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# Surface Adjustment Method for Cable Net Structures Considering Measurement Uncertainties

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**Abstract:** In the process of surface precision adjustment of cable net structures, the establishing variable configuration of cable net structures is the basis and precondition for implementation of surface adjustment. Due to the limitation of measurement errors and uncertainties, the measured information including node location, boundary conditions and cable tensions are uncertain. In this paper, the uncertain variables are considered as the interval values, and the interval force density method is proposed to calculate the root mean square error of uncertain cable net structures. Then, the optimization model is established to find the optimal adjustment amount of adjustable cables for the higher surface accuracy. The advance and retreat algorithm is introduced to solve the optimization model. Finally, a numerical example is presented to demonstrate the feasibility and validity of the proposed surface adjustment method.

**Keywords:** Uncertainty; Cable net structure; Interval variable; Force density; Surface adjustment; High accuracy.

## 1. Introduction

Cable net structure is a kind of attractive structural form which has been widely used in the fields of aerospace, architecture, and robots etc. because of many advantages such as large flexibility, light weight, small damping, and low natural frequencies. Typically, cable net structures have been successfully applied to many in-orbit deployable mesh antennas [1,2]. The surface accuracy described by the root mean square (RMS) error of cable net structures determines the antenna's electrical characteristics. The surface accuracy is generated by the prestressed cables. Extensive research has been done on the shape-state analysis of cable net structures to generate the reasonable pretension in cables, such as the force density method [3,4], dynamic relaxation method [5] and nonlinear finite element method [6] etc. However, because of manufacturing and assembling errors, the artificial surface adjustment becomes an essential and tiresome step for