Chapter 8 – CONCLUSIONS

This paper presented an overview of the research and technology development performed at NASA Dryden in support of fiber optic sensory structures development. Merits and theory of FBG sensor technology, as well as optical frequency domain reflectometry were presented to provide a fundamental understanding of the technical benefits that can be realized by the aerospace community in placing FOSS technology into service. FBG technology as implemented with an optical frequency domain reflectometry can provide thousands of measurements with virtually no added weight. These sensors are lightweight, about the size of a human hair, and can be multiplexed; thousands of sensors can be supported with a few small fibers. The sensors are also small enough to be placed on the outer moldline of lifting surfaces without negligible impact to flow field quality.

Both ground and flight systems have been developed and flight validated, FBG sensors have been characterized and attachment methods have been developed. One of the powerful aspects of this new sensor technology is that they can be used in conjunction with data driven structural transfer functions. This approach opens up new areas of research by gaining a more comprehensive understanding of both the internal loads obtained in response to the external forces that act upon FOSS airframes. Strain, temperature, wing shape, structural displacements, external loads, structural and material properties, and fatigue life are just a sampling of engineering parameters that can be accurately determined using these highly multiplexed sensor systems.

Recent examples of large-scale application of FOSS technologies were presented. Such examples included the strain and wing shape validation testing performed on NASAs Predator B UAV, called Ikhana. Large-scale ground testing was also performed on NESCs CCM. FBG sensors were placed around the perimeter of windows and the hatch to measure strain gradients around these regions. Ground and flight-test systems have also been deployed on the Global Observer UAV and data acquired to validate aircraft designs.

Lastly, the future role and vision of FBG, OFDR, and FOSS technologies was explored to further highlight the potential positive impact that these technologies can have in aerospace vehicle design. Each phase of the vehicle life cycle was evaluated through the use of a FOSS vision vehicle of the future. From vehicle concept to retirement, FOSS technology can increase fundamental understanding of aerospace vehicle performance with virtually no penalty, and thereby reduce airframe weight, intelligently adapt to both internal and external conditions, reduce costs, improve performance, increase range, and increase cargo and passenger capacity.