

# Energy-efficient Raman amplifier for edge computing



## Overview

The RAMAN accelerator is designed to leverage data and weight sparsity to deploy deep neural networks at the edge, ensuring low power consumption, minimal storage requirements, and reduced processing latency. 100x more energy-efficient than industry standard GPUs, Mythic's analog processing units (APUs) promise a new era of accelerated computing across the AI hardware stack, at the data center and the edge. Figure 1: Top-level architecture The key features of the RAMAN accelerator are: Sparsity: RAMAN leverages activation and weight sparsity in (a) Reducing latency by. Researchers at the Department of Electronic Systems Engineering, IISc, led by Chetan Singh Thakur, have developed an AI co-processor called RAMAN, or Re-configurable And sparse tinyML Accelerator for inference. RAMAN is an indigenous low-power AI co-processor designed for edge computing. Many near-sensor machine learning (ML) approaches have been implemented to introduce accurate and energy efficient template matching operations in resource-constrained edge sensing systems, such as wearables. Sparsity, in both activations and weights inherent to.



## Article Content

### A Hybrid Edge Classifier: Combining TinyML-Optimised CNN with

In this work, we are showcasing a mixed-signal approach in designing an energy efficient edge classifier by integrating optimised DNN techniques with ACAM-based pattern matching.

### A RRAM-based FPGA for Energy-efficient Edge Computing

The shift from centralized cloud to edge computing demands hardware systems with data processing capability at ultra-low power. Reconfigurable solutions such as Field-Programmable Gate Arrays

### Highly Efficient Micro-Joule All-Fiber Ultrafast Raman Amplifier at ...

We report a high-efficiency, high-energy, all-fiber, polarization maintaining, ultrafast Raman amplifier. The Raman laser consists of a ps pump seed and two pump/Raman fiber

### Raman Amplification

Raman amplification refers to a distributed amplification technology that utilizes stimulated Raman scattering within optical fibers to transfer energy from higher-frequency pump signals to lower

### On EDFA and Raman Fiber Amplifier Energy Efficiency

Abstract: We compare the energy efficiency of Distributed Raman Amplifiers (DRFA) and Erbium-Doped Fiber Amplifiers (EDFA) used in long-haul transmission systems.

### Enhanced gain Raman amplifiers using different pumping schemes

Raman amplifiers (RAs) can be represented as one of the best solutions for transmission techniques, where they can compensate attenuation and transmit the optical signal to long-haul

### Neural Signal Compression using RAMAN tinyML Accelerator for BCI ...

The CAE encoder section is implemented on RAMAN, an energy-efficient tinyML accelerator designed for edge computing. RAMAN leverages sparsity in activation and weights through zero skipping,

### RAMAN: An AI Co-Processor for Edge Computing –

The RAMAN accelerator is designed to leverage data and weight sparsity to deploy deep neural networks at the edge, ensuring low power

### (PDF) RAMAN: A Re-configurable and Sparse tinyML

In this paper, we present RAMAN, a Re-configurable and spARse tinyML Accelerator for inference on edge, architected to exploit the sparsity to

## A Comprehensive Review on Amplification of Laser

Although a better overall energy transfer between pump and seed has been attained with SBS, the experimentally demonstrated Raman amplifier

## An Efficient Diamond Raman Amplification Scheme Based on

This work not only elucidates the dynamic temporal coupling between Stokes and fundamental pulses in Raman amplification but also offers a structural framework for the

## Optimized design of Raman fiber amplifier based on improving

An efficient method to design the broadband gain-flattened Raman fiber amplifier (RFA) with multiple pumps is proposed based on a Extreme learning machine optimized by the salp swarm

## New criteria for efficient Raman and Brillouin amplification of laser ...

Second, the main quantity of merit for a Raman laser amplifier should be the absolute power or energy of the amplified seed pulse 6.

## Flexible Raman Amplifier Optimization Based on Machine Learning

Abstract—The problem of Raman amplifier optimization is studied. A differentiable interpolation function is obtained for the Raman gain coefficient using machine learning (ML), which allows for the gradient

## Performance optimization of different Raman amplifier configurations ...

The Raman amplifier, using three different pumping configurations, is designed and investigated for 50 × 100 Gbps DWDM system at channel spacing of 0.8 nm. System operates at an optimum input power

## Energy-Efficient Edge Detection using Approximate Ramanujan Sums

This paper proposes for the first time an approximate computing based energy-efficient hardware accelerator using Ramanujan Sums for edge detection applications.

## [2306.06493] RAMAN: A Re-configurable and Sparse tinyML

Deep Neural Network (DNN) based inference at the edge is challenging as these compute and data-intensive algorithms need to be implemented at low cost and low power while

## RAMAN: A Reconfigurable and Sparse tinyML Accelerator for

In this article, we present RAMAN, a Re-configurable and sparse tinyML Accelerator for inference on edge, architected to exploit the sparsity to reduce area (storage), power, as well as latency.

Performance optimization of different Raman amplifier configurations ...

Pump powers of the Raman amplifier are selected using multiparameter optimization algorithm to achieve maximum gain with small ripple. The effects of varying input powers on gain,

Raman Amplification Optimization in Short-Reach High Data Rate

For a short-reach metro network or DCI application with high-data-rate transceivers, the distributed Raman amplifier delivered the best transmission performance, compared with any other amplification

An Efficient Diamond Raman Amplification Scheme Based on

Both simulations and experiments revealed an adaptive temporal synchronization phenomenon, in which the Stokes pulse spontaneously drifts toward the pump peak, thereby

RAMAN – NeuRonICS Lab

As a result, there is a growing interest in deploying DNNs directly on edge devices to leverage benefits such as privacy, bandwidth savings, and reduced latency.

New criteria for efficient Raman and Brillouin amplification ...

In this paper, we reveal novel non-linear criteria for the initial seed pulse that will finally open the door to efficient Raman and Brillouin amplification to petawatt powers and Joule-level ...

Raman Amplifier

Raman amplification is an alternative amplification technology and has been increasingly implemented in long-haul system. The Raman amplifier is different from the EDFA in that it is a distributed

Enabling Energy-Efficient In-Memory Computing With Robust Assist

With the increasing gap between processing speed and memory bandwidth necessity for in/near-memory computing has emerged, to ensure high-performance, energy-efficient computing for

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