incidence to characterize the mirror in the mid- and high-frequency domains, and WFS measurements for the low-frequency domain.

By analyzing multiple out-of-focus images at different positions, the path of each photon can be determined, and the figure error necessary to generate that array of photon paths can be deduced. The method is applicable to any wavelength being examined, though the range of spatial periods that can be examined depends on what wavelength of light is being imaged, due to diffraction blurring out the focused image.

The innovation is unique in that it determines physical surface errors using a method that requires neither normal incidence access nor contact of the optical surface. The primary advantage of the technique is the ability to probe surface figure errors when the mirror is in a system that denies access to the front surface of the mirror, such as during x-ray testing (requiring the mirror to be in a vacuum chamber) or after it has been integrated into a highly nested structure. This software is capable of determining figure errors at the sub-micrometer level for up to 4th order errors.

This work was done by Scott Rohrbach and Timo Saha of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15926-1

Foam-on-Tile Damage Model

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An impact model was developed to predict how three specific foam types would damage the Space Shuttle Orbiter insulating tiles. The inputs needed for the model are the foam type, the foam mass, the foam impact velocity, the foam impact incident angle, the type being impacted, and whether the tile is new or aged (has flown at least one mission). The model will determine if the foam impact will cause damage to the tile. If it can cause damage, the model will output the damage cavity dimensions (length, depth, entry angle, exit angle, and sidewall angles).

It makes the calculations as soon as the inputs are entered (<1 second). The model allows for the rapid calculation of numerous scenarios in a short time. The model was developed from engineering principles coupled with significant impact testing (over 800 foam impact tests). This model is applicable to masses ranging from 0.0002 up to 0.4 pound (0.09 up to 181 g).

A prior tool performed a similar function, but was limited to the assessment of a small range of masses and did not have the large test database for verification. In addition, the prior model did not provide outputs of the cavity damage length, entry angle, exit angle, or sidewall angles.

This work was done by Michael Koharchik, Lindsay Murphy, and Paul Parker of The Boeing Company for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-24913-1