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Business and technology trends in capturing and managing existing-conditions data for engineering / construction / operations

Laser Scanning Space Shuttle Endeavour

NASA believes damage suffered by Space Shuttle Endeavour's protective tiles during liftoff last week does not threaten crew safety or mission operations. But mission managers are now evaluating whether repair work in space is needed to prevent further damage to the orbiter during reentry that would require lengthy repairs and delay future missions. These assessments are based on 3D data captured with a Laser Camera System (LCS) from Neptec Design Group, Ottawa, ON.

GSA Announces RFPs for 3D Laser Scanning, 3D/4D Modeling, BIM Services

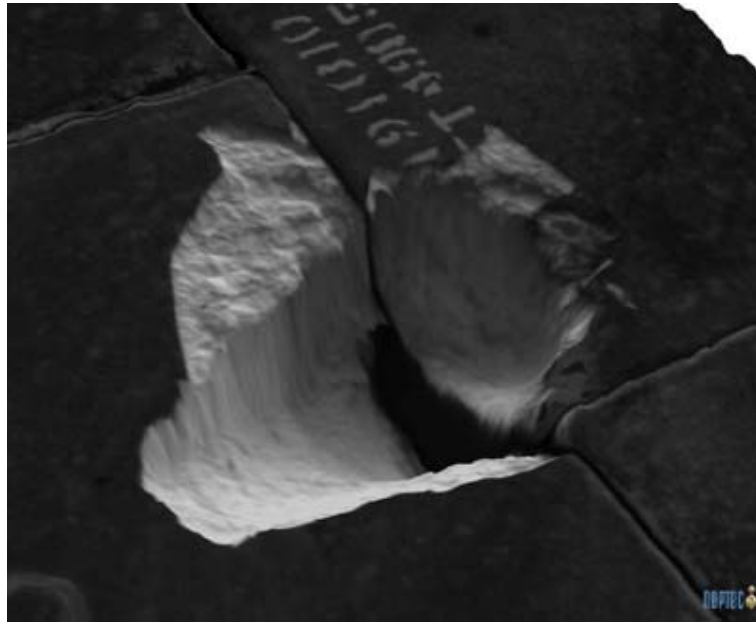**Laser Scanning Space Shuttle Endeavour**

Figure 1: 3D scan of damage to Endeavour's protective tiles captured with Neptec's Laser Camera System. *Images courtesy Neptec Design Group*
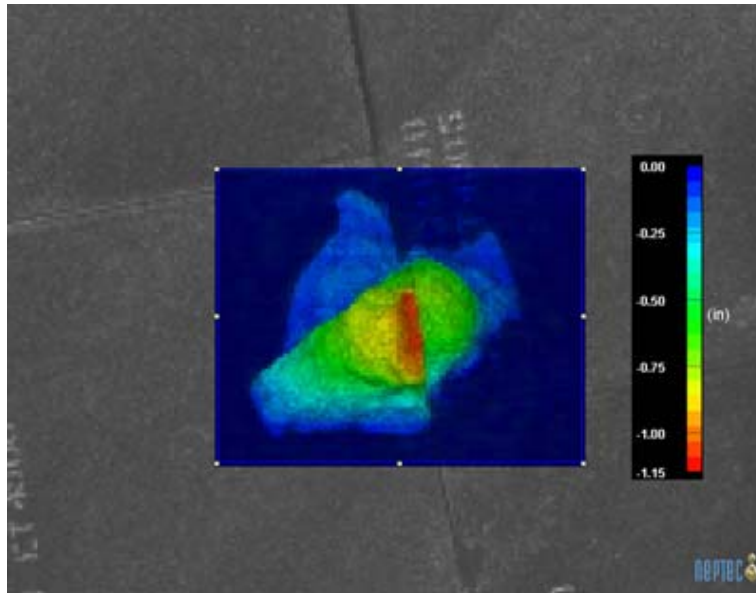

