

Methods Review Worksheet

Recalling and Comparing Moves in Your Reading

Instructions

1. Share with Prof. Powell : npowell@g.postech.edu
2. In groups, choose an order of explanation. Then, briefly introduce the paper you chose (for the week 6 methods reading assignment). Place your papers basic information in the table on page one in your order (1, 2, or 3)..
3. Compare and find different ways to express certain methods moves, grammatical forms, and useful vocabulary

Article Information 1		Article Info 2		Article Info 3		Article Info 4	
Title	Analog circuit generator based on deep neural network enhanced combinatorial optimization	Pruning Neural Belief Propagation Decoders	Design and Optimization on Training Sequence for mmWave Communications: A New Approach for Sparse Channel Estimation in Massive MIMO	Chip-Integrated Voltage Sources for Control of Trapped Ions			
Author (s)	Hakhamaneshi, Kourosh ;Werblun, Nick ;Abbeel, Pieter ;Stojanović, Vladimir	Andreas Buchberger, Christian Hager, Henry D. Pfister, Laurent Schmalen, Alexandre Graell i Amat	Xu Ma, Fang Yang, Sicong Liu, Jian Song, Zhu Han	Stuart, J.panock, R.Bruzewicz, C.D.Sedlacek, J. A.McConnel, R.Chuang, I.L.Sage, J. M.Chiaverini, J			
Journal Title	Proceedings of the 56th Annual Design Automation Conference	2020 IEEE International Symposium on Information Theory (ISIT)	IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS	Physical Review Applied			
Year of Publishing	2019	2020	2017	2019			

Volume/Issue	228/2019		Vol. 35, NO.7	11/2
Pages	1/2	p.5	pp. 1486-1487	8
Keywords / Search Terms	Deep neural network, discriminator, evolutionary algorithm	Pruning, Belief Propagation Algorithm, Decoder	mmWave communication, massive MIMO, channel estimation, training sequence, structured compressive sensing	voltage source, cryogenic

Methods Comparison Table

Methods & Experimentation (after background/related works)				
Moves	Example from article 1	Example from article 2	Example from article 3	
Review of research goals or Overview of procedure	In each iteration, we utilize the EA to create population candidates (new offspring). We then use a DNN to predict the quality of these new offspring and only simulate the samples that are classified as good design points.	In this paper, we introduce a method to tailor an overcomplete parity-check matrix to (neural) BP decoding using machine learning.	A novel channel estimation scheme with time-domain TS design and optimization is proposed for a MIMO-OFDM based mmWave systems to solve these problems.	Additionally, we present the incorporation of an integrated circuit that uses an analog switch to reduce voltage noise on trap electrodes due to the integrated amplifiers by over 50 dB. We verify the function of our integrated electronics by performing diagnostics with trapped ions and find noise and speed performance similar to those that we observe using external control elements.
Headings for Methods /	2 FRAMEWORK IMPLEMENTATION	III. OPTIMIZING THE PARITY-CHECK MATRIX	3. TS design and Optimization	IV. OPERATION WITH TRAPPED IONS

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Experimentation Sections	3 EXPERIMENTS			
Reference to prior research methods	On the other hand, population-based circuit optimization approaches [2] have been demonstrated as flexible global optimization frameworks, but confined to small-size designs due to their sample inefficiency.	This fact has been exploited by using redundant parity-check matrices [5]-[9]. Kothiyal et al. combined reliability-based decoding (e.g., ordered-statistics decoding) and BP decoding in a scheme where the parity-check matrix is adapted to the outcome of the reliability based decoding at the expense of high complexity [6].	Some work has been done in the CS-based channel estimation [29]-[35].	During experiments with ions, we operate the trap in a cryogenic vacuum apparatus (described in Ref. [14]).
Explaining quality or care of method	Using our approach, the design with zero cost was achieved using only 338 post extracted evaluations (7.1 hours on the same system - a more than a 200x runtime improvement).	We apply our method to different linear codes, BCH (63,45), BCH(63,36), BCH(127, 64) and BCH(127,99). Training was conducted using stochastic gradient descent with mini-batches. The training data is created by transmitting the zero codeword through an AWGN channel with varying SNRs ranging from 1dB to 8dB.	A novel approach of channel estimation based on TS is proposed. The auto-coherence and cross-coherence of the blocks are proposed as two key merit factors for block coherence optimization, which brings a new perspective to optimize the block coherence of the sensing matrix.	N/A
Limitations (boundaries of research) or difficulties in procedure	The optimization stops when a predetermined maximum number of evolution steps is reached.	Not mention	N/A	To further investigate the limitations to the heating rate with the EISs open, we attach a temperature-sensing diode to the surface of the chip. We find that the temperature of the chip increases from 4 K to just above 50 K when powered on in the CPGA mount. This temperature increase is due to the power dissipation of the chip-integrated DACs (500 mW), the limited cooling power of the cryostat, and the thermal resistance of the CPGA heat sink [34].
Grammatical Features	Example from article 1	Example from article 2	Example from article 3	

