Using Residue Number System in Synthetic Aperture Radar

SAR Radar

The real-time image forming in future, high-end synthetic aperture radar systems is an example of an application that puts new demands on computer architectures. The processing in the radar system is characterized by working on huge data sets, having complex memory access patterns, and doing real-time compensations for flight path errors.

The RNS Number System

The residue number system (RNS) divides an integer into a number of smaller integers (i.e. with a shorter binary representation) that can be processed in parallel independently of each other, thus reducing carry propagation. This opens possibilities for circuits to run at higher speeds and/or lower power dissipation.

Another potential benefit of using RNS numbers may be increased fault-tolerance. SAR radar are typically air-borne and subjected to radiation at high altitude. If numbers are stored in memory in RNS format instead of in the traditional binary system, fault-tolerance may increase since RNS numbers are non-weighted (i.e. all residues have an equal weight). Binary numbers are weighted and thus an error in a memory position holding the MSB (Most Significant Bit) should have a much higher impact on the result than errors in LSB (Least Significant Bit).

Task proposal 1

Investigate the potential advantage of using RNS in the processing chain in SAR. Specifically in the data interpolations. Focus on potential power dissipation reduction.

Task proposal 2

Investigate the potential fault-tolerance advantage of using RNS in SAR radar.

Company

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Number of students

1-2

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