



# Advanced Innovation Technology (AIT 2024)

January 8~10 2024 at Four Points by Sheraton Danang Hotel, in Danang, Vietnam

The 1st International Conference on Advanced Innovation Technology (AIT2024), organized and hosted by [The Korean Innovation Industry Society](#), will be held on January 8-10, 2024, at [Four Points by Sheraton Danang Hotel](#), in Danang, Vietnam.

AIT 2024 will be the most comprehensive conference focused on the various aspects of advances in Innovation-centered Technology. Our Conference provides a chance for academic and industry professionals to discuss recent progress in the areas of Innovation-centered Technology.

The goal of this conference is to bring together the researchers from academia and industry as well as practitioners to share ideas, problems and solutions relating to the multifaceted aspects of the advanced Innovation-centered Technology.

Accepted papers will be published by some International Journals (SCOPUS / SCIE indexed) after revision according to the reviewers' comments.

## TOPICS

All topics of advanced Innovation-centered Technology and related research works are acceptable

- Information technology
- Engineering technology
- Bio & Medical technology
- Culture & Art technology
- Human science & Education service technology
- Other interesting topics : Other innovation technology

## IMPORTANT DATES

We will follow the next time schedule:

- Paper submission deadline: **November 30, 2023**
- Acceptance notification: **December 08, 2023**
- Registration: **December 15, 2023**

## PAPER SUBMISSION

- Every submitted paper will be carefully reviewed by at least KIIS Society members.
- All papers should be submitted by website: [https://www.koriis.kr/board\\_thesis/list.php?board\\_name=board03&s\\_menu=s3&s\\_menu2=s3\\_3](https://www.koriis.kr/board_thesis/list.php?board_name=board03&s_menu=s3&s_menu2=s3_3)
- Download paper format: [https://www.koriis.kr/board/list.php?board\\_name=board02&s\\_menu=s3&s\\_menu2=s3\\_2](https://www.koriis.kr/board/list.php?board_name=board02&s_menu=s3&s_menu2=s3_2)

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## CONTACT INFORMATION

- If you have any question about the CFP and papers submission, please email to Secretary of AIT 2024 ([kiis22.member@gmail.com](mailto:kiis22.member@gmail.com)).

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Programs of  
International Conference on **Advanced Innovation Technology**  
– **AIT 2024** –

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• *Date*

**08–10 January, 2024**

• *Venue*

**Four Points by Sheraton, Danang, Vietnam**

• *Host by*

**KIIS**

• *Co-Organized by*

**MSS, NRF, KIKS**

• *Sponsored by*

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MT DATA . DELTA SYSTEM . DAEB0 Info . TAEJIN T&S  
BonC INCUVATORS . TURN SYSTEM . TRUEBON . K-ONE  
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**Program for the AIT2024****January 08, 2024 (Day 1)**

Time	Minute	Schedule		
		Grand Ballroom	Charm Meeting Room	Panorama Room
10:30 ~ 11:00	30	Registration		
11:00 ~ 12:00	60		Session P1	Session P2
12:00 ~ 13:00	60	Banquet		
13:00 ~ 14:00	60	Session P3	Session O1	Session P4
14:00 ~ 14:20	20	Break Time		
14:20 ~ 15:20	60	Session P5	Session O2	Session P6
15:20 ~ 15:40	20	Break Time		
15:40 ~ 16:40	60	Session P7	Session O3	Session P8
16:40 ~ 17:00	20	Award Ceremony Moderator : Yeun-Woong Kyung (Kongju National University, Korea)		

**January 09, 2024 (Day 2)**

Time	Minute	Schedule	
		On site A	On site B
14:00 ~ 15:30	90	Session V1	Session V2
15:30 ~ 16:00	30	Break Time	
16:00 ~ 17:30	90	Session V3	Session V4
17:30 ~ 18:00	30	Discussion	

**January 10, 2024 (Day 3)**

Time	Minute	Schedule	
		Charm Meeting Room	Vista Meeting Room
10:00 ~ 11:00	60	Subcommittee Discussion A	Subcommittee Discussion B
11:00 ~ 11:20	20	Break Time	
11:20 ~ 12:20	60	Academic Section Discussion	Industrial Section Discussion
12:30 ~ 13:00	30	Closing Ceremony Moderator : Byong-Kwon Lee (Seowon University, Korea)	

