Validation of VARTM Flow Model By infrared (IR) Thermography

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Under the Composites Affordability Initiative program, a manufacturing study was initiated to assess the repeatability and consistency of the Boeing double bag vacuum infusion (DBVI) VARTM process. The part that was utilized for this study was a flat 60" x 42" panel with simple stiffener configuration, simulating a fuselage application.

Five stiffened, fuselage panels were fabricated using established parameters. A series of dimensional verifications, nondestructive evaluations, physical analyses, and mechanical property tests were performed on the five panels to verify the repeatability of the DBVI process. In a parallel effort to the fabrication of the panels, the University of Delaware - Center for Composite Materials demonstrated the capability of available analytical flow prediction techniques to accurately predict resin flow during the VARTM process. The demonstration involved development of the model of the panel geometry, creation of a finite element mesh file, assignment of material properties to the various elements including the distribution media, and parametric study by simulation of the flow for various possible scenarios. A recommendation was established for the optimum injection scheme and layout of the distribution media.

A selected panel was infused using the recommended injection scheme; resin flow was monitored in real time, utilizing a non-intrusive infrared (IR) thermography technique that was developed specially for use with the VARTM process. The results of resin flow modeling and IR monitoring demonstrated the successful application of both technologies to simulation of the process. This is a significant advance over trial and error methodology that can only be validated by repeated fabrication and assures a more robust process than one that might be achieved empirically.