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Past Passive	The layout, schematic and testbench generators <u>were prepared</u> using BAG.	As a loss function, the bitwise cross-entropy between the transmitted codeword and the VN output LLR of the final VN layer was used in [1], [2].	The first 60-GHz regulations was issued by Japan for unlicensed utilization in the 59-66GHz band in 2000.	This work was sponsored by the Assistant Secretary of Defense for Research and Engineering under Air Force Contract No. FA8721-05-C-0002.
Reason for use	Prior to the experiment, <u>past passive</u> was used to describe how the training data was prepared.	To explain that 'bitwise cross-entropy' was used in other research.	In the past, Japan announced the mmWave policy.	It is used when there is no need to mention the actor because the subject of the action in the past is unspecified or unclear.
Present Passive	The cardinality of each design parameters <u>is annotated</u> in Figure 2(a).	While WBP decoding improves upon conventional BP decoding, its performance is still limited by the underlying parity-check matrix.	In the framework of CS, the CIR recovery performance is related with the sensing matrix, which is determined by the TS's of all transmit antennas.	This measurement is limited by the noise floor of our instruments [see Fig. 2(b)],
Reason for use	In the figure in the paper, <u>present passive</u> was used to show how the parameters were marked.	To explain that new method(WBP decoding) has not solved the limitation even though it has been applied.	Conditions related to the performance of the channel.	It is used when there is no need to mention the actor because the subject of the action is an unspecified majority or unclear.
Active	Through this example, the proposed approach <u>demonstrates</u> the potential to tackle complex analog and mixed-signal design problems.	To this end, we prune a large overcomplete parity check matrix and allow it to consist of different parity-check equations in each iteration.	Therefore, a small value of block coherence can decrease the probability of confusing different blocks in the recovery process, which is an important approach to improve the accuracy of recovery performance.	In this work, we advance the integration of control voltages to the microscopic level by presenting a design for a voltage source, with performance similar to modern external sources, that is incorporated into the substrate beneath the electrodes of an ion trap.
Reason for use	Active is used to explain how the proposed method in this paper can be applied to the circuit field.	Explain the core(purpose) of a paper	Explain the advantages that can be obtained by the method.	The active voice is used to convey the meaning clearly.
Transition phrase used	<u>However</u> , a lot of progress needs be made to make these DRL approaches scalable to real analog design problems.	1. After the optimization has converged, we find the index and the iteration of the lowest CN weight and set it to zero, i.e., we prune the corresponding parity check equation from W.	As an alternative evaluation method, the mutual incoherence property (MIP), which is the maximum coherence between different columns, is easy to be calculated and can be a necessary and sufficient condition especially when the greedy algorithms are adopted	Integrating devices into the trap array itself could potentially solve this scaling problem but this design will require a trade-off among device area, power, speed, and noise.