**Session P1****Chair : Seong-Mi Park (Korea Lift College)**

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020	An Experimental Study on Bond Behavior of Fabric Reinforced Cementitious Matrix	Yujae, Seo, Meiramov Didar, Jinhyeong Heo, Junseo Hong, Hyunjin Ju (Korea)	65
021	Applicability of Steel Tube Connections in Precast Concrete Double-Wall	Didar Meiramov, Seo Yujae, Chanseo Jung, Hyunjin Ju (Korea)	67
022	Review of certificate status verification methods	Eun-Gi Kim (Korea)	69
023	An Empirical Study on the Effect of Supply Chain Environmental Management on Business Performance in Small and Medium- sized Manufacturing Company	Yeo-Myeong Choi, Hyeon-Suk Park (Korea)	71
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025	Design and Implementation of a Real-Time Fatigue Management System Using EEG	Jae-Kyu Kim, Ssang-Hee Seo (Korea)	79

**Session P2****Chair : Byong-Kwan Lee (Seowon Univ.)**

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063	Analysis of Bidding Price using K-means Cluster in Public Institution Competitive Bidding: Targeting Service Projects in the Chungcheong Region	Young-Hun Kim, Dong-Hyung Lee, Gitae Kim (Korea)	190
064	Identifying Strategic Priorities for SME Safety and Health Management Using SWOT/AHP Approach	Jae-young Yoo, Dong-Hyung Lee, SungMin Bae (Korea)	193
065	Introduction and Revitalization of MES in Korean Small Companies	Jun-Ki Hong, Soo-Yong Park, Dong-Hyung Lee (Korea)	195
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# Estimation of Single Antenna SNR in 5G NR communication Environments using CNN

Woong-Jong Yun<sup>1</sup>, Seok-Jin Hong<sup>1</sup>, Eui-Rim Jeong<sup>1\*</sup>

<sup>1</sup>Department of Artificial Intelligence, Hanbat National University, 34158 Daejeon, South Korea

Corresponding author\* : erjeong@hanbat.ac.kr

## Abstract

This paper introduces a technique for estimating the Signal-to-Noise Ratio (SNR) of a single antenna based on Convolutional Neural Network (CNN) in the 5G NR communication environment. The considered communication system utilizes a single antenna and performs bidirectional communication through Time Division Duplexing (TDD). In this system, after receiving signals using a single antenna, the SNR of the received signal is employed to estimate the SNR at a future transmission point. Existing methods involve predicting SNR using the average of past received SNRs or using the SNR of the most recent signal received. The proposed approach uses CNN to predict SNR. Experimental results from simulations demonstrate that the CNN-based proposed method outperforms the existing methods in the 5G NR environment, showcasing a superior average Mean Absolute Error (MAE).

**Keywords:** 5G NR, TDD, SISO, SNR Prediction, Deep Learning, CNN

## 1. Introduction

With the advancement of key technologies such as AI and IoT, necessitating high-speed, high-capacity data transmission, the introduction of 5G NR, as defined by 3GPP, has emerged[1]. In mobile wireless communication environments, including 5G NR, the Doppler effect occurs in proportion to the movement speed, leading to performance degradation. Hence, research is underway to estimate the SNR that varies over time between base stations and devices to enhance reception performance[2]. This paper proposes a technique within the 5G NR communication environment that predicts the Signal-to-Noise Ratio (SNR) of a single antenna based on Convolutional Neural Network (CNN). It predicts the antenna SNR at a future transmission point using the received signal's SNR as input data. Comparative performance analysis between the existing methods and the proposed approach is conducted through computer simulations.

## 2. System Model

The proposed model predicts SNR at future transmission points based on past antenna channel quality in the Time Division Duplexing (TDD) environment. SNR is measured at the receiving antenna, combined into a vector after preprocessing, and fed into a CNN for prediction. The system uses 100 Down-link and 6 Up-link data to ensure adequate transmission and reception times. Despite the variable TDD format in 5G NR, a fixed 45-beat structure with equal Downlink and Uplink ratios is employed in this study.

