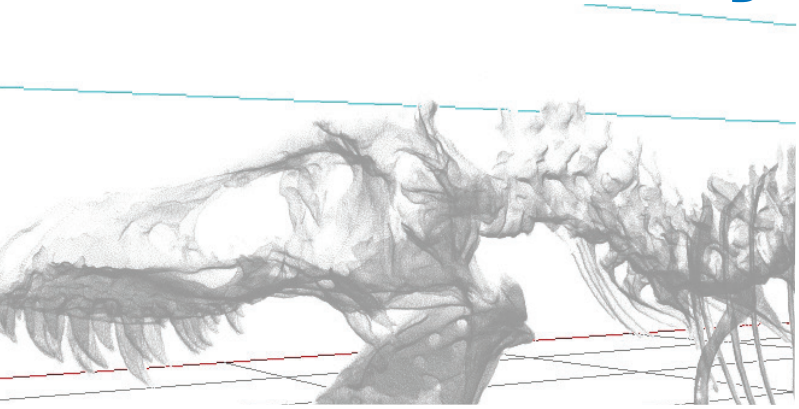
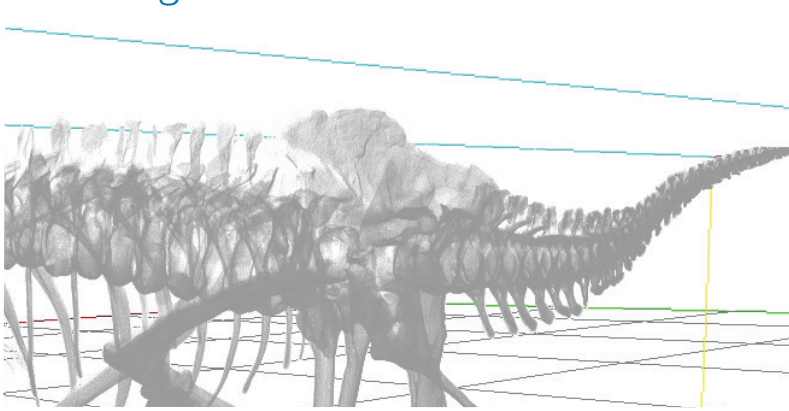
How we build reality

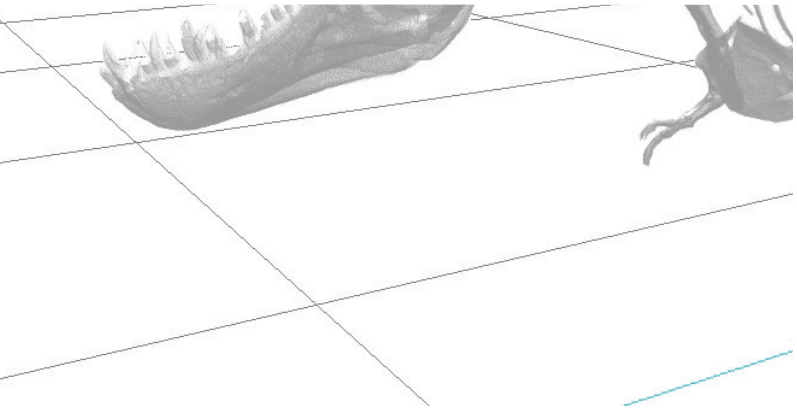
Zoller+Fröhlich

Case Study

Estimating mass properties of dinosaurs using laser imaging and 3D computer modeling







Company Overview

Z+F is the world leader in the manufacturer of phase based laser scanners.

Our strengths lie in our powerful 3D laser scanning hardware and software innovations which are considered to be the best on the market, the continual nature of these innovations and the support that we show to our customers who are loyal and longstanding owing to the service we provide.

In cooperation with the University of Manchester Palaeontology Research Group

Introduction

Estimating the body mass of vertebrates is an important factor to quantify if we are to understand the locomotion and behavior of both, extant and extinct species.

Mass estimates can be more carefully estimated when complete to near-complete mounted skeletons are laser scanned. The data can be used to reconstruct digital models.

The 3D digital model can then be imported to suitable processing software that allow mass estimations to be calculated. The virtual body volume can also be manipulated to account for subtile changes in body mass that might affect locomotor ability and centre of mass.

The benefits of rapid 3D capture are now also being realised in the broader fields of geological heritage conservation (geoconservation) where 3D digital outcrop models provide valuable data on the year on year weathering of type localities or important excavation sites.

