THE DESIGN OF HOMOLOGICALLY DEFORMING CYCLICALLY SYMMETRIC STRUCTURES

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Abstract

It can be shown that for a given diameter of a radio telescope whose structure is designed to be as stiff as possible, there is a minimum wavelength at which it can operate. Below this limit the distortion of the parabolic reflecting surface, produced by the gravitational deformation of the surface supporting structure, becomes too large for it to act as a sufficiently good reflector. One way of passing this gravitational wavelength limit is to design a surface supporting structure which deforms homologically, as the telescope is tilted. In other words, the surface supporting structure is designed so that its gravitational deformation is such that a parabolic reflecting surface is always maintained. An interactive computer supported design procedure, for homologically deforming millimetre wave telescope structures is presented, and demonstrated. It uses an iterative improvement scheme to deal with the non-linear and mixed continuous-discontinuous variable problem created by the design of practical homologically deforming millimetre wave telescope structures.

The most suitable form for a potentially homologically deforming telescope structure is a purely cyclically symmetric one. However, for millimetre wave telescopes this form of structure presents practical difficulties, so a region of structural non-cyclic symmetry is introduced. To enable the complete telescope structure to be analysed, yet still to take advantage of its high degree of cyclic symmetry, of reduce the size of the analysis problem, an analytical method is presented which is able to deal with a cyclically symmetric structure having a region of structural non-cyclic symmetry and which is subjected to general non-cyclically symmetric loads.