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VARIOUS REFLECTING SURFACE DEFECTS SIMULATION FOR SPACE MIRROR CONCENTRATING SYSTEMS

Abstract

It is necessary to use reliable and cost-effective methods and tools while projecting any technical system, especially at the early stages of design. Speaking about characteristics of these systems this allows us to analyze and to predict them depending on the operation conditions.

The efficiency of mirror concentrating systems (MCS) designed to work as a part of high-temperature solar power plant primarily depends on geometrical and optical characteristics of reflecting surface. Shape inaccuracy in turn can be caused by manufacturing defects, deformations under the influence of power and thermal loads, change of material properties in time. Optical inaccuracies of reflecting surface are caused by roughness, hollows, craters, pollution and other defects and even breakdowns which appear as a result of erosion or any physical damage.

It is required to conduct complicated and expensive experiments to obtain MCS characteristics, especially in case of ultra low mass large-sized and space-related constructions. One should also remember about the significant limitations on the results interpretation, as well as about limitations imposed by the dimensions and relatively low structure rigidity. Moreover, while functioning the characteristics of such systems may vary due to various internal and external factors, for example, micrometeorite erosion. So, it is evident that long-term and endurance testing is even more difficult task. Therefore the development of a mathematical model which allow MCS power characteristics estimation taking into account the influence of operating conditions, design features, roughness and other shape defects is of particular interest.

In this regard the statistical mathematical model of radiation heat exchange based on the use of Monte Carlo methods and Finite Element Method was developed and realized in the software complex, which gives an opportunity to calculate MCS main characteristics.

Availability of such software and possibility of its subsequent development allow analyzing various structural and technological solutions, making it possible to create the system with maximum energy and weight efficiency.

The use of inflatable rigidizable constructions is one of the most promising approaches at present, because they allow the creation of MCS with sufficiently high accuracy, reliability, as well as with low weight and minimum volume in transfer position, which is extremely important for space applications.