For this case study, the work on body mass estimates for dinosaurs, undertaken by Paleontology Research Group based at the University of Manchester, 3D laser scanning technologies was used to modify model properties non-destructively.

The 3D laser scanning technology of Z+F was used to scan five specimens of dinosaurs at museums in the UK, USA, China and Argentina over a 12 months period.

The whole process was filmed by National Geographic who saw this innovative application of the new techniques as an important example of how 21st Century technology is assisting palaeontology.

3D laser scan of the Tyrannosaurus rex known as "Stan".

Methodology

The Z+F IMAGER® 5006i was the perfect choice for use of 3D scanning by teams of palaeontologists in the field to scan dinosaur excavations and dinosaur tracksites.

Instruments and Software
The Z+F IMAGER® 5006i phased based scanner was used due to its accuracy, resolution and data acquisition rate of 500,000 points per second.

Vast amounts of data were quickly generated and stored on the IMAGER® 5006i internal hard drive (sometimes directly to an attached netbook which was both, very cost effective and allowed a secondary back-up to the internal hard-drive of the scanner).

The huge advantage of the Z+F IMAGER® scanners is that they are totally encapsulated units where no peripherals are required to operate. This was a great advantage for setup positions the skeletons where any cabeling would beneath an obstacle.

It was important that the scanner was portable and light due to the diversity of environments in which it was used by the Manchester team, from desert to museums and from mountain slopes to floorplains.

Many scans were produced and registered via the cloud-to-cloud technique. Preview scans in real-time enabled onsite verification of the recorded data.

3D models were then generated to produce a high resolution skeletal framework for use in locomotion software written by members of the team at the University of Manchester.

Why was laserscanning chosen
To enable the researchers to estimate how Dinosaurs moved and functioned, it is important to be able to capture precise data on the geometry and morphology of mounted skeletons. The Z+F scanner provided the fastest and accurate data capture technique available to the team.

The data captured provides detailed information on the measurements, dimensions and colour (if desired) of real-world objects or environments.

This provides a powerful source of data for the software to help determine the different key features of the dinosaur that impacted on properties such as body mass, skeleton loading, accurate body mass segments, moments of inertia for each element of the animal, etc.

Access to many of the visited sites around the world was time limited, therefore it was extremely important that this time was used productively and as much data as possible was captured.

Various scanning solutions were considered however the phased based scanner of Z+F was chosen because of its high resolution, scan rate, portability and overall ease of operation in extreme environments.

By utilising this powerful Z+F technology, the researchers were able to spend less time on site. The quality of the data produced has enabled paleontologists to make more accurate estimates of the key locomotor parameters that help constrain their virtual dinosaurs models.

Z+F IMAGER® 5006i used to scan specimens of dinosaur

Deliverables

Final deliverables

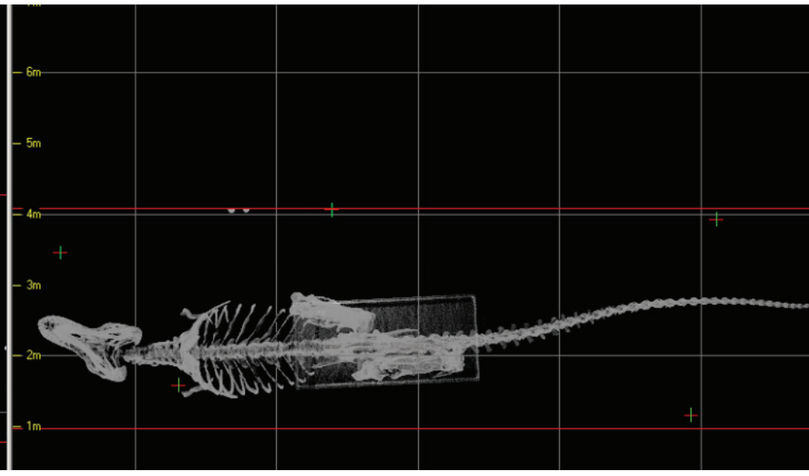
The Z+F IMAGER® provided scans in ASCII format for use in the University of Manchester's CAD system. LFM Register, a powerful piece of laser scanning software, developed by Z+F UK, allowed the scans to be registered together to create a 3D model for use in CAD.

