ON THE DESIGN OF SUB-MM WAVE AMPLITUDE HOLOGRAMS FOR CATR

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We are working on two different experiments for demonstrating the performance of a novel type of compact antenna test range (CATR). The CATR is based on use of a sub-mm wave amplitude hologram as the focusing element. One hologram is designed for testing a large reflector antenna (diam. 1.5 m) operating at 322 GHz, while the other is designed for demonstrating the feasibility of the hologram CATR at the frequency of 650 GHz.

In the early 1990's, Radio Laboratory at HUT proposed the use of an amplitude hologram as the focusing element in CATR (see Fig. 1). The hologram can be fabricated by etching a computer-generated binarized interference pattern consisting of radio transparent slots onto a thin metal-plated substrate (see Fig. 2). Due to the simple structure of the hologram and its relatively low manufacturing cost, the hologram CATR could be a considerable alternative to the reflector CATR in the sub-mm wave antenna testing. The extremely tight surface accuracy requirement (~$\lambda/100$) makes manufacturing of reflectors very difficult and highly expensive at sub-mm wavelengths. The hologram is a transmission type of element and, thus, the surface accuracy requirement is much lower (~$\lambda/10$). Tensioning the hologram with a frame makes the structure very flat. The required pattern resolution can be achieved by using direct laser-writing of the pattern onto a photo-resist-coated substrate.

Design and numerical analysis of the holograms are based on the use of the Finite-Difference Time-Domain method and physical optics. The simulation results of 322 and 650 GHz holograms will be presented in this paper. Also, manufacturing and testing of the holograms will be discussed.

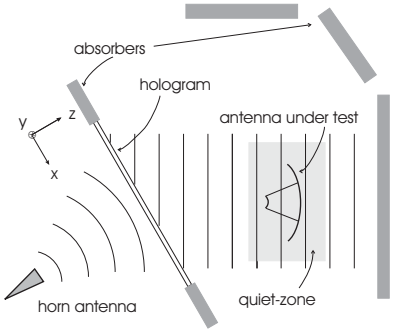

Fig. 1. Hologram CATR.

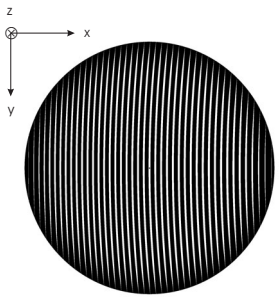

Fig. 2. Amplitude hologram pattern. Metal stripes are in black and radio transparent slots in white.

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