
CASE STUDY
PolyWorks Software helps recreate the magic of the St. Pancras statue through virtual animation
InnovMETRIC Software
PolyWorks®
Total Point Cloud Inspection and Reverse-Engineering Solution
Manchester Metropolitan University

Academic partner overview

Manchester Metropolitan University

Manchester Metropolitan University is a new English university based in the city of Manchester. It is the fourth largest university in Britain, with over 21,000 full-time and 10,000 part-time students.

The Department of Engineering and Technology is part of the Faculty of Science and Engineering, which is based near Manchester City Centre. It is a large and diverse department with nearly 40 academic staff plus numerous postdoctoral staff, research fellows, and research students. Senior Lecturer Mr. Ian Kennedy teaches design, manufacturing and management, with a specialization in reverse-engineering in product development. Through his department, he is head of a group responsible for conducting various reverse-engineering projects for clients in the private sector.

St. Pancras

It may be a destination in its own right

Platform View of St. Pancras International Station

That's how some people view the refurbished St. Pancras International station in central London, the sleek, revamped terminal for high speed Eurostar trains to continental Europe.

Originally completed in 1868 and known as St. Pancras station, this massive structure has always been hailed as a favorite London landmark. In the 2000s, the station was renovated, expanded, and reopened as St. Pancras International, a modern rail passenger terminal that also houses trendy shops and restaurants. It officially opened in November 2007.

A focal point in the station is a bronze sculpture, "The Meeting Place," commissioned by London & Continental Railways, the company behind the restoration. The sculpture, a man and woman in a romantic embrace, is placed on a special plinth under a replica of the famous clock near the Barlow Train Shed at St. Pancras International.

Visualizing art

Before the bronze sculpture was completed to its full nine-meter height however, architects wanted to see how it would look in situ. To do that, they commissioned a scaled up "virtual" sculpture to be created by the 3D visualization studio, Neat 3D Ltd in Liverpool, and placed it under the St. Pancras clock in an electronically rendered visualization of the station.

Neat 3D asked Manchester Metropolitan University to digitize an 18-inch clay model of the sculpture. The digital data could then be manipulated to create a virtual model of the sculpture that fit into the station.

To create the digitized model, technicians at Manchester Metropolitan University used PolyWorks® software from InnovMetric Software Inc., a full-featured metrology and reverse-engineering software that automates and streamlines many of the operations associated with gathering extremely large amounts of dimensional data and integrating it with CAD programs. PolyWorks software takes point cloud data and manipulates it so that it can be used in a variety of ways, including animation and visualization applications, to create extremely accurate models of intricate shapes.

Technicians at MMU used a 2.8 meter CimCore 3000i portable arm coordinate measuring machine equipped with a Perceptron V4 3D laser scanner and made several scans of the model using a PolyWorks plug-in to capture the details of the design. This measuring arm and laser scanner combination is highly accurate and is optimized for scanning smaller, more detailed objects.

A challenge facing the MMU team was time constraint.

"We received the clay model by courier at 10 a.m. and only had it until 4 p.m.. The scan took about five hours, and we had to have it completed that same day and deliver an aligned polygon mesh to Neat 3D the next day."

Ian Kennedy

Department of Engineering and Technology at MMU

Streamlining data

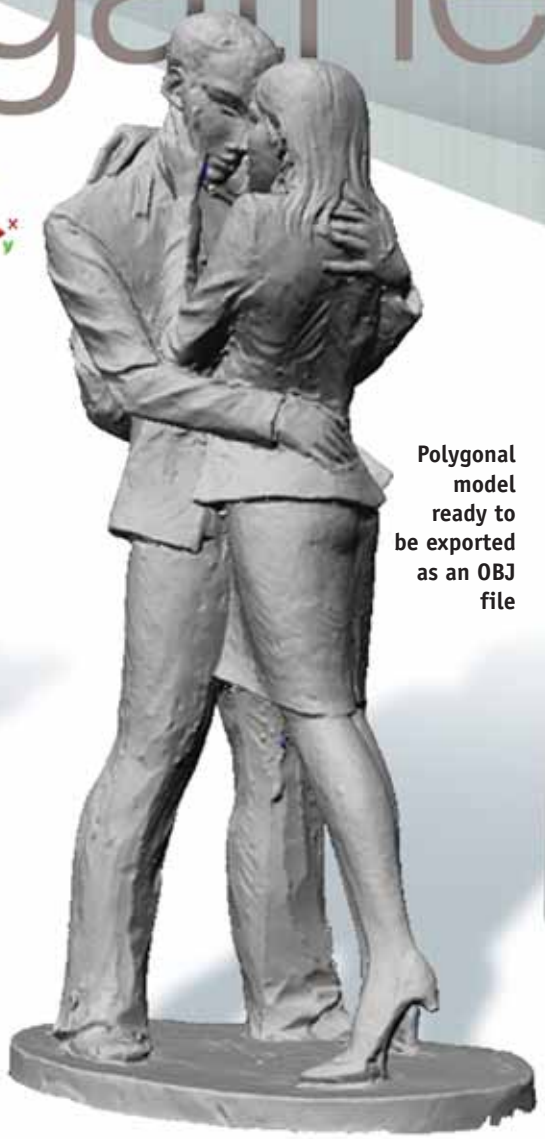
Clay model of the sculpture

Aligned point cloud in IMAlign module

The PolyWorks IMAlign™ module offers a Perceptron plug-in that enables the digitizing of the model directly from the PolyWorks interface. It then automatically aligns the scan paths using a best-fit algorithm to create an aligned point cloud model. Finally, the "reduce overlap" functionality is applied to create one unique skin of data points. "The complicated shape meant that some areas had to be scanned many times to obtain data," Mr. Kennedy said. "This created a large, 420 MB file, but the software handled all the points without any problems."

