Emerging Technology

PT01

Combining Low-Density Parity Check (LDPC) and Guessing Random Additive Noise Decoding (GRAND)

Po-Yi Yeh[1] and Cheng-Hung Lin[1, 2]
[1]Department of Electrical Engineering, Yuan Ze University
[2]Biomedical Engineering Research Center, Yuan Ze University

Inevitably, there will have some errors when we sent the messages from the transmitter to the receiver created by the noise. To correct those errors, this paper introduces a universal decoding algorithm named Guessing Random Additive Noise Decoding (GRAND) and the details of the core module in the GRAND decoder. We tried different ways and different parameters to reduce the calculations, and also compared their performances.

PT02

iWalkSafe - Wearable Navigation Assistance for the Visually Impaired Based on Miniaturized Edge AI

Wei En Tsai[1], Kuo Cheng Chin[2], Borhan Lee[1], Wei Chung Chen[1], and Ren Song Tsay[1]
[1]National Tsing Hua University
[2]DeepMentor Technology

We propose a computer vision-based, wearable navigation assistance based on a miniaturized AI model, utilizing the benefit brought by a specialized edge AI box. This study contributes to the literature in two ways. First, we implement a navigation system with high mobility, helping the visually impaired eliminate most of the common dangers in their daily lives. Second, we demonstrate how our previous work — a patented CNN miniaturization method — may be put into a critical application such as offline navigation assistance. The miniaturization technology enables the system with high mobility and low power consumption, with a negligible precision trade-off.

PT03

VLSI Implementation of the Traveling Salesman Problem Solver using Annealer Chip

Hsin-Tung Hua[1] and Yuan-Ho Chen[1, 2]
[1]Dept. of Electronics Engineering, Chang Gung University
[2]Dept. of Radiation Oncology, Chang Gung Memorial Hospital

Quantum computing is one of the mainstream technologies in the future. However, due to temperature and cost constraints, this technology cannot be popularized. Thus many researchers have proposed "digital annealing" to replace it. Digital annealing is a new technique dedicated to solving large-scale, complex, and intractable quadratic unconstrained binary optimization (QUBO). By simulating the properties of quantum fluctuations, the optimal solution to the problem can be calculated. This study proposes an Ising model hardware architecture that can solve combinatorial optimization problems. Ising models can represent QUBO formulations with multiple solutions as polynomials, mapping to a fully connected Ising model architecture. According to the characteristics of digital annealing, the optimal solution can be obtained quickly. The proposed chip was implemented using a TSMC 90nm CMOS technology, the operating frequency is 50MHz, and the chip area is 3.24mm2.

PT04

VLSI Implementation of the Annealing Chip for Nurse Scheduling Optimal Problem

Che-An Chou[1] and Yuan-Ho Chen[1, 2]
[1]Dept. of Electronics Engineering, Chang Gung University
[2]Dept. of Radiation Oncology, Chang Gung Memorial Hospital

In recent years, COVID-19 has changed everyone's life, and the world has been affected by its powerful contagion. Because of this, the allocation of medical resources is very important, especially the issue of nurses scheduling. The nurse scheduling problem is an optimization problem that can be solved using quantum computing. Quantum computing converts the problem into an Ising model and uses a quantum computer to find the optimal solution. This study proposes an annealed chip realized by VLSI, which can effectively solve the optimal solution of the Ising model by imitating the quantum computer. This work uses TSMC 90nm COMS to realize this chip, which achieves an operating frequency of 100MHz, a chip area of 2.15mm2 , and maximum power consumption of 15.38mW. Compared with chips in the existing works, this paper achieves a low-power, high-speed chip implementation.

PT05

A Low-Cost Way to Pick the Sick Image in Sick OCT Volume

Chih-Hsuan Yu[1], Cheng-Hung Lin[1, 2], Jia-Kang Wang[1, 3], and Tzu-Lun Huang[1, 3]
[1]Department of Electrical Engineering, Yuan Ze University
[2]Biomedical Engineering Research Center, Yuan Ze University
[3]Department of Ophthalmology, Far Eastern Memorial Hospital

We propose to solve the problem of noise images in sick volume by using a screening process. In order to find out the noise image in the FEMH dataset by using the Duke dataset, we use CycleGAN to convert the image style of the FEMH dataset into the image style of the Duke dataset, by the above way, the success rate is increased from 76% to 83%.

PT06

Detecting Anomalous Lane-Changing Decisions for Connected and Autonomous Vehicles

Sheng-Li Wang, Chien Lin, and Chung-Wei Lin
National Taiwan University

The goal of this work is to detect if a lane-changing decision and the sensed or received information are anomalous. We develop three anomaly detection approaches based on deep learning, where all of them do not need anomalous data nor lateral features so that they can generally consider lane-changing decisions before the vehicles start moving along the lateral axis. They achieve at least 82% and up to 93% F1 scores against anomaly on data from Simulation of Urban MObility (SUMO) and HighD. We also examine system properties and verify that the detected anomaly includes more dangerous scenarios.