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FEASIBILITY STUDY ON A TWISTED WRAP-RIB REFLECTOR.

Abstract

Reflector antennas with large apertures are being used for more sophisticated radio astronomy and satellite communication missions. Even for small satellites, which have been increasingly utilized in recent years, deployable antennas with a relatively larger reflector have been developed. These reflector antennas are expected to use radio waves with frequencies from Ka-band to higher for communication applications, and several hundred GHz for radio astronomy, which requires extremely high reflector surface accuracy. In addition, a solid reflective surface such as a CFRP reflective surface is required because a flexible metal mesh cannot constitute an appropriate reflective surface for very high-frequency radio waves. However, solid reflective surfaces are inefficient as deployment structures for satellites. Therefore, the concept of a twisted wrap-rib reflector is proposed as a reflector concept that can store and deploy a solid reflector surface with high surface accuracy, and its feasibility is investigated in this study. A twisted wrap-rib reflector consists of 12 solid petals and 12 central hub joints. The central hub joints are pin-connected to the edges of the solid petal sections and compose a deployable structure. The motion of the deployable structure allows the petals to rotate against the central hub joint in accordance with the vertical movement of each central hub joint. This movement causes each petal to rotate 90 degrees relative to its deployed state during the storage process. Then the petals rolled around the central hub in the stowed configuration. The twisted warp-rib reflector can deploy by the reverse process of this storage process. The twisted wrap-rib reflector can reduce the plane approximation error and pillow deformation caused by the mesh surface, and can be expected to have high mirror surface accuracy compared with mesh antennas, such as cable-network antennas and conventional wrap-rib antennas. A numerical model was designed using CAD software, and a proof of concept was manufactured. The model's deployment analyses and stowage experiments were conducted, and we confirmed that the proposed antenna system could be stowed and deployed. The feasibility of this reflector system was demonstrated through these analyses and experiments.