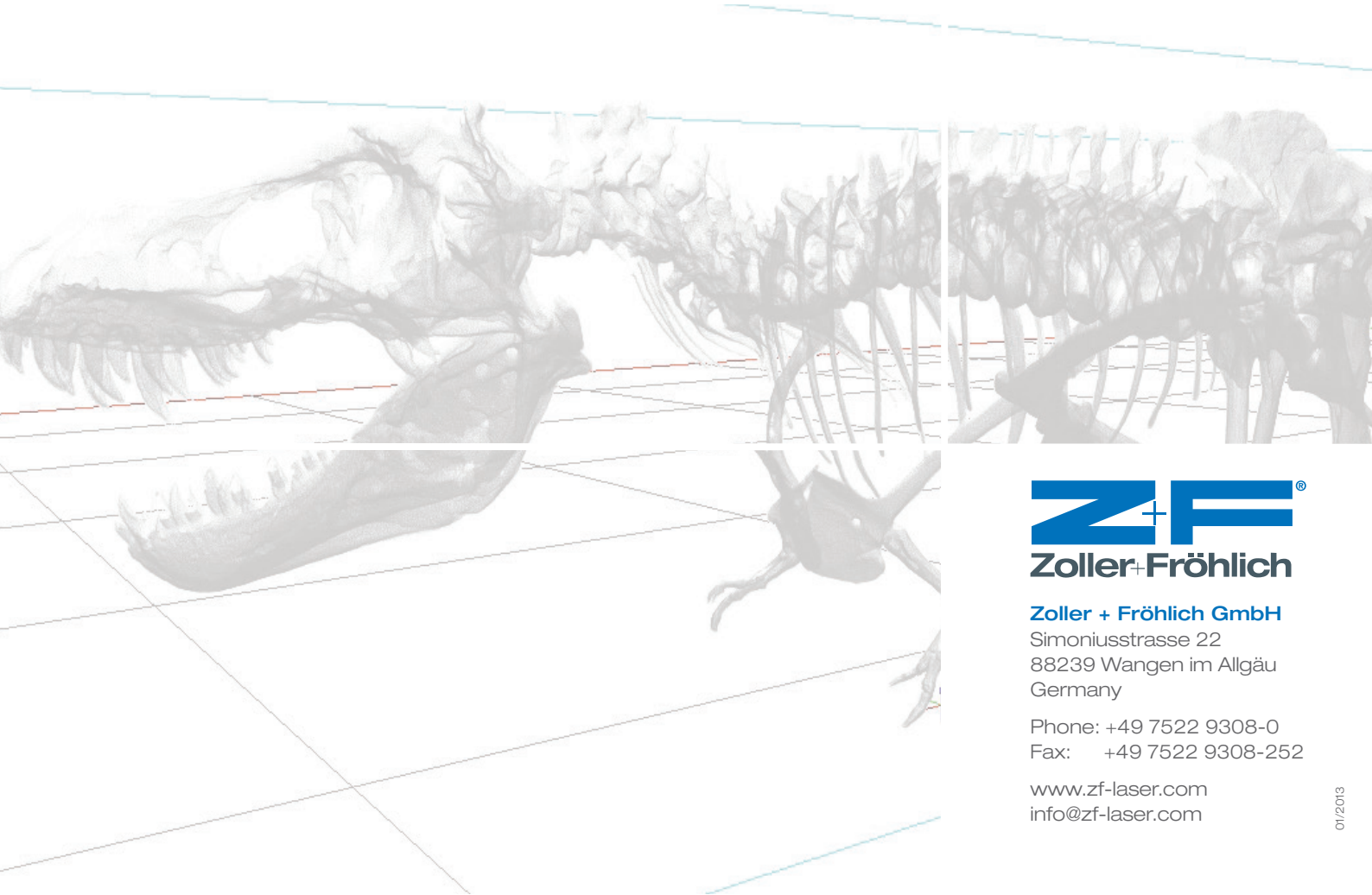
The final deliverable enabled the palaeontologists, in cooperation with the computational biologists, to generate a virtual model of each dinosaur. Virtual muscle groups were fitted to the virtual model to find out about the muscle activation patterns. This was achieved by using an evolutionary search algorithm operating within a dynamic engine physics simulator.

The resultant models generated stable locomotor gaits for all the species of dinosaurs studied. This enables researches to create a moving 3D version simulating how the dinosaur might have once moved. The project generated significant interest in the research on the maximum running speeds of dinosaurs and how they once moved. The process and results of this work is included in a new six part series called "Jurassic CSI" commissioned by the National Geographic Channel, hosted by the Manchester palaeontologist Dr Phil Manning.

The series explores the application of 21st Century science to palaeontology and includes the work of leading scientists from around the world.

Published by the National Geographic Channel, www.natgeotv.com.





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