GSI's Accelerated SAR (Synthetic Aperture Radar) Image Formation with Fast Back Projection Solution Brief

Introduction

GSI presents the NEW Synthetic Aperture Radar (SAR) Fast BP accelerated processing solution based on GSI's Gemini® APU hardware and the fast back projection algorithm that forms the spotlight synthetic-aperture-radar images from the SAR input array of pulses.

GSI's SAR solution dramatically improves the image formation performance, bringing Real Time (RT) and money saving performance to the field of SAR spotlight remote sensing.

Fast BP Algorithm Advantages

Back projection is widely considered to be the "Gold Standard" algorithm for SAR spotlight-mode image formation. It's best suited for data transmitted from space, airborne platforms, drones, and quadcopters—permitting submeter ground resolution and various frequencies with better image quality and flexibility. However, its usage remains prohibitive, due to the high computational cost of running it on a CPU or GPU.

GSI's APU Hardware Changes It All

The processing speed of the GSI APU is significantly faster than CPU and GPU.
Optimized to take advantage of the GSI chip's parallel computing power, the GSI SAR solution allows:

1. Using the Fast back projection algorithm for best image formation results.
2. Real Time (RT) processing capabilities that significantly shorten the images/data delivery time to customer.
3. Significant total computing cost reduction.
4. On-board processing capabilities, when required, for example, on a manned intelligence mission aircraft, drone, etc.

How It Works

Satellites, manned mission planes, and drones use SAR sensors to send out Radar beams continuously, day and night, under all weather conditions. The information received back from these beams is then used to form an image of the area.

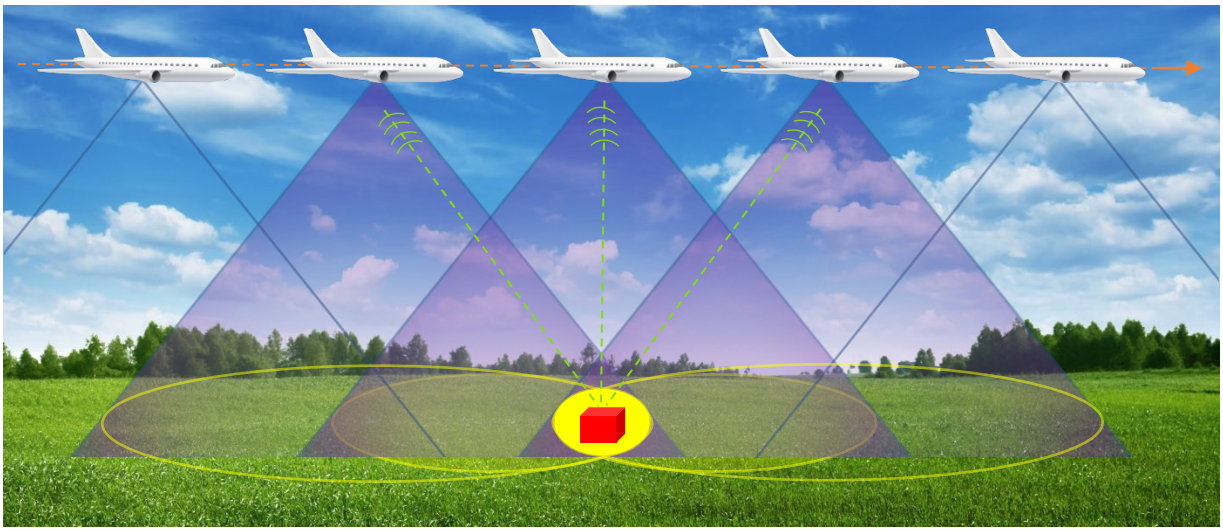
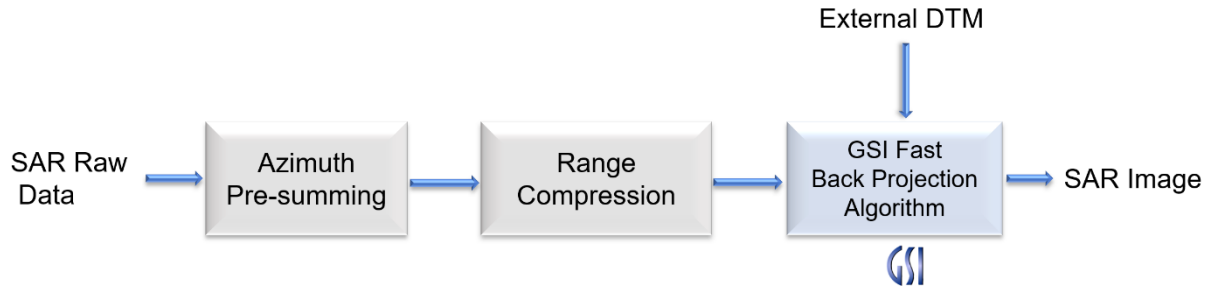


Figure 1: Multiple Radar Beams

The GSI server application receives the SAR row data in H5 file format, which includes 2 files—the Pulse file and the DTM file. Using Fast Back Projection (FBP) processed on GSI APU hardware, it is able to analyze the intensity of the radar beams projected back from the ground to the platform and to form an image of the area.

Figure 2: SAR Image

SAR Process Block Diagram



Specifications

Specification	Category	Supported range
Platform speed	Manned mission aircrafts	Up to 900 Km/hour
	Low & Medium class Drones	Up to 170 Km/hour
	High-altitude drones	Up to 450 Km/hour
	LEO satellites	~ 28,100 Km/hour
Supported transmission altitudes	Mission aircrafts, Drones, Quadcopters	Up to 20 Km
	Satellites	Up to 1000 Km
Pulse input array	Capacity	Typically: 1000–20,000 pulses (No limitations for higher needs)
File input format	GSI SAR server application	Support H5 file format include 1 Pulses file and 1 DTM file
Surface topography Z-tolerance	All	Support all
Image ground resolution	Area of ground covered by digital individual pixel	0.1 meters up to 100 meters
Precision mode	Variable fixed point	High precision mode using 16 bits fixed points

Performance

Image Characteristic				
Pulses	**N-samples**	**Size (Pixels)**	**DTM (m)**	**Resolution (m)**
10,000	10,000	10,000*10,000	5,000*5,000	0.5
Range	**Frequency**		**Delta Frequency**	
10.5 km	9,340 MHz		28 KHz	

Actual Hardware Configuration in Use		
Desktop	Intel CPU—1	GSI—2 APU Leda E Boards
GSI Actual Measured Performances—Throughput ~11 seconds Can be run and checked by customer via remote access on GSI server.		

Developed Hardware Configuration (Leda E)—Software is still in development		
2 U Server—Sky 6200	Intel CPU—2	GSI—8 APU Leda E Boards
GSI Estimated Performances—Throughput ~4.4–5.5 seconds		

Developed Hardware Configuration (Leda S)—Software is still in development		
1 U Server—Super micro	Intel CPU—2	GSI—16 APU Leda S Boards
GSI Estimated Performances—Throughput ~2.64–3.3 seconds		

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