SPATIAL INTEGRATED SYSTEMS, INC.

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SIS White Paper January 2011

SIS Plays Pivotal Role in Reverse Engineering a Composite Aircraft Component

THE PROBLEM

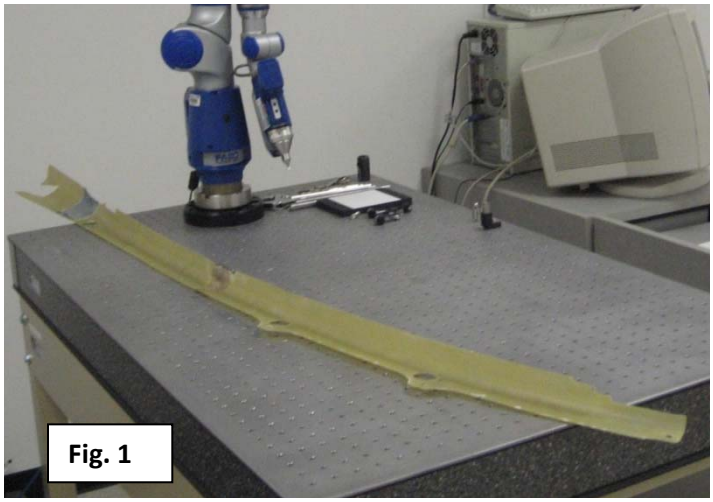


Fig. 1

A Navy depot identified an issue potentially requiring a redesign of a composite aircraft component. Through normal maintenance and lifecycle repairs of an older helicopter platform, inspectors discovered certain failures occurring to a particular composite component. A stub wing fairing, this part had no current supply vendors and limited technical data that would be required to remanufacture a replacement. Additionally, this was a composite part that needed detailed material inspection of the particular makeup, requiring the proper tooling, molds, and process identified for the fabrication process.

THE SOLUTION

The suggested solution involved redesigning the component using similar composite materials. However, the blueprints or models were not available for this particular part. A decision was made to make use of the latest 3D imaging technology to reverse engineer the stub wing fairing, redesign the model, create the mold for composite layup, and then manufacture the redesigned part.

Spatial Integrated Systems, Inc. (SIS) was chosen to provide the 3D imaging and reverse engineering services for this project. Headquartered in Kinston, NC in close proximity to the Navy depot, SIS provides reverse engineering services, using some of its own proprietary products along with third party equipment. It was a natural choice to leverage SIS's expertise in replicating the component in a 3D digital format. VX Aerospace, also with operations in North Carolina, was enlisted to help with the mold making and layup of composites. N.C. State University tested and analyzed the part for its properties and suggested an appropriate composite fiber / resin combination, and weave form and layup scheme to meet the required performance specifications.

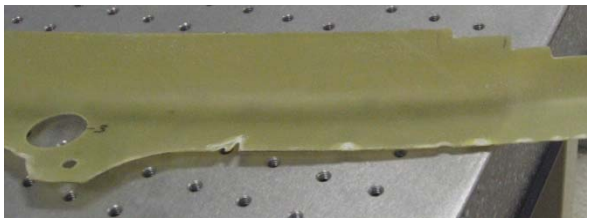


Fig. 2

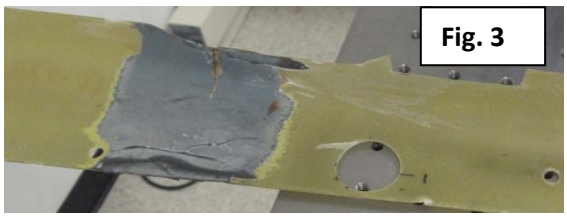
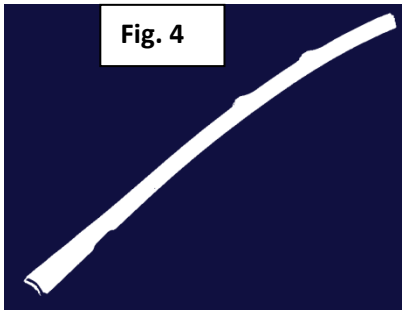