Figure 2: False-color scan of damaged area – deeper damage is color-coded red. *Image courtesy Neptec Design Group*
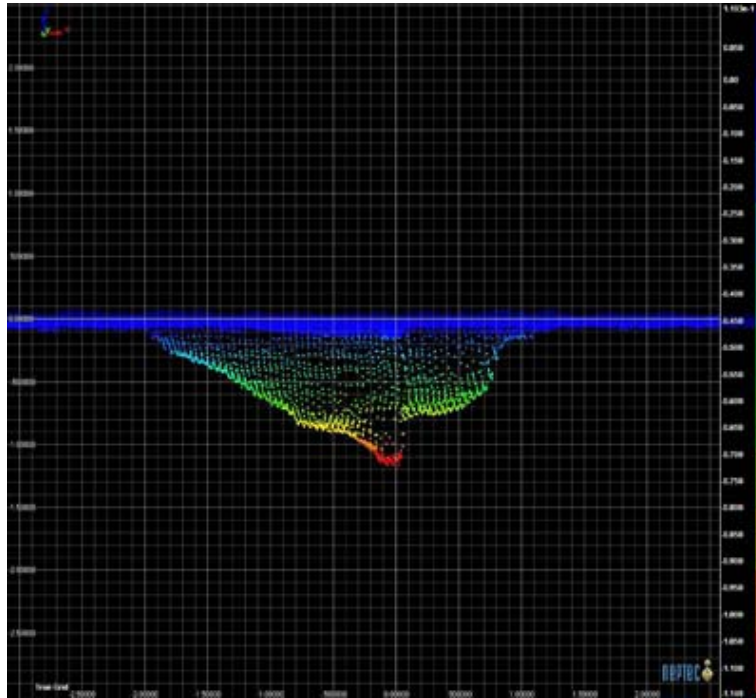
Figure 3: Side profile showing depth of tile damage – 3D model created from scan data. *Image courtesy Neptec Design Group*
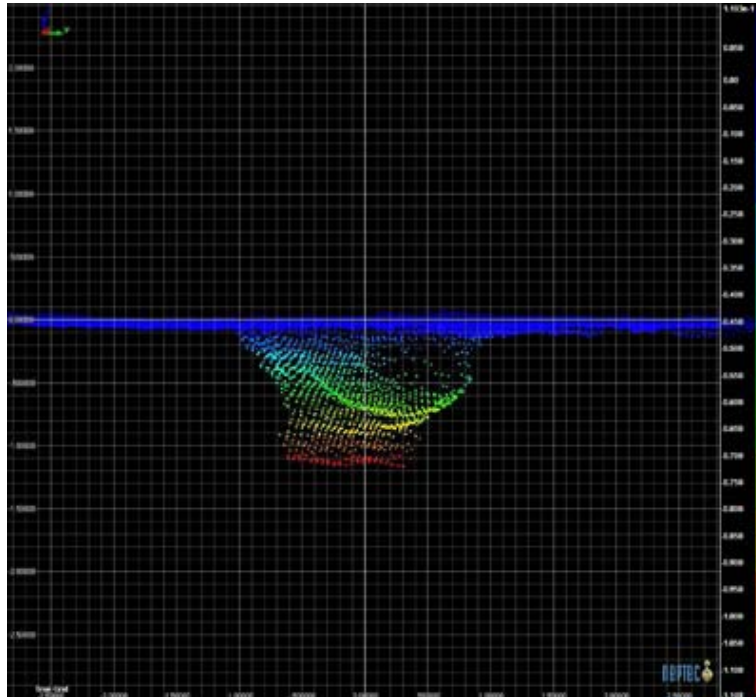

Figure 4: End profile showing depth of tile damage – 3D model created from scan data. *Image courtesy Neptec Design Group*

Click to watch video of tile damage (8.4Mb Windows Media Audio/Video file). *Courtesy Neptec Design Group*

The LCS was first used on the shuttle's return-to-flight mission in 2005 – see our coverage here. During the current mission, STS-118, we got an update from Neptec president Iain Christie. Starting with the 2005 flight, "shuttle crews routinely do an inspection with our Laser Camera System when they first get to orbit," he says. "They scan the whole leading edge of both wings." Then as the shuttle approaches the International Space Station, the crew performs a "rendezvous pitch maneuver" to let space station astronauts photograph the shuttle's underside – this is how Endeavour's tile damage was first detected.

"That was designated a 'priority focused inspection area,'" Christie says, "so NASA had the astronauts set up the LCS to capture high-resolution scans and take multiple images" of the damaged area. Once the scans were downloaded from the shuttle, Neptec transformed the data from the scanner's spherical coordinate system to an x,y,z-format point cloud. Then Christie says Neptec used its LCS Analysis Tool software and PolyWorks to measure the damage, especially the critical question of how deeply the tiles were penetrated. All this data was then transmitted to NASA for further analysis. "At the end of the day," Christie sums up, "the mission management team gets a report based on accurate 3D data."

In 2005 NASA engineers also developed a procedure using laser scan data to recreate tile damage on the ground for physical testing. In this procedure, scan data is processed with Geomagic software to produce a NURBS model of the damaged area, then this data is exported to a CAM application to machine a duplicate of the damaged tiles. NASA can then use this physical model in its arc-jet furnace to simulate reentry conditions and, if needed, test repair techniques. Geomagic CEO Ping Fu tells us this activity is currently underway at NASA, adding that the agency has found multiple uses for her company's software – for example, scanning ice formations on the shuttle's external tank, then measuring their volume to calculate weight and impact characteristics.

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