This paper presents the full structure simulation of a parallel-plate slot array antenna panel with a designed waveguide feeding network, which operate in 9.50 GHz-9.80 GHz (T. Wang, T. Tomura, and J. Hirokawa, Intl. Symp. Antennas Proag., TA1P-1, Oct. 2019). Fig.1 shows the proposed antenna structure. The waveguide feeder with coupling slots is located at the middle and beneath the antenna panel. The input wave couples with the parallel plates through inclined coupling slots. An inductive wall is added for each coupling slot for reflection-canceling. The coupled waves then propagate in both the +y and the −y directions and radiate through radiating slot pairs. Two dielectric hard walls ($\varepsilon_r=3.6$) with appropriate width truncate the parallel plates for supporting quasi-TEM mode propagation. The designed waveguide feeder could provide a uniform excitation in parallel plates.

A design procedure of the feeder network is given as follows. (1) Design the matching slot and the $\tau$ junction with two center slots by HFSS. (2) Analyze the slot array by Galerkin’s Method of Moment (MoM) for the fast design. The goal is to control the coupling for a uniform field distribution in parallel plates and to suppress the reflection. The design parameter relationship between HFSS and MoM models is found for compensating the inaccuracy caused by simplified assumptions in the MoM analysis. The MoM designed parameters are converted to the HFSS equivalent parameters as the fabrication parameters. The full structure consisting of the designed feeder network with antenna panel is simulated in HFSS. The size of the antenna panel is 687 mm × 689 mm. Fig. 2 shows the frequency behavior of the directivity. A peak directivity of 36.0dBi and 67.7% aperture efficiency is achieved at 9.65GHz and the reduction within 300MHz bandwidth is 2.2dB. Reflection below -20 dB is achieved throughout the target bandwidth.