## 3. CNN-Based SNR Prediction Method

### A. Existing Methods

In the context of existing techniques, two methods are considered for performance comparison with the proposed method. The first method involves predicting the target SNR by using the average of the received antenna SNRs measured at a specified time, known as the Mean Value method. The second method, the Recent Value method, predicts the target SNR by using the

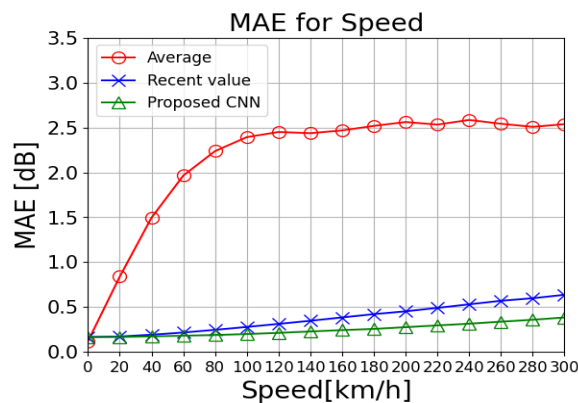
most recently measured received SNR at the time of transmission.

## B. Proposed CNN Method

The method proposed in this paper involves using CNN to predict future transmission SNR. It consists of five convolutional layers and two fully connected layers. Each convolutional layer in all models includes a batch normalization layer, uses convolution filters of size 1 with a stride of 1, employs ReLU as the activation function, and uses Linear in the FC Layer. Subsequently, the predicted antenna SNR values are output through the regression layer. During training, the optimization method used is Adam with a learning rate of 0.01, a batch size of 128, and 200 epochs. The loss function employed is Mean Squared Error (MSE).

## 4. Simulation Result

According to the 5G NR standard, the bandwidth is 100MHz, and the carrier frequency is 3.6GHz. The experiment randomly selects between LoS and Non-LoS channels, using Rayleigh and Rician channel models with a K-factor of 10dB. The input data length is 100, and the average SNR of each signal varies randomly between 0 and 30dB, while the movement speed ranges randomly from 0km/h to 300km/h. Each slot comprises 14 OFDM symbols. The proposed CNN model is trained with 200,000 training and 20,000 validation data samples, structured as 100x1 inputs, using MSE as the loss function. Test data is generated at 20km/h intervals from 0km/h to 300km/h, resulting in 20,000 samples per speed. MAE is used as the performance metric, and the proposed CNN method is compared against the Mean Value and Recent Value methods.



**Fig. 1. Performance comparison**

Fig. 1 illustrates the SNR estimation performance according to the movement speed, presenting the SNR estimation MAE in the 5G NR channel environment. According to the simulation results, both Recent Value, Mean Value, and CNN exhibit an increasing trend in MAE with higher speeds. This increase in MAE with faster speeds is attributed to the Doppler effect and rapid signal variations, causing differences between the estimated SNR values and the ground truth. The proposed CNN model demonstrates degraded performance as the speed increases. Except for 0 km/h, it exhibits the best performance across all speed ranges. The MAE for the Mean Value method and Recent Value method are 2.1367dB and 0.3722dB, respectively, while the proposed CNN method achieves an MAE of 0.2448dB, showcasing its superior performance. Through this study, it is anticipated that higher predictive SNR accuracy in 5G NR communication will ensure greater communication reliability compared to conventional methods.

## 5. References

- [1] M. Shafi et al., "5G: A Tutorial Overview of Standards, Trials, Challenges, Deployment, and Practice," in *IEEE Journal on Selected Areas in Communications*, vol. 35, no. 6, pp. 1201-1221, June 2017, doi: 10.1109/JSAC.2017.2692307.
- [2] J. -C. Guey, P. -K. Liao, Y. -S. Chen, A. Hsu, C. -H. Hwang and G. Lin, "On 5G radio access architecture and technology [Industry Perspectives]," in *IEEE Wireless Communications*, vol. 22, no. 5, pp. 2-5, October 2015, doi: 10.1109/MWC.2015.7306369.