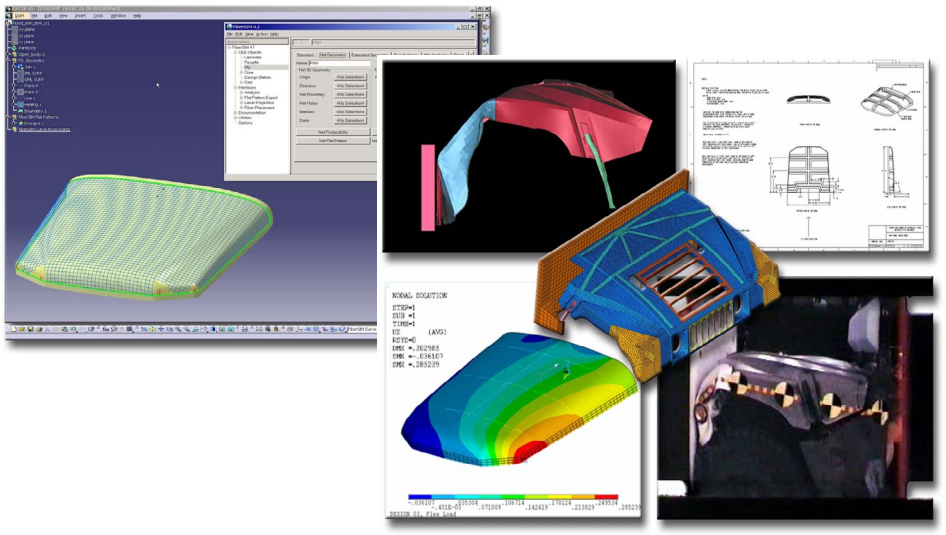
Virtual Product Design

UD-CCM as a world-wide leader in composites science and engineering is providing extensive consulting services to our industrial partners. The services range from material characterization and synthesis, to part design, manufacturing and full-scale testing. UD-CCM's design engineering capabilities include digital 3-D geometry scanning, CAD/Solid Modeling capability, coupled with extensive FEA capabilities and "custom" analysis tools. CCM has extensive experience in the application of these tools to solve industrial problems. A noteworthy highlight is the establishment of a dedicated Re-engineering Lab to house our equipment and software for Computer Aided Design and Manufacturing. This equipment includes a 6-axis arm with laser scanner and software to create surface and 3D solid models through direct digitization of existing geometry. Software capabilities include CATIA V5 and SolidWorks for mechanical design, surface and 3D solid modeling as well as CATIA / CPD to conduct manufacturing producibility simulation, ply-cutting pattern generation and composite laminate schedule "drawings". These capabilities provide the platform for integration with our analysis capabilities, CNC machining, laser cutting, data management, and other functions required to conduct interdisciplinary research within CCM as well as to interface efficiently with our sponsors.

Work Cell Technologies

UD-CCM has been able to transition the technology and expertise to our industrial partners though a "workcell technology" approach. These workcells combined enable the establishment of an "agile manufacturing enterprise". Specific work cell technologies can be utilized independently as required. The capabilities include reverse engineering and re-engineering, tooling, ply cutting and preforming, process simulation (draping and mold flow), intelligent process control, data collection and on-line quality assurance (QA)/quality control (QC), and ultimately, an intelligent system to link these work cells to allow communication and sharing of data among them.



Benefits of Virtual Product Design

- "Cradle to grave" development from design to manufacturing, without the typical associated high cost of prototyping
- Unique combination of engineering expertise and equipment allows leveraging of government investment in UD-CCM

Re-Engineering Technology

The "re-engineering" work cell incorporates several key capabilities that are critical to allowing rapid design of composite replacement components to displace existing metallic designs/components. These capabilities include the ability to capture part geometry, either through existing computer-aided design (CAD) or drawing data, or through three-dimensional (3-D) scanning of components. The 3-D scanning technologies are critical since, in many cases, accurate or detailed drawings or CAD information are not available.

In addition to the capture of the component geometry, UD-CCM has the expertise to revise or modify a design and develop a composite architecture

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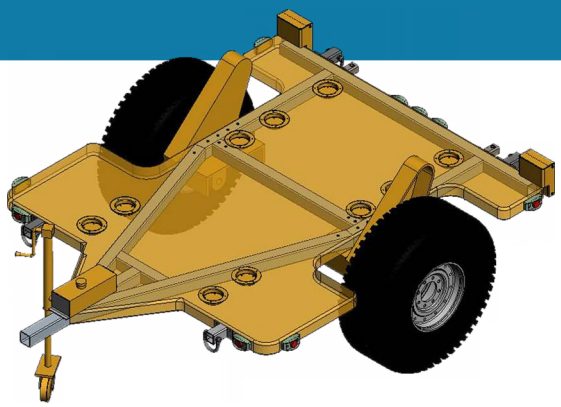
which meets or exceeds the requirements for the specific component. The goal of "re-engineering" is to be able to accomplish a redesign of a steel (or other metallic) part in composites via a combination of integrated software tools and application of these tools and experience to the re-engineering process. These software tools can include finite element analysis, integrated custom design tools (for components with similar geometries or loading), integrated material databases with in situ properties, and custom empirically and/or analytically based design tools for localized joint and attachment details.

Development and Application

The re-engineering system has been extensively applied as part of our Composite Replacement Parts program for Wheeled Tactical Vehicles, a collaborative effort with the US Army TARDEC. To date, the re-engineering technology including digital scanning, detailed FEA, CAD/CAM capability (for geometry definition and mold/tool building), preforming technology including design with CPD, as well as preform fabrication using the Solectria Diaphorm process have been applied to various composite vehicle components including HMMWV hoods, HMMWV transmission shipping containers, M35A3 Truck Hoods, M939 Truck Fenders, MATV hoods, a lightweight advanced trailer technology demonstrator and a large, thick section lower hull for an FCS prototype test article.



Engineering & Design Technologies

- Digital Geometry Capture (Scanning)
- Virtual Product Design-CAD/CAM (CATIA v5) integrated with tooling construction/machining
- Analysis (FE, analytical, process simulation, dynamics)
- Composite Design and Analysis (FiberSIM Integrated with ply cutting and pre-forming
- Documentation (Electronic, and Fabrication Drawings)

As these programs move forward, these technologies will be further applied, developed, and integrated to achieve the overall integrated workcell goals. In addition, the individual or combined capabilities utilized in these (Re)engineering efforts can be applied to other projects and solutions for both military and industrial partners.

Conclusions

Utilizing UD-CCM expertise allows our industrial partners "cradle to grave" development from design to manufacturing, without the typical associated high cost of prototyping. The extensive investment of the government in UD-CCM to implement a unique combination of engineering expertise and equipment allows leveraging of these resources.

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