SAR RAW SIGNAL SIMULATION BASED ON GPU PARALLEL COMPUTATION

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1. INTRODUCTION

SAR raw signal simulation plays a significant role in studies concerning noise and clutter rejection, and may contribute optimizing SAR system parameters. Several works on SAR raw signal simulation have been published in the past. V.H.Kaupp and T.K.Pike adopted a time domain algorithms called Range Time Domain Pulse Coherence.[1][2]. In 1992, Giorgio Franceschetti presented us a SAR raw signal simulator in frequency domain. Algorithms in frequency domain usually concern a SAR operating in stripmap mode and are based on the straight line motion hypothesis concerning the SAR platform. This allows us to obtain the raw signal from very extended targets with a short CPU time. A time-domain raw simulator, evaluating a coherent sum of the target echo for each transmitted radar impulse, can easily consider the real orbit of the platform and other effects such as mechanical structure oscillation and the target backscattering coefficient variation during the system integration time.

However, time domain algorithms need a long CPU time. Therefore, in this paper we present a method of SAR raw data simulation based on GPU, instead of CPU. GPU(Graphic Process Unit) is designed for graphic applications. GPU can take advantage of data-parallelism and has a better performance than CPU. SAR Raw signal simulation based on GPU is much faster than CPU and is acceptable in a time domain algorithms.

2. SAR RAW SIGNAL SIMULATION

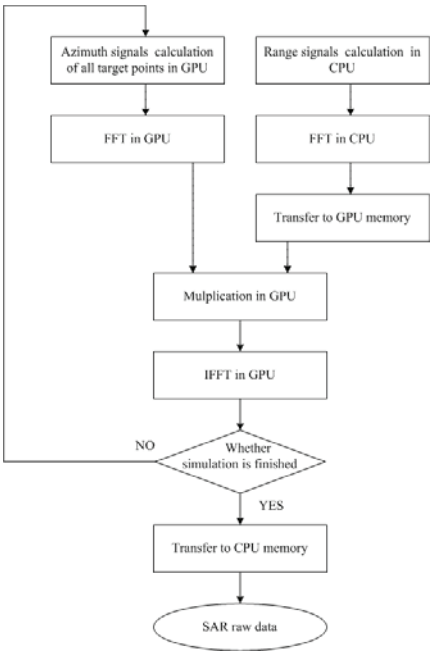

Fig.1 flowchart of raw signal simulation

This paper makes a comparison between algorithms operation on GPU and on CPU. Raw signal simulation flowchart is shown in Fig1. Range spectrum of signal can be generated at a time, but azimuth spectrum changes with the slow time.After computing azimuth spectrum of all the targets in every slow time, two-dimension spectrum can be gained through multiplying range spectrum by azimuth spectrum. Then we can get the raw signal through IFFT.

3. SIMULATION EXAMPLE

This paper gives a simulation example below. The parameters of SAR are listed in Table 1 and comparison is shown in Table 2. Backscattering coefficient is shown in Fig2. In order to test the effectiveness of simulated data, we give the imaging result of raw data generated, shown in Fig.3. Table 2 shows the computing time of algorithms both on GPU and CPU. From the result we can make a conclusion that in the same algorithms processing speed of GPU is much bigger than that of CPU. Therefore raw signal simulation can be conducted on GPU in a way of having both better efficiency and algorithms.

Table 1 SAR parameters

parameters	value	Parameters	Value
Wave length	0.05m	Sampling frequency	60M
PRF	300.4464Hz	Platform velocity	130m/s
Pulse duration	10us	Squint angle	0°
Band width	30M	Data matrix	2048×2048

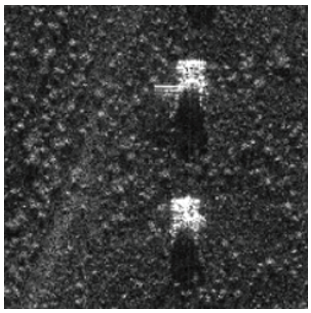

Fig.2 Backscattering coefficient

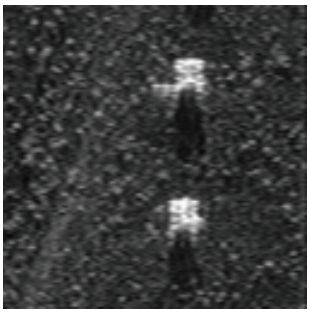

Fig.3 imaging result of raw signal

Table 2 comparison of computing time between GPU and CPU

	Value	Computing time
CPU	Intel Core2 Quad CPU(4 cores) Q6600(2.4GHz), 4G	106.892s
GPU	RAM	4.562s
	Nvidia GeForce 9500 GT, 512M	

4. REFERENCES

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