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# Inspection and Model Based Inversion of Highly Curved Composite Surfaces with Flash Thermography

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With the development of advanced aircraft structures and stringent mechanical requirements, robust and reliable inspection methods are needed to ensure safe operation and maximum utilization of the equipment [1]. Aircraft composite parts can exhibit complex geometries and tight curvature, such as leading edges and chines. These curved structures are difficult to inspect for defects, especially where the local curvature is high [2–4]. Pulsed thermography has the potential for rapid inspection of large areas, making it attractive for depot or field inspection of large aircraft parts. When imaging areas of high curvature, there are a number of confounding factors, including: i) a buildup of heat at the inner bend due to the conservation of energy, ii) non-uniform illumination of the surface, and iii) an angular dependence of surface emissivity. To describe the buildup of heat at the inner bend in a general composite, we represent the geometry as flat in a curved space, rather than curved in a flat space. This involves a surface parameterization which defines the mapping between coordinate systems and the diffusion of heat in the curvilinear coordinates. This parameterization, or 'flattened' space, captures the confounding effects of geometry on heat conduction. To utilize the data in a model based inversion, the thermal data is mapped to the surface of the part by performing camera calibration and 3D object registration. An algorithm maps the thermal image to the discretized surface. By considering the confounding effect of geometry on heat conduction and mapping the thermal images to the complex geometry, model based inversion can be used to solve for subsurface defects.

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