K5 PERFORMANCE ANALYSIS USING ANTENNA MODEL

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1. INTRODUCTION

Modern spaceborne synthetic aperture radar (SAR) systems such as KOMPSAT-5 require an way to model antenna pattern during system design, calibration and SAR processing due to their operational complexity and accuracy requirement . To perform accurate performance analysis during SAR system design, an Antenna Model is used to derive a set of antenna beams generated by the K5 phase array antenna. In order to allow trade-off among system parameters, an optimization capability is included in the Antenna modeling tool. This Antenna Model could be used for calibration and SAR processing also. A SAR raw signal simulation was performed using the antenna model and is used to examine image quality.

2. ANTENNA MODEL

A radiation pattern of phased array antenna is adjusted by controlling phase and amplitude of its element. An array factor of two-dimensional array is calculated as follows ;

$$AF(\theta,\phi) = \sum_{n,m} \left| a_{mn} \right| e^{j\left(\frac{2\pi}{\lambda}\left[x\sin\theta\cos\phi + y\sin\theta\sin\phi\right] - \varphi_{mn}\right)} \quad (1)$$

The antenna pattern can be estimated by taking the array factor and radiation pattern of the array element into account. In order to increase computational accuracy, offset and errors of each element can be included in the antenna model.

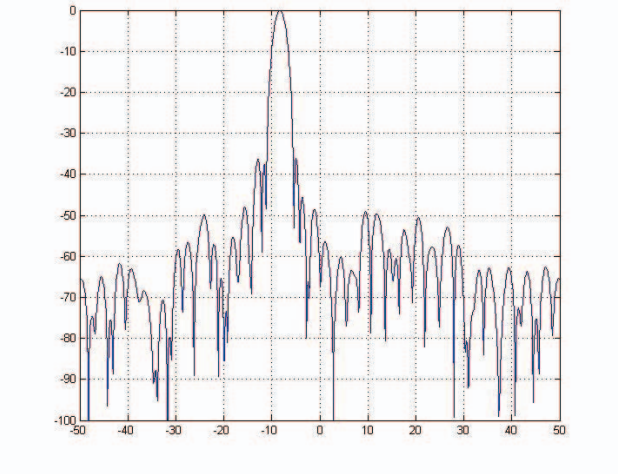

Figure 1 Simulated Antenna Pattern

3. ANTENNA PATTERN OPTIMIZATION

An uniform illumination is one of simplest configuration of the antenna array. In case of low incidence angle, wider beamwidth is demanded to have enough swath of the SAR image while more antenna gain is needed in case of high incidence angle. Wider beamwidth can be achieved by controlling phase or amplitude settings carefully. An optimization algorithm has been used to derive the element settings which meet swath and NESZ requirement at the same time.

4. SAR PERFORMANCE ANALYSIS

An accurate radiation pattern of the antenna is required for NESZ and. The pattern of its main lobe shall be considered NESZ performance while side lobe pattern affects ambiguity performance mainly. NESZ and ambiguity analysis using the antenna model will be demonstrated in this paper.

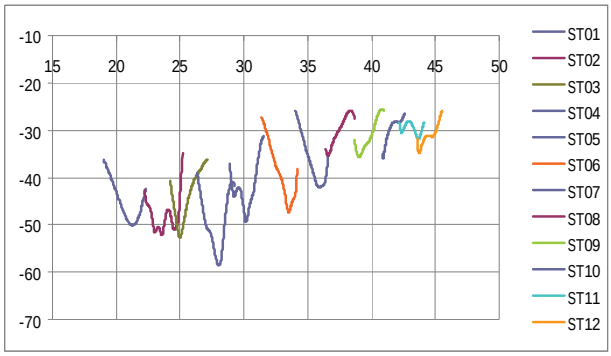

Figure 2. Result of Range Ambiguity Anaysis

5. SAR IMAGE QUALITY SIMUALTION

In order to examine SAR image quality in system level, an SAR raw signal simulation has been performed. The simulation tool includes spacecraft orbit/attitude model , SAR H/W model and SAR antenna model.

5. REFERENCES

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