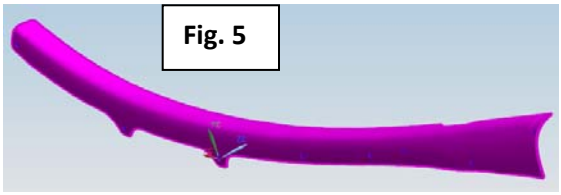
Fig. 3

REVERSE ENGINEERING PROCESS

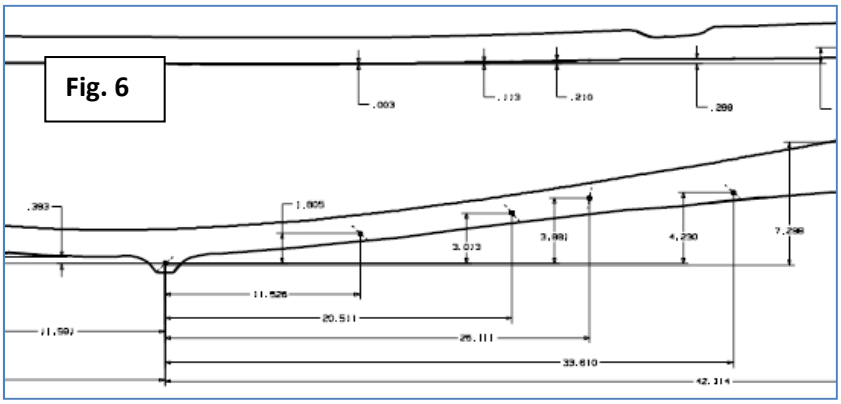
SIS used a Faro Platinum ScanArm to laser scan the inner and outer surfaces of the part shown (Fig. 1). As can be seen from the images (Fig. 2 & 3), the part had been damaged in service due to the reasons mentioned above.



A point cloud (Fig. 4) was generated and imported into Siemens PLM reverse engineering software, Imageware, where the initial groundwork for surface modeling was undertaken. The final deliverable from this reverse engineering process was a solid (CAD) model (Fig. 5) created in Siemens NX software, which was then exported to ParaSolid format for downstream vendor software importation. Although the primary deliverable for downstream application was the 3D model, SIS also created a 2D drawing showing major dimensions as a complementary measure (Fig. 6).



N.C. State University analyzed the part for engineering properties, which also included destructive testing of samples. Finally, the properties of the composite material were formulated (material type, weave, direction, resin, number of layers, thickness) for the intended purpose.



3D PROTOTYPE

SIS used a Z Corp. 3-dimensional printer to produce a rapid prototype of the part from the 3D CAD model. Given that the part was much larger than the build size of the Z Corp. printer, SIS printed five sections of the part and devised a method of connecting the sections together to build one large prototype. The newly developed full-size rapid prototype part was then placed on the aircraft for testing the form and fit of the newly developed CAD model before any downstream processes were started. If the rapid prototype part fit the aircraft, it would almost guarantee that the final product would fit as well. It is cheaper to print a 3D rapid prototype and test for fit rather than go through the manufacturing process only to find out upon installation that a problem exists.

DELIVERABLES AND DOWNSTREAM APPLICATIONS

TOOLING DEVELOPMENT

Martin Marietta manufactured the fabrication mold for layup, vacuum bagging and curing of the composite part from the 3D CAD model supplied by SIS. The CAD model for the newly designed mold was returned to SIS where the original 3D model was virtually assembled on the fixture using Siemens NX CAD software assembly modeling. Figure 7 shows the tooling from Martin Marietta with the SIS 3D model assembled and checked for differences. No differences in the surface models were found.

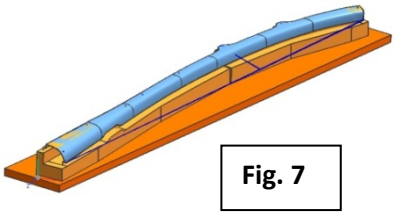


Fig. 7

VX Aerospace took the lead in developing a checking tool for downstream processes and fabrication of the composite part. The check tool was made from tooling board, one of the materials typically used in such applications - to verify the fabricated stub wing fairing composite part (Fig. 8). As an added verification measure, the check tool was then sent to SIS to scan for verification, which SIS conducted (Fig. 9). Figure 9 shows that there were no major significant differences between the original and the redesigned part. The fabricated part was also verified for fit on the actual aircraft.

Fig. 8

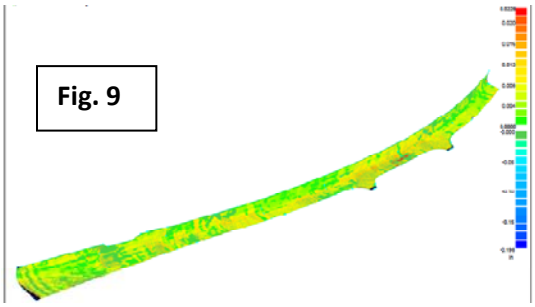


Fig. 9

END RESULT AND VALUE TO THE CUSTOMER

The benefits resulting from this process were multi-fold. The immediate tangible deliverables included a redesigned composite part along with a layup mold. Additionally, a check tool and fixture, along with computerized CAD models and electronic drawings were created as a result of this reverse engineering process, and would be available for future documentation, database, and engineering changes. Thus, in addition to the resolution of the immediate problem—redesigning an existing part to be built with more durable configuration — the additional byproducts of this process would generate long-term savings and productivity increases.

Through its expertise in 3D imaging and reverse engineering, SIS thus delivered a dimensionally accurate solid model that could be used in any number of downstream design and manufacturing applications. This case study shows the value of SIS's ISO-certified reverse engineering process when original designs or technical data is no longer available. SIS has performed countless 3D imaging projects on objects ranging in size from a few inches to Navy ships in order to capture and document in a 3D digital format an object's geometric features accurately.

For More Information: Please visit SIS at www.sisinc.org or call 252-522-1456.