The aligned paths were then merged using the PolyWorks software's IMMerge™ module to create a highly accurate polygonal mesh. MMU technicians created three different models to compare the trade off between detail on the model and file size. By varying the surface sampling step parameter (0.6mm, 0.35mm, and 0.2mm) different polygon meshes (triangle sizes) were obtained. The surface sampling step setting determines the density of the mesh vertices in the model. "We wanted to provide Neat 3D with the most dimensionally detailed model possible and the most efficient file size for their visualization software," Mr. Kennedy said. "We used the polygonal model with the step of 0.35mm as a good compromise between detail and file size."

gathering



Polygonal model ready to be exported as an OBJ file

3D visualization of the statue model in Autodesk 3ds Max software

The polygonal mesh was then transferred to the software's IMEdit™ module to optimize the polygonal model using a wide range of editing tools. Some areas of the model were impossible to scan since they were out of the line of sight of the laser scanner, creating large, complex holes to fill. "We used the automatic hole filling function in the IMEdit module to fill most of the holes," Mr. Kennedy said. "For the large and more complicated holes we used a combination of 'fit and fill' plus the software's NURBS-based editing tools to create composite Bezier surfaces."

The completed model was exported as a 137 MB OBJ file. The OBJ file is a simple data format that represents 3D geometry alone, and is compatible with the Autodesk® 3ds Max® software used by Neat 3D for modeling, animation, rendering, and design visualization. From there, the model was electronically bronzed and fitted into the virtual St. Pancras International layout. The resulting "tour", including a dramatic flyby, helped architects and backers get a realistic glimpse into the future.

"The complicated shape and the time constraint combined to make this a very challenging job, we had to do it right the first time."
Ian Kennedy

Department of Engineering and Technology at MMU

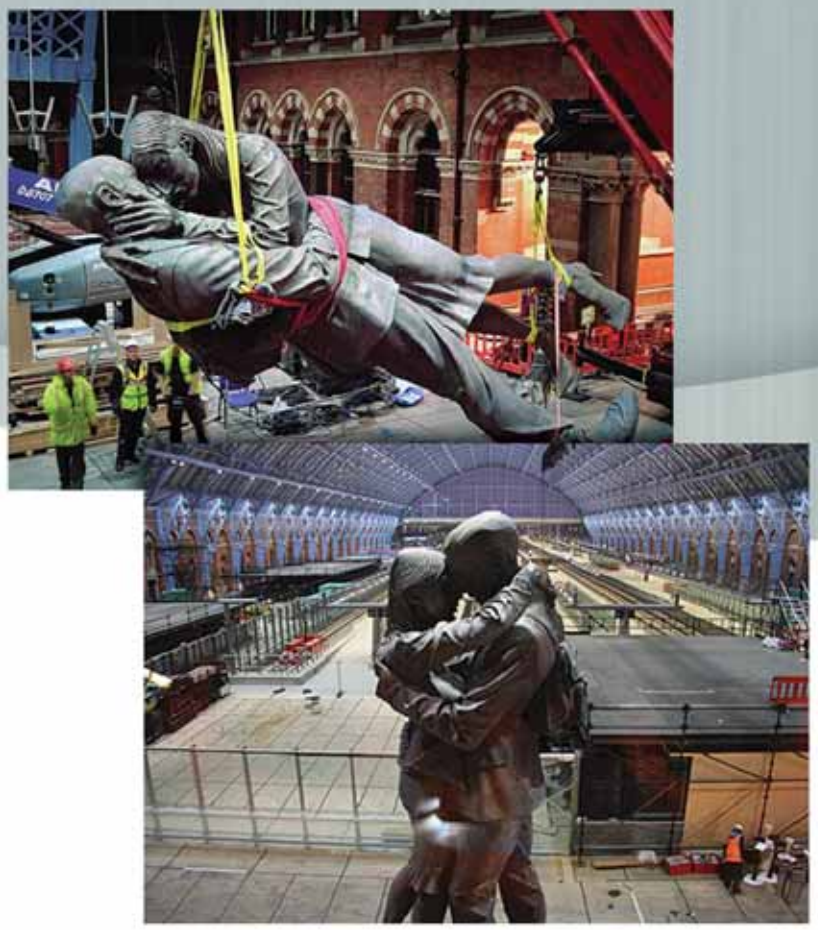
Results

▲ 1984

◀ 2008

About St. Pancras Railway Station

St. Pancras International is a major railway station opened in 1868 and celebrated for its architecture. The station is situated in the St. Pancras area of central London between the British Library and King's Cross station. Since 2000, the complex has been renovated, expanded and reopened—branded St. Pancras International—with a new security-sealed terminal area for Eurostar trains to continental Europe. The station is served by the King's Cross St. Pancras tube station on the London Underground network.



Setting up the statue at "The Meeting Place" in St. Pancras railway station

Virtual animation of the statue in St. Pancras railway station

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