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# ANALYSIS OF THE IMPACT OF THERMAL AND STRUCTURAL DYNAMICS ON THE PERFORMANCE AND STABILITY OF WAVEGUIDES IN SPACE-BASED COMMUNICATION SYSTEMS

**Abstract**

In space-based communication systems, thermal and structural dynamics of waveguides assume a pivotal role. These dynamics significantly influence signal transmission efficiency and the overall performance of the communication system. This paper delves into the challenges posed by temperature fluctuations and operational loads, specifically focusing on the performance and stability of waveguides. Key issues addressed include the impact of temperature variations on the lowest eigenfrequency and the critical compressive force experienced by a waveguide. Additionally, the requisite strength and rigidity necessary to withstand operational loads in antenna-feeder systems are explored. The challenge of selecting optimal support types and their precise placement for a waveguide positioned between two microwave units is also meticulously examined. To tackle these problems, innovative solutions are proposed. These encompass the application of the beam theories for waveguide modelling and the presentation of common support arrangement schemes for individual waveguides. The technical theory of beams was implemented in calculating the integral characteristics of cross-section, stress distributions, and deflections of twisted waveguides. The paper's findings reveal a critical threshold temperature beyond which the vibration frequency dwindles to zero, signifying a loss of waveguide structural stability. An emphasis is placed on the necessity of applying minimum integral characteristics to the cross-section of waveguides, regardless of the load direction, to bolster system resilience. Through a comprehensive assessment, factors influencing the first natural vibration frequency and the minimum critical compressive force are unraveled. Finally, the findings revealed that altering the support arrangements of a single waveguide results in a 6-fold increase in its first natural frequency and a 16-fold increase in the first critical force. Consequently, the waveguide becomes capable of transmitting data at a higher frequency, leading to faster data transmission rates. Furthermore, enhancing the critical compressive force contributes to the robustness and stability of the waveguide, especially under high-stress conditions.