AD-Vol. 56, Recent Advances in Mechanics of
Aerospace Structures and Materials — 1998
ASME 1998

DESIGN APPROACHES FOR OPTICAL STRUCTURES IN SPACE COMMUNICATION SYSTEMS

Dr. Keith T. Kedward
University of California at Santa Barbara
Santa Barbara, California

ABSTRACT

In a wide variety of space communication systems advanced composites applications have favorably impacted the performance of optical surfaces and structures. However, there is presently a thrust to advance the state-of-the-art of primary mirrors assemblies for diffraction-limited, visible systems. Such mirror assemblies typically provide areal densities (the index used to convey weight efficiency) ranging from 25 to 30 kg/m^2. But composite reflectors have also established their effectiveness by achieving areal densities as low as a few kg/m^2 in recent years. As a consequence, opportunities and incentives that embrace composite technology advancements with concomitant benefits to optical performance (enabled by the proven thermal stability advantages) have drawn the attention of the space optics community.

In this paper the feasibility of isogrid concepts being used currently for lightweight, precision membrane reflectors is presented and evaluated with respect to future exploitation in the higher precision, mirror applications. We begin with a review of one form of isogrid concept in which the backup structure is comprised of interlocking continuous ribs in the isogrid configuration. Consideration with respect to fiber, matrix, and laminate configuration are presented in the body of the paper. Further, critical design detail treatment is presented with respect to intersections in the backup structure and the attachment of backup structure to the ref lector face sheet.

Results of a thermal distortion analysis also serve to emphasize the importance of attention to detail in composite design due to the high degree of anisotropy in stiffness, strength and thermal expansion properties. Finally, the translation of the surface precision from that of the original mold surface to the as-fabricated reflector surface as well as to environmental influences will be addressed.