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		2. Also , a rate 0.5-LDPC code of length 128 performs within 1.5 dB of the ML performance, giving an improvement of 0.5dB over conventional BP.	in the recovery process.	
Context phrase used	In each iteration, we utilize the EA to create <u>population candidates (new offspring)</u> .	We consider the weights in the Tanner graph as an indication of the importance of the connected check nodes (CNs) to decoding and use them to prune unimportant CNs .	To accurately recover the data, each receiver has to acquire multiple channel state information (CSI) whose amount is equal to the amount of the transmit antennas.	To solve these problems, we have designed a switchable filter by placing a complementary pair of high-voltage field-effect transistors (FETs) between the output of the amplifier and the trap electrode, shown in the schematic of Fig. 1(d).
Additional features	Example from article 1	Example from article 2	Example from article 3	
Reference to an existing model or equation	We then use a DNN to predict the quality of these new offspring and only simulate the samples that are classified as good design points.	This fact has been exploited by using redundant parity-check matrices [5]–[9]. Kothiyal et al. combined reliability-based decoding (e.g., ordered-statistics decoding) and BP decoding in a scheme where the parity check matrix is adapted to the outcome of the reliability based decoding at the expense of high complexity [5].	It is widely known that the CIR of the wireless channel can be modeled as a sparse vector [39].	heating rate of the motional mode, \dot{n} , is given by $\dot{n}(\omega_l) = \frac{q^2}{4m\hbar\omega_l} \frac{S_V(\omega_l)}{D_{\text{eff}}^2}, \quad (1)$
Use of I / my or We / our	We conducted an experiment of an end-to-end realization of a differential optical link receiver front-end operating in GF14nm technology.	We obtain significant performance gains while keeping the complexity practical.	We randomly select two individuals based on the selection probability, and perform the operations of crossover and mutation for every element of the two individuals one by one.	We calculate the value of D_{eff} using a finite-element electrostatic simulation to determine the electric field at the ion's position for a given voltage applied to the trap electrodes.
Vocabulary	Example from article 1	Example from article 2	Example from article 3	
Verb	Word - Definition: <u>prune out</u> (verb) - to take something or someone away from somewhere, or off something Source sentence (with vocab word bolded and underlined): We present a	Word - Definition: Prune : to reduce especially by eliminating superfluous matter Source sentence (with vocab word	Word - Definition: fulfill - to do what is required by something Source sentence (with vocab word bolded and underlined): The sensing matrix is considered to fulfill RIP.	Word - Definition: sacrifice [to give up (something that you want to keep) especially in order to get or do something else or to help someone]

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	framework that is built on top of an evolutionary algorithm (EA) and leverages a DNN trained as a discriminator to <u>prune out</u> "bad" children to reduce the evaluation time spent in post-layout simulation.	<u>bolded and underlined</u>) : We consider the weights in the Tanner graph as an indication of the importance of the connected check nodes (CNs) to decoding and use them to prune unimportant CNs.		Source sentence (with <u>vocab word bolded and underlined</u>) : Thus we <u>sacrifice</u> some of the reproducibility usually afforded by CMOS and must ensure basic operation at our chosen temperature
Adjective or adverb	Word - Definition: <u>state-of-the-art</u> (Adjective) - very modern and using the most recent ideas and methods Source sentence (with <u>vocab word bolded and underlined</u>) : Each evaluation includes a layout and schematic instance generation, LVS, RC extraction, testbench generation and characterization of the circuit, which takes roughly 78 seconds per design instance on a <u>state-of-the-art</u> compute server.	Word - Definition : conventional (Adjective) : traditional and ordinary Source sentence (with <u>vocab word bolded and underlined</u>) : While WBP decoding improves upon conventional BP decoding, its performance is still limited by the underlying parity-check matrix.	Word - Definition: sparse - present only in a small amounts, less than necessary or normal Source sentence (with <u>vocab word bolded and underlined</u>) : Many researchers have successfully improved the sparse signal recovery performance by optimizing the coherence of the sensing matrix.	Word - Definition: bulky [large and difficult to carry or store] Source sentence (with <u>vocab word bolded and underlined</u>) : Trapped-ion quantum-information processors offer many advantages for achieving high-fidelity operations on a large number of qubits, but current experiments require <u>bulky</u> external equipment for classical and quantum control of many ions.